RESISTANCE GROUNDING/NGR MONITORING
GROUND-CONDUCTOR MONITORING
GROUND-FAULT PROTECTION
SWITCHING RELAYS & CONTROLS
FEEDER PROTECTION
ARC-FLASH PROTECTION
MOTOR & PUMP PROTECTION
PUMP CONTROLLERS
AC SYSTEM MONITORS/LOAD SENSORS
TOWER AND OBSTRUCTION LIGHTING CONTROL
TIMERS
FLASHERS
Over 1000 Littelfuse MotorSaver®, PumpSaver®, and SSAC parts added!

New Arc-Flash Relays
AF0500 with zone protection and AF0100 with compact, cost-effective design

New Smart Motor Protection Relay MP8000 with Bluetooth® capabilities

*Bluetooth is a trademark of its respective owner.
Your questions answered, any way you ask them.

Choose your preferred product-selection method from the examples below.

→ By Product Category & Part Number: Table of Contents ........................................................................Pg 2-5

7 MOTOR AND PUMP PROTECTION

PGR-6100 Motor Ground-Fault & Insulation Relay ..................................................94

→ By Application ...................................................................................................................... Pg 6

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>COMMON PROBLEMS</th>
<th>PRODUCT PROTECTION CATEGORY (PG NO.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERATORS</td>
<td>- Insulation breakdown due to vibration and corrosion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Ground-fault currents often exceed short-circuit current</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Arc-flash hazard from local and paralleled generators</td>
<td></td>
</tr>
<tr>
<td>TRANSFORMERS</td>
<td>- Overloading and overvoltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ground Fault (pg 43)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resistance Grounding (pg 61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arc Flash (pg 73)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resistance Grounding (pg 61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feeder (pg 69)</td>
<td></td>
</tr>
</tbody>
</table>

→ By Feature Set ............................................................................................................. Pg 7-10

7 Arc-Flash Relays

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>PGR-8800</th>
<th>AF0100</th>
<th>AF0500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current detection</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Point sensors</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Fiber optic sensors</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>

→ By Product Category & Common Questions: Product Selection Guide .........................Pg 11-41

7 ARC-FLASH PROTECTION

ARC-FLASH DETECTION

Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

Sensor Health Monitoring

Overcurrent Detection

PGR-8800 SERIES

Pg 75

AF0500 SERIES

Pg 77

D0500

Pg 74

→ By Keyword or Part Number: Alphanumeric Index ......................................................... Pg 517-520

<table>
<thead>
<tr>
<th>Arc-Flash Protection</th>
<th>pg 14, 73</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARP Series</td>
<td>pg 157</td>
</tr>
<tr>
<td>ASQU / ASTU Series</td>
<td>pg 270</td>
</tr>
<tr>
<td>Brackets &amp; Clips</td>
<td>pg 486</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS

FIND THE RIGHT PRODUCT FOR YOUR APPLICATION

Typical Product Application .................................................. 6
Product Feature Comparison .................................................. 7-10
Product Selection Guide ...................................................... 11-42
Alphanumeric Index .......................................................... 537-540

1 GROUND-FAULT PROTECTION

Un grounded AC Systems
EL3100 Series Ground-Fault & Phase-Voltage Indicator ............... 44
PGR-3100 Series Ground-Fault Indication System ...................... 45
PGR-3200 Series Insulation Monitor ....................................... 46

Un grounded DC System
SE-601 Series DC Ground-Fault Monitor ................................ 47

Grounded AC/DC System
EL731 Series AC/DC Sensitive Earth-Leakage Relay ................. 48

Solidly-Grounded Systems
SE-701 Series Ground-Fault Monitor ..................................... 50
SE-703 Series Earth-Leakage Monitor ................................. 51
SE-704 Series Earth-leakage monitor .................................... 52

Ground-Fault Circuit Interrupters
SB500 Series Industrial Shock-Block ................................ 53
SB6000 Series Industrial Shock-Block ............................... 55

Generator and Single-Function Protection
PGR-4300 Series Generator Ground-Fault Relay ........................ 55

2 GROUND-CONDUCTOR MONITORING

SE-105 / SE-107 Series Ground-Fault Ground-Check Monitor ...... 60
SE-134C / SE-135 Series Ground-Fault Ground-Check Monitor .... 61

3 RESISTANCE GROUNDING/NGR MONITORING

Neutral-Grounding-Resistor Sizing Chart .............................. 62
SE-325 Series Neutral-Grounding-Resistor Monitor ................ 64
SE-330 / SE-330HV Series Neutral-Grounding-Resistor Monitor . 65
SE-330AU Series Neutral-Grounding-Resistor Monitor ............. 67
NGR Series –US Neutral Grounding Resistor System ................ 68
NGR Series –Canada Neutral Grounding Resistor System ......... 77
NGR-ENC Series Enclosed Neutral Grounding Resistor Monitor ... 83

4 FEEDER PROTECTION

FPU-32 Series Feeder Protection Unit ..................................... 86
FPS Series Feeder Protection System .................................... 87

5 ARC-FLASH PROTECTION

D0920 Arc Detection Unit .................................................... 90
PGR-8800 Series Arc-Flash Relay .......................................... 91
AF0500 Series Arc-Flash Relay ............................................. 93
AF0100 Series Arc-Flash Relay ............................................. 95
A0220 Series Light Sensor ................................................... 96
PGA-1100 Diode Logic ....................................................... 97

6 SWITCHING RELAYS & CONTROLS

PHS Series Phase Control ..................................................... 100
SIR Series Solid-State Relay - Isolated .................................... 102
SLR Series Solid-State Relay - Non-Isolated .......................... 104
TCR9C Temperature Controller .......................................... 106

7 MOTOR & PUMP PROTECTION

PGR-6100 Series Motor Ground-Fault & Insulation Relay ........ 110
PGR-6101-120 Motor Ground-Fault & Insulation Relay .......... 111
MPU-32 Series Motor Protection Unit .................................... 112
MPS Series Motor Protection System ................................... 114
MPS-32-X69X Series Motor Protection Relay Retrofit Kit .... 116
MPS-469X Series Motor Protection Relay Retrofit Kit ........ 116
111-Insider-P / 231-Insider-P ............................................. 117
232-Insider Single-Phase Pump Monitor ............................ 120
111P / 233P / 233P-1.5 Series Single-Phase Pump Monitor .... 122
234-P Single-Phase Pump Monitor ..................................... 124
235P Single-Phase Pump Monitor .................................... 126
MP8000 Series Bluetooth® Current & Voltage Monitor ......... 128
777 Series 3-Phase Current & Voltage Monitor ................... 132
777 / 77C Series Single-Phase Current & Voltage Monitor .... 134
777-KW/HP-P2 Series 3-Phase Current & Voltage Monitor .... 136
777-AccuPower Single-Phase Current & Voltage Monitor .... 139
77C-KW/HP Series 3-Phase Current & Voltage Monitor ....... 141
SIO-RTD-02-00 Temperature Input Monitor ......................... 143

*Bluetooth is a trademark of its respective owner.
TABLE OF CONTENTS

8 PUMP CONTROLS/ LIQUID LEVEL CONTROLS
ACBC-120 Series Alarm Controller / Battery Charging Unit ... 146
PC-102 Series Dual Channel Switch ...................... 148
PC-105 5-Channel Pump Controller .................. 149
PC-XXX-LLC-CZ Series Liquid Level Control Relay .......... 150
PC-XXX-LLC-GM Series Liquid Level Control Relay .......... 150
201-100-SLD Single-Channel Seal-Leak Detector .......... 152
460-15-100-LLS Single-Channel Liquid Level Sensor .......... 153
460-15-100-SLD Single-Channel Seal-Leak Detector .......... 155
LLC1 Series Open Board Liquid Level Control .......... 157
LLC2 Series Open Board Liquid Level Control .......... 159
LLC4 Series Octal Plug-In Liquid Level Control ............. 161
LLCS Series Liquid Level Control .......................... 163
LLCS Series Low Level Cutoff Liquid Level Control ........ 165
LLCB Series Low Level Cutoff Liquid Level Control ........ 167
Alternating Relays
ALT Series 8-Pin Plug-in Alternating Relays ............ 169
ALT-XXX-1-SW / ALT-XXX-3-SW Series Alternating Relays .................. 171
ARP Series Alternating Relays ............................... 173
50R-400-ALT Alternating Relay ............................. 175
Intrinsically Safe Relays
ISS-100 Intrinsically Safe Switch ......................... 176
ISS-101 Intrinsically Safe Switch ......................... 177
ISS-102 Series Two-Channel Intrinsically Safe Switch ....... 179
ISS-105 Series Five-Channel Intrinsically Safe Switch ....... 181

9 AC SYSTEM MONITORS/LOAD SENSORS
Current Monitoring Relays and Transducers
CPS Series Single-Phase Current Monitor ................. 184
LSR-0 Load Sensor, Low Cost Relay ..................... 185
LSR-XXX Series Load Sensors ............................. 186
LSRU Series Load Sensors .................................. 187
LSRX / LSRX-C Series Load Sensors, Low Cost Relays .... 189
ECS Series Current Sensors ..................................... 191
ECSW Series Current Sensors ................................ 194
TCS Series Current Sensors ................................... 197
TCSA Series Current Transducers .......................... 199
DCSA Series Current Transducers ........................ 201
LCS10T12 / LPM Series Current Indicators ................ 203

Voltage Monitoring Relays
50R Series Single-Phase Voltage Monitor ............... 204
201-XXX-SP Series Single-Phase Voltage/Phase Monitor .... 206
201-XXX-SP-DPDT Series Single-Phase Voltage/Phase Monitor 208
202-200-SP Series Single-Phase Voltage/Phase Monitor .... 210
460-XXX-SP Series Single-Phase Voltage Monitor .......... 212
102A Series 3-Phase Voltage/Phase Monitor ............. 214
201A Series 3-Phase Voltage/Phase Monitor ............. 216
201A-AU Series 3-Phase Voltage/Phase Monitor ........... 218
201-XXX-DPDT Series 3-Phase Voltage/Phase Monitor .... 220
202 Series 3-Phase Voltage/Phase Monitor .............. 222
250A Series 3-Phase Voltage/Phase Monitor ............ 224
350 Series 3-Phase Voltage/Phase Monitor ............ 226
355 Series 3-Phase Voltage/Phase Monitor ............ 228
455 Series 3-Phase Voltage/Phase Monitor ........... 230
460 Series 3-Phase Voltage Monitor ..................... 232
601 Series 3-Phase Voltage & Frequency Monitor ....... 234
601-CS-D-P1 3-Phase Power Monitor .............. 236
WVM Series Voltage Monitor .................. 238
DLMU Series Voltage Monitor .................. 240
HLMU Series Voltage Monitor .................. 243
PLMU11 Voltage Monitor .................. 245
PLM Series Voltage Monitor .................. 247
TVM Series Voltage Monitor .................. 249
TVM Series Voltage Monitor .................. 251
PLR Series Voltage Monitor .................. 253
PLS Series Voltage Monitor .................. 255
HLV8243 Single-Phase Monitor .......... 257
KVM Series ........................................... 259

10 REMOTE INDICATION & MONITORING
RM1000 Series Remote Monitor .................. 262
RM2000 Series Remote Monitor .................. 264
Informer Informer MS Remote Diagnostics Tool ........... 266
Informer-MS Remote Diagnostics Tool ........... 268

11 COMMUNICATION MODULES
RS485MS/2W Communication Module ............ 270
CIO-MB/CIO-120-MB Communication Module ............ 271
CIO-DN-P/CIO-120-DN-P Devicenet™ Interface .... 273
CIO-777-PR Profinet Interface .................. 275
CIO-EN Modbus-TCP and Modbus-RTU Interface ........ 276
COM 4-20 Output Module for use with the 777-AccuPower ... 277

© 2023 Littelfuse, Inc.
# TABLE OF CONTENTS

## TIME DELAY RELAYS

**Timer Function Guide** ................................................................. 280

**Multifunction**
TRDU Series .......................................................... 281
TRU Series .................................................................. 283
ASOU / ASTU Series .............................................. 286
DSOU / DSTU Series .............................................. 288

**Dedicated**
**On Delay**
T10 Series .................................................................. 290

**Delay-on-Make**
ERDM Series .......................................................... 291
HRDM Series .......................................................... 293
KRD Series ............................................................. 295
KRDPS Series .......................................................... 297
KSD1 Series ............................................................. 300
KSDU Series ............................................................. 302
KSPS Series ............................................................. 304
MSM Series ............................................................. 307
ORM Series ............................................................. 309
PRLM Series ............................................................. 311
TDM / DMH / TDMU Series .................................... 313
TDU / TDUH / TDUU Series .................................... 315
TH1 Series ................................................................. 317
THD18412.5S ............................................................. 319
TMV8000 / TSU2000 Series .................................. 321
TMU Series .............................................................. 323
TS1 Series ................................................................. 325
TSD1 Series .............................................................. 327

**Delay-on-Make, Normally Closed**
TS44116S ................................................................. 329

**Delay-on-Break**
HRDB Series .......................................................... 331
HRPS / HRIS Series ............................................... 333
KRD Series ............................................................. 335
KSDB Series ............................................................. 337
ORB Series ............................................................... 339
TDB / TDBH / TDBU Series .................................... 341
TDBU Series ............................................................. 343
THDB Series ............................................................. 345
TRB Series ................................................................. 347
TSD Series ................................................................. 349
TSDB Series ............................................................. 351

**Single Shot**
HRDS Series ........................................................... 353
HSP2A22SL ............................................................... 355
KRD Series ............................................................. 357
KSDS Series ............................................................. 359
ORS Series ............................................................. 361
PRS65 ....................................................................... 363
TDS / TDSH / TDSL Series ....................................... 364
TDU Series ............................................................. 366
THC / THS Series ..................................................... 368
THDS Series ............................................................. 370
TR Series ................................................................. 372
TSDS Series ............................................................. 374
TSS Series ................................................................. 376

**Interval**
ERD Series .............................................................. 378
HRD Series .............................................................. 380
KRD Series ............................................................. 382
KSD2 Series ............................................................. 384
KSPU Series ............................................................. 386
TDI / TDIH / TDIL Series ......................................... 388
TDLU / TDLUH / TDLUL Series .................................. 390
THD Series ............................................................... 392
THD Series ............................................................... 394
TS2 / TS6 Series ...................................................... 396
TSD2 Series ............................................................. 398
TSD6 Series ............................................................. 400
TSD7 Series ............................................................. 402

**Retriigerable Single Shot**
KRD9 Series ............................................................. 404
TS2D4110SB .............................................................. 406

**Recycle**
ECD1425A ................................................................. 407
ESDR Series ............................................................. 409
HRDR Series ............................................................. 412
KRD3 Series ............................................................. 414
KRD3 Series ............................................................. 416
KSD3 Series ............................................................. 418
KSDR Series ............................................................. 420
KSPDU Series ............................................................. 422
RS Series ................................................................. 424
TDR Series .............................................................. 426
TCD3C25A ................................................................. 428
TSD3411S ................................................................. 430
TSDR Series ............................................................. 432
# TABLE OF CONTENTS

## Percentage
- PTHF-4900DK .................................................. 434

## Dual Function
- TDMB Series .................................................. 436
- ESD5233 ........................................................ 438
- KRPD Series .................................................... 440

## HVAC
- CT Series ....................................................... 442
- T2D120A15M .................................................. 444
- TA Series ........................................................ 446
- TAC1 Series .................................................... 448
- TL Series ........................................................ 450
- TSA14130 ....................................................... 452

## Coin Vending
- HRV Series .................................................... 453

## Flashers & Tower Lighting Controls

### Flashers
- FSU1000 Series ............................................... 456
- FS100 Series Low Current Flasher ...................... 458
- FS100 Series Med Power Flasher ....................... 460
- FS200 Series .................................................. 462
- FS300 Series .................................................. 464
- FS491 ............................................................ 466
- FS500 Series .................................................. 467
- SC3 / SC4 Series Sequencing Controls .................. 469

### Tower and Obstruction Lighting Controls
- FA / FS Series .................................................. 471
- FB Series Flasher & Incandescent Beacon Alarm Relay... 473
- SCR490D Obstruction Lamp Alarm Relay .................. 474
- SCR Series Universal Lamp Alarm Relay .................. 475
- FB9L Universal Lamp Alarm Relay ......................... 477
- SCR9L Universal Lamp Alarm Relay ....................... 479
- PCR Series Photo Control .................................... 481

## Accessories
- Software ......................................................... 484
- Electrical ....................................................... 485
- Ground Reference Modules, High-Tension Couplers, & Relay Testers 488
- Remote Indication ........................................... 489
- Communication Adapters & Modules ........................ 492
- Terminations & Adapters .................................... 493
- Liquid Level Control ........................................ 495

## Current Transformers (CTs)
- CT Selection Guide .......................................... 496
- Current Transformers ....................................... 497
- Instrumentation & Metering Transformers ............... 498
- Current Transformer Sizing Chart ......................... 498
- ELCT Series .................................................. 499
- ZSCT Series .................................................. 501

## Mounting Adapters and Enclosures
- Panel-Mount Adapters ....................................... 502
- DIN Rail & Mounting Adapters ............................... 503
- Brackets & Clips ............................................. 504
- Enclosures & Watertight Covers ......................... 505

## Protection Overview

- Glossary of Terms ........................................ 510
- Introduction ............................................... 513
  - I. Introduction to Protection Relays .................. 513
  - II. Relay Application .................................. 514
  - III. CT Application ..................................... 522
  - IV. Resistance-Grounding Conversion .............. 523
- IEEE/ANSI Device Numbers and Typical Suffixes 526
- Typical Suffixes ........................................... 526

## Appendix
- Dimensional Drawings ..................................... 527

## Alphanumeric Index
- Alphanumeric Index ....................................... 537
<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>COMMON PROBLEMS</th>
<th>PRODUCT PROTECTION CATEGORY (PG NO.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERATORS</td>
<td>- Insulation breakdown due to vibration and corrosion</td>
<td>Ground Fault</td>
</tr>
<tr>
<td></td>
<td>- Ground-fault currents often exceed short-circuit current</td>
<td>Resistance Grounding</td>
</tr>
<tr>
<td></td>
<td>- Arc-flash hazard from local and paralleled generators</td>
<td>Arc Flash</td>
</tr>
<tr>
<td>Transformer</td>
<td>- Overloading and overvoltage</td>
<td>Resistance Grounding</td>
</tr>
<tr>
<td></td>
<td>- Highest average downtime (IEEE 493-1997)</td>
<td>Motor</td>
</tr>
<tr>
<td></td>
<td>- Arc-flash risk to personnel maintaining and working on live equipment</td>
<td>Feeder</td>
</tr>
<tr>
<td></td>
<td>- A fault on one load or feeder trips the entire lineup</td>
<td>Arc Flash</td>
</tr>
<tr>
<td>SWITCHGEAR &amp; MCCs</td>
<td>- Low-level leakage current undetected by typical OCPDs</td>
<td>Ground Fault</td>
</tr>
<tr>
<td>SWITCHGEAR &amp; MCCs</td>
<td>- Switching frequencies cause nuisance tripping</td>
<td>Ground Fault</td>
</tr>
<tr>
<td></td>
<td>- Resistance grounded drives require sensitive, wide-frequency ground-fault protection</td>
<td>Motor</td>
</tr>
<tr>
<td></td>
<td>- Winding faults due to overloading, water, dust and vibration</td>
<td>Arc Flash</td>
</tr>
<tr>
<td>MOTORS &amp; PUMPS</td>
<td>- Pump damage due to dry running, deadheading, rapid cycling, seal failure (submersible pumps), over heating, plugged intake, jammed impeller, or voltage fault conditions.</td>
<td>Ground Fault</td>
</tr>
<tr>
<td></td>
<td>- Temperature and mechanical stress lead to severe damage</td>
<td>Motor</td>
</tr>
<tr>
<td></td>
<td>- Uncoordinated feeders causing unnecessary downtime</td>
<td>Arc Flash</td>
</tr>
<tr>
<td>FEEDER CIRCUITS</td>
<td>- Movement causing broken conductors and failed insulation</td>
<td>Ground Fault</td>
</tr>
<tr>
<td></td>
<td>- Requirement to keep low ground-fault potential</td>
<td>Feeder</td>
</tr>
<tr>
<td></td>
<td>- Loss of ground or high ground resistance due to cable faults</td>
<td>Arc Flash</td>
</tr>
<tr>
<td>PORTABLE EQUIPMENT</td>
<td>- Open-circuit resistors due to corrosion or loose connections</td>
<td>Ground Fault</td>
</tr>
<tr>
<td></td>
<td>- Electrocuton hazard due to personnel working on submersible pumps or in vicinity of water and electricity</td>
<td>Motor</td>
</tr>
<tr>
<td></td>
<td>- Pump damage due to dry running, deadheading, rapid cycling, seal failure (submersible pumps), over heating, plugged intake, jammed impeller, or voltage fault conditions.</td>
<td>Arc Flash</td>
</tr>
<tr>
<td>WATER/WASTEWATER</td>
<td>- Higher risk of arc flash and steam blast due to moisture</td>
<td>Ground Fault</td>
</tr>
<tr>
<td></td>
<td>- Electrical conductors can cause explosions in explosive methane atmosphere</td>
<td>Motor</td>
</tr>
<tr>
<td></td>
<td>- H2S causing premature electronics failure</td>
<td>Arc Flash</td>
</tr>
<tr>
<td>HVACR</td>
<td>- Voltage issues causing premature failure</td>
<td>Ground Fault</td>
</tr>
<tr>
<td></td>
<td>- Short cycling increasing wear and tear on compressors</td>
<td>Motor</td>
</tr>
<tr>
<td></td>
<td>- Worn contactor causing voltage fault on compressor motor</td>
<td>Time Delay</td>
</tr>
<tr>
<td></td>
<td>- Rapid cycling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Low voltage/brownout condition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Contactor chatter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Reverse phase in a 3-phase system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Overload</td>
<td></td>
</tr>
</tbody>
</table>
# FEATURE COMPARISONS

Use the feature tables below and the Product Selection Guide on pages 11-41 to choose the appropriate protection relay or monitor for your application.

## Ground-Fault Protection Relays

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Detects GF via Voltage</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Detects GF via Current</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Detects DC GF</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Adjustable GF Pickup</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Adjustable Time Delay</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Remote Reset</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Analog Output</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Fail-Safe Option</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Harmonic Filtering</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>CT-Loop Monitoring</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Insulation Monitoring</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Ground-Check Monitoring</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Grounding-Resistor Monitoring</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>PTC/RTD Overtemperature</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Communications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Conformal Coating</td>
<td>‡</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

## Arc-Flash Relays

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>PGR-8800</th>
<th>AF0100</th>
<th>AF0500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Detection</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Point Sensors</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Fiber Optic Sensors</td>
<td>✔</td>
<td>-</td>
<td>✔</td>
</tr>
<tr>
<td>Cable Monitoring on Sensor Inputs</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>USB</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>DC Supply</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>AC Supply</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Data Logging</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Multi-Zone</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Communications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

**NOTE:** Tables are for reference only and include standard and optional configurations. Please see the respective catalog page for exact product specifications.

‡ Optional
### FEATURE COMPARISONS

**Pump Controllers**

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>MP8000</th>
<th>777-KW</th>
<th>77C-KW</th>
<th>MPU-32</th>
<th>MPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>Single-Phase or 3-Phase 90–690 VAC</td>
<td>3-Phase 200-480 VAC*</td>
<td>Single-Phase 100-240 VAC*</td>
<td>65-265 VAC, 80-275 VDC</td>
<td>Accepts broad range of external CTs</td>
</tr>
<tr>
<td>Monitored Current</td>
<td>0.5-1.000A (&gt;100A w/external CTs)</td>
<td>2-800A (&gt;90 A w/external CTs)*</td>
<td>Accepts broad range of external CTs</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>HP Rating</td>
<td>Any</td>
<td>871</td>
<td>Any</td>
<td>Any</td>
<td>Any</td>
</tr>
</tbody>
</table>

| Control Box Compatibility | - | - | - | - | - |
| Overload | ✔ | ✔ | ✔ | ✔ | ✔ |
| Underload/Dry-well/Dead-head | ✔ | ✔ | ✔ | ✔ | ✔ |
| Undercurrent/Dry-well/Dead-head | ✔ | ✔ | ✔ | ✔ | ✔ |
| Overcurrent/Jam | ✔ | ✔ | ✔ | ✔ | ✔ |
| Reduced Overcurrent Mode | - | - | - | - | - |
| Current Unbalance, Phase Loss/Reversal | ✔ | ✔ | ✔ | ✔ | ✔ |
| Over/Undervoltage | ✔ | ✔ | ✔ | ✔ | ✔ |
| Voltage Unbalance | ✔ | ✔ | ✔ | ✔ | ✔ |
| Ground Fault | Calculated | Calculated | Calculated | - | - |
| Overtemperature | - | - | - | - | - |
| Dynamic Thermal Model | - | - | - | - | - |
| Over/Underfrequency | - | - | - | - | - |
| Failure to Accelerate/Underspeed | - | - | - | - | - |
| Power Factor | - | - | - | - | - |
| Rapid Cycling/Jog | ✔ | ✔ | ✔ | ✔ | ✔ |
| Starter Control | - | - | - | - | - |
| Differential | - | - | - | - | - |
| Output Contact Rating | 10 A at 240 VAC | 10 A at 240 VAC* | 8 A at 250 VAC | - | - |
| Internal CT's | ✔ (up to 100 A)* | ✔ (up to 90 A)* | - | - | - |
| On-unit Metering | 3 Digit display | 4 line x 20 characters | 4 line x 20 characters | - | - |
| Remote Display | Via smartphone | ✔ | ✔ | ✔ | ✔ |
| Remote Reset Button | - | - | - | - | - |
| Datalogging | Last 1,000 faults | Last fault | Last fault | 100 events | 64 events |
| Local Communications | RS-485 | RS-485 | RS-232 | RS-485 | - |
| Bluetooth® Communication to Smartphone App** | ✔ | ✔ | ✔ | ✔ | ✔ |
| Modbus TCP | ✔ | ✔ | ✔ | ✔ | ✔ |
| Modbus RTU | ✔ | ✔ | ✔ | ✔ | ✔ |
| DeviceNet | ✔ | ✔ | ✔ | ✔ | ✔ |
| Profibus | ✔ | ✔ | ✔ | ✔ | ✔ |
| Ethernet/IP | ✔ | ✔ | ✔ | ✔ | ✔ |
| Allen-Bradley DF1 | - | - | - | - | - |
| Analog Output | - | - | - | - | - |
| Analog Input (Prog.) | - | - | - | - | - |
| Digital Input (Prog.) | - | - | - | - | - |
| Conformal Coating | - | - | - | - | - |
| Operating Temp Degree C | -40 to 70 | -20 to 70 | -20 to 70 | -40 to 60 | -40 to 60 |
| Warranty | 5 year | 10 year | - | - | - |
| Certifications | UL, CSA, CE | - | - | - | - |

*Other versions exist with different voltage ranges, current monitoring ranges, output contact ratings, and temperature monitoring. Consult specific series datasheets for more details.

** iPhone® and select Android™ smartphones and tablets are supported via Littelfuse app.
## FEATURE COMPARISONS

### Pump Controllers

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>111P</th>
<th>111-INSIDER-P, 231-INSIDER-P</th>
<th>232-INSIDER</th>
<th>233P</th>
<th>234-P</th>
<th>235P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitored Current</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HP Rating</td>
<td>1/5 – 1hp</td>
<td>1/5 – 1/2hp or 1/5 – 1hp</td>
<td>1/5 – 1hp</td>
<td>1/5 – 1.5hp or 1/5 – 3hp</td>
<td>1/5 – 3hp (external CT required)</td>
<td></td>
</tr>
<tr>
<td>Control Box Compatibility</td>
<td>-</td>
<td>Franklin™, Pentek®, CentriPro™, Flint &amp; Walling™, Grundfos® (mid-2014 or later)</td>
<td>Grundfos® (prior to mid-2014)</td>
<td>-</td>
<td>Grundfos®</td>
<td>-</td>
</tr>
<tr>
<td>Overload</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Underload/Dry-well/Dead-head</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Undercurrent/Dry-well/Dead-head</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Overcurrent/Jam</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Reduced Overcurrent Mode</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Current Unbalance, Phase Loss/ Reversal</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Over/Undervoltage</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Voltage Unbalance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Ground Fault</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Overtemperature</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Dynamic Thermal Model</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Over/Underfrequency</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Failure to Accelerate/Underspeed</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Power Factor</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Rapid Cycling/Jog</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Starter Control</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Differential</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Output Contact Rating</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Internal CT’s</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>On-unit Metering</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Remote Display</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Remote Reset Button</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Datalogging</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Local Communications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Bluetooth® Communication to Smartphone App**</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

### NETWORK COMS. (Optional)

- Modbus TCP
- Modbus RTU
- DeviceNet
- Profinet
- Ethernet/IP
- Allen-Bradley DF1

### Analog Output

- -40 to 60

### Analog Input (Prog.)

- -40 to 60

### Digital Input (Prog.)

- -40 to 60

### Conformal Coating

- 5 year

### Operating Temp Degree C

- -40 to 60

### Warranty

- 5 year

### Certifications

- cULus
- cURus
- cCSAus, cURus
- cULus
- cULus
- cULus

*Other versions exist with different voltage ranges, current monitoring ranges, output contact ratings, and temperature monitoring. Consult specific series datasheets for more details.

** iPhone® and select Android™ smartphones and tablets are supported via Littelfuse app.
# Motor & Feeder Protection Relays

<table>
<thead>
<tr>
<th>FUNCTION/FEATURE (IEEE#)</th>
<th>MP8000</th>
<th>777</th>
<th>77C</th>
<th>MPU-32</th>
<th>MPS</th>
<th>FPU-32</th>
<th>FPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>Single or 3-Phase 90-690 VAC</td>
<td>3-Phase 200-480 VAC*</td>
<td>Single-Phase 100-240 VAC*</td>
<td>65-265 VAC, 80-275 VDC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitored Current</td>
<td>0.5-1,000A (&lt;100A w/ external CTs)</td>
<td>2-800A (&lt;90A w/external CTs)*</td>
<td>Accepts broad range of external CTs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload (49, 51)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Underload</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent (50, 51)/Jam</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reduced Overcurrent Mode</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undercurrent (37)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Current Unbalance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Phase Loss/Reversal (37)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Over (59)/Undervoltage (27)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Voltage Unbalance (47)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ground Fault (50G/N, 51G/N)</td>
<td>Calculated</td>
<td>Calculated</td>
<td>Calculated</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Overfrequency (81)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dynamic Thermal Model</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Failure to Accelerate/Underspeed</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Power Factor (55)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rapid Cycling/Jog</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Starter Control</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaker Control</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential (87)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Feeder Protection</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definite-time Overcurrent</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inverse-time Overcurrent</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Contact Rating</td>
<td>10A at 240 VAC</td>
<td>10A at 240 VAC*</td>
<td></td>
<td>8A at 250 VAC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal CTs</td>
<td>✓ (up to 100 A)</td>
<td>✓ (up to 90 A)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-unit Metering</td>
<td>3 Digit display</td>
<td>4 line x 20 characters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote Display</td>
<td>Via smartphone</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Remote Reset Button</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Datalogging</td>
<td>Last 1,000 faults</td>
<td>Last fault</td>
<td>Last fault</td>
<td>100 events</td>
<td>64 events</td>
<td>100 events</td>
<td>64 events</td>
</tr>
<tr>
<td>Local Communications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluetooth® Communication to Smartphone App**</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NETWORK COMS. (Optional)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modbus TCP</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Modbus RTU</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DeviceNet</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Profibus</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ethernet/IP</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Allen-Bradley DF1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Analog Output</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Analog Input (Prog.)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Digital Input (Prog.)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Conformal Coating</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Operating Temp Deg C</td>
<td>-40 to +70</td>
<td>-20 to +70</td>
<td>-20 to +70</td>
<td>-40 to +60</td>
<td>-40 to +60</td>
<td>-40 to +60</td>
<td>-40 to +60</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 year</td>
<td>5 year</td>
<td>5 year</td>
<td>10 year</td>
<td>10 year</td>
<td>10 year</td>
<td>10 year</td>
</tr>
<tr>
<td>Certifications</td>
<td>UL, CSA, CE</td>
<td>UL, CSA, CE</td>
<td>UL, CSA, CE</td>
<td>UL Recognized, CSA, CE, RCM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Other versions exist with different voltage ranges, current monitoring ranges, output contact ratings, and temperature monitoring. Consult specific series datasheets for more details.

** iPhone® and select Android™ smartphones and tablets are supported via Littelfuse app

** IEEE Device Numbers are shown in parenthesis after the applicable features.
# PRODUCT SELECTION GUIDE

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground-Fault Protection</td>
<td>12</td>
</tr>
<tr>
<td>Ground-Conductor Monitoring</td>
<td>13</td>
</tr>
<tr>
<td>Resistance Grounding / NGR Monitoring</td>
<td>13</td>
</tr>
<tr>
<td>Feeder Protection</td>
<td>14</td>
</tr>
<tr>
<td>Arc-Flash Protection</td>
<td>14</td>
</tr>
<tr>
<td>Switching Relays &amp; Controls</td>
<td>15</td>
</tr>
<tr>
<td>Motor &amp; Pump Protection</td>
<td>16</td>
</tr>
<tr>
<td>Pump Controllers</td>
<td>18</td>
</tr>
<tr>
<td>AC System Monitors / Load Sensors</td>
<td>22</td>
</tr>
<tr>
<td>Timers</td>
<td>26</td>
</tr>
<tr>
<td>Flashers, Tower and Obstruction Lighting Control</td>
<td>40</td>
</tr>
</tbody>
</table>
STEP 1: Select the needed features in each category

**UNGROUNDED**
Detect ground faults on an ungrounded system

- DC
- AC

**GROUND-FAULT PROTECTION**

- Detect & Limit Ground Faults
- Locate Ground Fault & Reduce Transient Overvoltage
- Detect Insulation Breakdown

**GROUNDED**
Detect ground faults on a grounded system

- DC + VFDs
- AC

- Detect Low-Level Ground-Faults Currents
- Solidly Grounded
- Resistance Grounded

- Reduce Potential for Arc Flash
- Convert System to Resistance Grounding

- Personnel Protection
- Detect AC/DC Ground Fault in VFDs

**Output Contact**

- Digital Metering & Communications

**Connectors**

- Type
- Locate Ground Fault & Reduce Transient Overvoltage
- Detect Insulation Breakdown
- Detect Ground Fault by Phase-Voltage Measurement

**Ground Fault Protection Relays**

- SE-601 SERIES pg. 47
- PGR-3200 SERIES pg. 46
- EL3100 SERIES pg. 44
- PGR-3100 SERIES pg. 45
- EL731 SERIES pg. 48
- PGR-4300 SERIES pg. 55
- SE-701 SERIES pg. 50
- SE-703 SERIES pg. 51
- SE-704 SERIES pg. 52
- SB6100 pg. 53
**GROUND-FAULT & GROUND-CHECK**

Ensure ground-conductor continuity for portable equipment and submersible pumps, and detect ground faults.

- **Cable Voltage**
  - <5kV
  - >5kV

**GROUND-CONDUCTOR MONITORING**

- **SE-105, SE-107 SERIES pg. 58**
- **SE-134C, SE-135 SERIES pg. 59**

**GROUND-FAULT & GROUND-CHECK**

- **SE-330 & SE-701 SERIES (use in combination) pg. 63 pg. 50**
- **SE-330 SERIES pg. 63**
- **SE-325 SERIES pg. 62**
- **NGR SERIES pg. 66**

**RESISTANCE GROUNDING/NGR MONITORING**

- **NGR SERIES pg. 66**

**RESISTANCE-GROUNDED AC**

Solve problems commonly associated with ungrounded and solidly grounded systems and monitor the neutral-to-ground connection.

- **Neutral-Grounding Resistance (NGR) Continuity Monitoring**
- **Implement Resistance Grounding**
- **Pulsing, Digital Filtering, Communications, or Software**
  - Y
  - N
- **Identify Faulted Feeder**
  - Y
  - N

**Ground-Conductor Monitoring Relays**

**Resistance Grounding Systems & NGR Monitors**
Select product category

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH PROTECTION**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH PROTECTION**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

**STANDARD**
- Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

**ADVANCED**
- Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

**STEP 1**

**STEP 2**

**STEP 3**

**ARC-FLASH DETECTION**
- Rapidly detect an arc flash to reduce damage to equipment and risk to personnel
**MOTOR & PUMP PROTECTION**

**SUPPLEMENTAL PROTECTION (MOTOR)**
Protection for motors against insulation degradation, overheating, or ventilation failure

**BASIC (PUMP)**
Protection of single-phase pumps against dry-well, dead-head, jammed impeller, rapid-cycling and over/under voltage

---

**STEP 1**
Select product category

**STEP 2**
Select the needed features in each category

**STEP 3**
Find the recommended product for your application

---

- **PGR-6100 SERIES**
  - pg. 94
- **SIO-RTD-02-00 SERIES**
  - pg. 128
- **111P SERIES**
  - pg. 106
- **233P SERIES**
  - pg. 106
- **235P SERIES**
  - pg. 110
- **111-INSIDER-P SERIES**
  - pg. 101
- **231-INSIDER-P SERIES**
  - pg. 101
- **232-INSIDER SERIES**
  - pg. 104
- **234-P SERIES**
  - pg. 108
- **INFORMER SERIES**
  - pg. 250

Basic Motor & Pump Protection
MOTOR & PUMP PROTECTION

STANDARD
Multi-function protection for low and medium voltage motors

Single-Phase

Three-Phase

Under Power Protection for Pump Applications

Y
N

Y
N

4-20mA Output Power

Temperature Protection & Reduced Overcurrent

Y
N

Y
N

77C-KW/HP SERIES
pg. 118

77C SERIES
pg. 118

777-ACCUPOWER & COM 4-20
(use in combination)
pg. 123

777-KW/HP-P2 SERIES
pg. 120

MPU-32 SERIES
pg. 96

777-P2 SERIES
pg. 114

Standard Motor & Pump Protection

STANDARD WITH BLUETOOTH®
Multi-function protection for single-phase and three-phase low and medium voltage motors and pumps with real-time data, programming and troubleshooting via iPhone® or Android™ app

MP8000 SERIES
pg. 112

Standard Motor & Pump Protection with Bluetooth®

*Bluetooth is a trademark of its respective owner
LIQUID LEVEL CONTROLS

Control liquid pumping operations in a pump-up or pump-down application

Sensing Type

- PROBE
- FLOAT

Mounting Option

- 8-PIN SOCKET
- 11-PIN SOCKET
- OPEN BOARD
- DIN RAIL/SURFACE MOUNT

Probe Style

- SINGLE PROBE
- DUAL PROBE

Compatibility

- GEM’S SERIES 16M LIQUID LEVEL CONTROL
- CROUZET’S PNR & PNRU SERIES LIQUID LEVEL CONTROL

Low Liquid Level Cut-off Protection That Meets UL 353

- Y
- N

Liquid Level Controls

LLC4 SERIES pg. 145
LLC5 SERIES pg. 147
PC-XXX-LLC-GM SERIES pg. 134
PC-XXX-LLC-CZ SERIES pg. 134
LLC6 SERIES pg. 149
460-15-100-LLS SERIES pg. 137
LLC8 SERIES pg. 151
LLC1 SERIES pg. 141
LLC2 SERIES pg. 143
PC-105 SERIES pg. 133
PUMP CONTROLLERS

ALTERNATING RELAYS

Used in duplex pumping applications to balance the run time of both pumps

Float Switch Configuration

STEP 1
Select product category

STEP 2
Select the needed features in each category

STEP 3
Find the recommended product for your application

Select product category

Find the needed features in each category

Find the recommended product for your application

Alternating Relays

ALTERNATING RELAYS

Used in duplex pumping applications to balance the run time of both pumps
**PUMPM CONTROLLERS**

**ALARM CONTROLS/ BATTERY CHARGERS**
Dual-purpose alarm control/battery charger for pump control panels

**INTRINSICALLY SAFE RELAYS**
Used to interface between hazardous and non-hazardous areas

**INTRINSICALLY SAFE PUMP CONTROLLER**
Programmable to control/equalize run time of 2, 3, or 4 pumps, with the ability to interface between hazardous and non-hazardous areas

<table>
<thead>
<tr>
<th>12-Pin Socket Included</th>
<th>Number of Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Y</strong></td>
<td>SINGLE-CHANNEL</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>TWO CHANNELS</td>
</tr>
<tr>
<td></td>
<td>THREE CHANNELS</td>
</tr>
<tr>
<td></td>
<td>FOUR CHANNELS</td>
</tr>
<tr>
<td></td>
<td>FIVE CHANNELS</td>
</tr>
</tbody>
</table>

**Mounting Option**
- DIN RAIL/SURFACE MOUNT
- 8-PIN SOCKET

**Alarm Control/Battery Charger**
- ACBC-120-SD
  - pg. 130

**Intrinsically Safe Relays**
- ISS-100
  - pg. 160
- ISS-101
  - pg. 161
- ISS-102 SERIES
  - pg. 163
- ISS-105-ISO-3
  - pg. 165
- ISS-105-ISO-4
  - pg. 165
- ISS-105-ISO
  - pg. 165

**Intrinsically Safe Pump Controller**
- ISS-105
  - pg. 165
VOLTAGE MONITORS (1 of 2)

Highly accurate and precise voltage measurements to provide high sensitivity while minimizing nuisance tripping

Ac System Monitors/Load Sensors

201A-AU SERIES

201-XXX-DPDT SERIES

202-RP

455 SERIES & INFORMER-MS (use in combination)

Voltage Monitoring Relays

22
Voltage Monitoring Relays

Voltage Monitors (1 of 2) (Continued from previous page)

- **Output Contacts**
- **600V Rated**
- **2 FORM C**
  - **FORM C SCREW TERMINAL**
  - **FORM C FAST-ONS**
- **Adjustable % Unbalance**
- **Fault Memory**
- **Universal 190-480 VAC**
- **Adjustable Trip Delays**
- **Frequency Monitoring**
- **Adjustable Voltage Range**

- **HLMU SERIES** pg. 227
- **250A SERIES** pg. 208
- **601 SERIES** pg. 218
- **WVM SERIES** pg. 222
- **102A SERIES** pg. 198
- **TVW SERIES** pg. 233
- **TVM SERIES** pg. 235
- **355 SERIES** pg. 212
- **350 SERIES** pg. 210
CURRENT MONITORS/LOAD SENSORS (2 of 2)

(Continued from previous page)
**FACTORY PROGRAMMABLE**

Microprocessor based circuitry provides excellent repeat accuracy and stability

---

**STEP 1**
Select product category

**STEP 2**
Select the needed features in each category

**STEP 3**
Find the recommended product for your application

---

**FACTORY PROGRAMMABLE Timers**

- **HRIS SERIES**, pg. 317
- **HRPSD12HI**, pg. 317
- **KRPD SERIES**, pg. 424
- **KRPS SERIES**, pg. 281
- **HSPZ22SSL**, pg. 339
- **KSPD SERIES**, pg. 406
- **KSPU SERIES**, pg. 270
- **KSPS SERIES**, pg. 208

---

Factory Programmable Timers

---
MULTIFUNCTION
Universal and fully programmable timing relays

Relay Output

Timing Functions Available

Solid-State Output

Timing Adjustment

ON-BOARD KNOB

DIP SWITCH

Termination Style

Termination Style

QUICK CONNECTS

SCREW TERMINAL BLOCKS

Quick Connects

Screw Terminal Blocks

Power Supply

Timing Functions Available

Power Supply

Timing Functions Available

Power Supply

Timing Adjustment

Termination Style

Termination Style

Designed for use in OEM equipment

Relay Output

Relay Output

Relay Output

Relay Output

Relay Output

Relay Output

TRU SERIES
pg. 268

ASQU SERIES
pg. 270

DSQU SERIES
pg. 272

DSU SERIES
pg. 272

TRDU SERIES
pg. 265

ASTU SERIES
pg. 270

Multifunction Timers
TIMERS

DEDICATED — SINGLE FUNCTION
Wide product offering to meet OEM and industrial requirements

STEP 1
Select the needed features in each category

STEP 2
Find the recommended product for your application

STEP 3
Select product category

Delay-on-Make Timers
DEDICATED — SINGLE FUNCTION

(Continued from previous page)
DEDICATED — SINGLE FUNCTION

(Continued from previous page)

**STEP 1**
Select the needed features in each category

**STEP 2**
Find the recommended product for your application

**STEP 3**
Select product category
DEDICATED — SINGLE FUNCTION

Wide product offering to meet OEM and industrial requirements

Package Style

- 8-PIN OR 11-PIN PLUG-IN
- OPEN PC BOARD
- SURFACE MOUNT

DIP Switch Adjustment

- Y
- N

Timing Ranges

- 1-1023 s in increments of 1 s
- 0.1-102.3 s in increments of 0.1 s
- 10-10,230 s in increments of 10 s

Delay-on-Break Timers

- TDB SERIES pg. 325
- TDBH SERIES pg. 325
- TDBL SERIES pg. 329
- TRB SERIES pg. 331
- ORB SERIES pg. 323
- HRDB SERIES pg. 315
- KRDB SERIES pg. 319

Relay Output

- Y
- N

Isolated

- Solid-State with Normally Open Contacts

Timing Ranges

- SPDT/DPDT

- 0.1 s to 100 m in 5 ranges
- 0.1 s to 1000 m in 6 ranges
DEDICATED — SINGLE FUNCTION

(Continued from previous page)

STEP 1
Select product category

STEP 2
Select the needed features in each category

STEP 3
Find the recommended product for your application

High Current (6, 10, or 20A)

Low Current (1A)

Extended Operating Temperature Range

Adjustment Style

Timing Ranges

0.1 s – 1000 m in 6 ranges
0.05 s – 600 s in 4 ranges
1 s to 1000 m in 5 ranges

THD7 SERIES
pg. 376

THDB SERIES
pg. 329

TSDB SERIES
pg. 335

TSB SERIES
pg. 333

TSD7 SERIES
pg. 386

KSDB SERIES
pg. 321

TDUB SERIES
pg. 327

Delay-on-Break Timers
DEDICATED — SINGLE FUNCTION
Wide product offering to meet OEM and industrial requirements

SINGLE SHOT

Package Style

- 8-PIN OR 11-PIN PLUG-IN
- OPEN PC BOARD
- SURFACE MOUNT

DIP Switch Adjustment

- Y
- N

Timing Ranges

- 1-1023 s in increments of 1 s
- 0.1-102.3 s in increments of 0.1 s
- 10-10,230 s in increments of 10 s

Fixed/Knob/External Adjustment

- Y
- N

Knob Adjust Only

- Y
- N

Knob Adjust Only

- Y
- N

Timing Ranges

- 0.1 s to 1000 m in 6 ranges

Relay Output

- Y
- N

Relay Output

- Y
- N

Isolated

- Y
- N

Isolated

- Y
- N

TIMERS

- 1-1023 s in increments of 1 s
- 0.1-102.3 s in increments of 0.1 s
- 10-10,230 s in increments of 10 s

Single Shot Timers

TDS SERIES pg. 348
TDSH SERIES pg. 348
TDSL SERIES pg. 348
TRS SERIES pg. 356
PR565 pg. 347
ORS SERIES pg. 345
KRD9 SERIES pg. 388
TSD94110SB pg. 390
ERDI SERIES pg. 362
KRDS SERIES pg. 341
HRDS SERIES pg. 337
DEDICATED — SINGLE FUNCTION

(Continued from previous page)

STEP 1: Select product category

STEP 2: Select the needed features in each category

STEP 3: Find the recommended product for your application

---

Single Shot Timers

THC421C
THDS SERIES
THS SERIES
TSDS SERIES
KSDS SERIES
TSS SERIES
TDUS SERIES

pg. 352
pg. 354
pg. 352
pg. 358
pg. 343
pg. 360
pg. 350
DEDICATED — SINGLE FUNCTION
Wide product offering to meet OEM and industrial requirements

TIMERS

INTERVAL

Package Style

8-PIN PLUG-IN
SURFACE MOUNT

Timing Ranges

1-1023 s in increments of 1 s
0.1-102.3 s in increments of 0.1 s
10-10,230 s in increments of 10 s

Relay Output

Y

Solid-State Output

N

Y

Isolated

N

High Current (6, 10, or 20A)

Y

Timing Ranges

0.1 s to 1000 m in 6 ranges
1 s to 1000 m in 5 ranges

DPDT

SPDT

TDI SERIES pg. 372
TDIH SERIES pg. 372
TDIL SERIES pg. 372
ERDI SERIES pg. 362
KRDI SERIES pg. 366
HRDI SERIES pg. 364
THD2 SERIES pg. 376
THD7 SERIES pg. 378
DEDICATED — SINGLE FUNCTION

(Continued from previous page)

Low Current (1A) → Adjustment Style

- DIP SWITCH
- FIXED/EXTERNAL
- FIXED/ONBOARD KNOB/EXTERNAL

Input Voltage
- AC
- DC

Timing Ranges
- 0.1 s to 100 h in 7 ranges
- 0.1 s to 1000 m in 6 ranges

Input Voltage
- 1 s to 1000 m in 5 ranges
- 0.05 s to 600 s in 4 ranges

- AC
- DC

Interval Timers

TDUI SERIES pg. 374
TSD7 SERIES pg. 366
TS2 SERIES pg. 380
TS6 SERIES pg. 380
TSD2 SERIES pg. 382
TSD6 SERIES pg. 384
KSD2 SERIES pg. 368
DEDICATED — SINGLE FUNCTION
Wide product offering to meet OEM and industrial requirements

Recycling

Package Style

SURFACE MOUNT

8-PIN PLUG-IN

Relay Output

Solid-State with Normally Open Contacts

Recycling Flashers

Isolated

High Current (6, 10, or 20A)

Contacts Type

Timing Ranges

Low Current (1A)

0.1 s to 1000 m in 6 ranges

Extended Operating Temperature Range

Adjustment Style

SPDT

DPDT

FIXED/ONBOARD KNOB

FIXED/ONBOARD KNOB/EXTERNAL

TIMERS

Recycling Timers
DEDICATED — SINGLE FUNCTION

(Continued from previous page)

Adjustment Style

- DIP SWITCH
- KNOB/EXTERNAL/FIXED
- EXTERNAL

Input Voltage

- AC/DC
- AC

Recycling Timers

- RS SERIES pg. 408
- KSDR SERIES pg. 404
- ESDR SERIES pg. 393
- TSDR SERIES pg. 416

Percentage Timers

- PTHF4900DK pg. 418
DEDICATED

Wide product offering to meet OEM and industrial requirements

DUAL FUNCTION

HVAC

COIN VENDING

DELAY-ON-MAKE/
DELAY-ON-BREAK

DELAY-ON-MAKE/
INTERVAL

Y

N

Lockout Delay

Anti-short Cycle with Random Start

Anti-short Cycle with Random Start

Low Voltage Brownout Protection

Fan Delay

Y

N

Y

N

Y

N

Y

N

Y

N

Y

N

Y

N

Y

N

Y

N

Y

N

DELAY-ON-MAKE /
DELAY-ON-BREAK

DELAY-ON-MAKE /
INTERVAL

TDDB SERIESp. 420
ESD5 SERIESp. 422
T2D120A15M SERIESp. 428
TSA141300 SERIESp. 430
TA SERIESp. 434
TL SERIESp. 432
TAC1 SERIESp. 426
CT SERIESp. 426
HRV SERIESp. 437

Dedicated Timers – Dual Function
Dedicated Timers – HVAC
Dedicated Timers – Coin Vending
Flashers, Tower & Obstruction Lighting Control

**Flashers**

Designed to cycle power to lamps and LEDs to turn them on and off repeatedly.

**STEP 1**
Select the needed features in each category.

**STEP 2**
Find the recommended product for your application.

**STEP 3**
Select the product category.

---

**Flashers**

**3 or 4 Channel Chaser Designed for Sequential Circuit Flashing of Incandescent Lamp Loads**

- **Y**: Solid-State with No Moving Parts
- **N**: 8-PIN SOCKET

**Flashes Per Minute (FPM)**

- 10-100 ON-BOARD ADJUSTABLE
- 10-180 (CUSTOM) 75 (FIXED)
- 45-150 (CUSTOM) 75 (FIXED)
- 60-150 (CUSTOM) 75 (FIXED)

**For Controlling Inductive, Incandescent, or Resistive Loads**

- 24 or 120VAC LOW AMP
- 24-240VAC; 1, 6, 10 or 20 AMP

**Medium Amp**

- 24VDC
- 12VDC

**Low Leakage for Controlling LED or Resistive Loads**

- 24, 120, or 230VAC
- 24VDC

**High Immunity to Line Noise and Transients for Moving Vehicle Applications**

- 12VDC
- 24VDC

---

**SC3/SC4 SERIES**
pg. 453

**FSU1000 SERIES**
pg. 440

**FS126**
FS127
FS146
pg. 442

**FS143**
FS152
FS162
pg. 444

**FS219-45**
FS224
pg. 446

**FS224**
pg. 448

**FS491**
FS312
pg. 450

**FS324**
pg. 448

**FS500 SERIES**
pg. 451
ALARMS RELAYS

Monitors any failures in flashers & incandescent beacons, obstruction and universal lamps

- **FLASHER AND INCANDESCENT BEACON**
  - Used to Monitor the Operation of One Two-lamp Incandescent Beacon and One Beacon Flasher
  - FB SERIES pg. 457

- **BEACON OR OBSTRUCTION LAMP**
  - Used to Provide Remote Monitoring of Steady Burning Incandescent Marker and Obstruction Lighting
  - SCR490D pg. 458

- **UNIVERSAL LAMP**
  - Designed to Sense the Failure of Various Kinds of Lamps
  - SCR SERIES pg. 459

- **FLASHERS, TOWER & OBSTRUCTION LIGHTING CONTROL**
  - FB9L pg. 461
  - SCR9L pg. 463

Alarm Relays
Select product category

STEP 1
Select the needed features in each category

STEP 2
Find the recommended product for your application

STEP 3
Select product category

BEACON TOWER FLASHERS
Designed for use on communication towers, smoke stacks, cooling towers, tall buildings, bridges, and utility towers

PHOTO CONTROL
Designed to meet the demands of the most vigorous requirement tower & obstruction lighting control. Factory calibrated to meet FAA and FCC specifications

FS SERIES
pg. 455

FA SERIES
pg. 455

PCR SERIES
pg. 465

Beacon Tower Flashers

Photo Control
GROUND-FAULT PROTECTION

Create safer working environments and reduce incidents of arc flash without affecting the uptime of critical operations. Vital in manufacturing and processing environments, sensitive ground-fault relays with advanced filtering will detect breakdown in insulation resistance without nuisance trips. Breakdown in insulation resistance can be caused by moisture, vibration, chemicals and dust.

Ungrounded AC Systems
- EL3100 Series  Ground-Fault & Phase-Voltage Indicator  44
- PGR-3100 Series  Ground-Fault Indication System  45
- PGR-3200 Series  Insulation Monitor  46

Ungrounded DC System
- SE-601 Series  DC Ground-Fault Monitor  47

AC/DC Earthed System
- EL731 Series  AC/DC Sensitive Earth-Leakage Relay  48

Solidly Grounded Systems
- SE-701 Series  Ground-Fault Monitor  50
- SE-703 Series  Earth-Leakage Monitor  51
- SE-704 Series  Earth-leakage monitor  52

Ground-Fault Circuit Interrupters – Personnel Protection
- SB5000 Series  Industrial Shock Block  53
- SB6000 Series  Industrial Shock Block  55

Generator and Single-Function
- PGR-4300 Series  Generator Ground-Fault Relay  57

For More Information…
and to download our White Paper on Ground-Fault Protection with VFDs, visit Littelfuse.com/TechnicalCenter
EL3100 SERIES
Ground-Fault & Phase-Voltage Indicator

Description
The EL3100 is a self-powered ground-fault and phase-voltage indication system for 3-phase systems. The EL3100 meets the National Electrical Code (NEC) and the Canadian Electrical Code (CEC) requirements for ground detectors for ungrounded alternating-current systems. Voltage connections are provided on the EL3100 for 208, 240, 480, and 600-V systems. Three green LED’s on the EL3100 indicate the presence of phase-to-ground voltage and one red LED indicates a ground fault. The EL3100 can operate stand-alone or with up to five remote LED indicators. A solid-state relay output provides indication of a ground fault. The output relay is closed when the 3-phase neutral voltage shifts as the result of ground leakage.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC® and CEC Code compliant</td>
<td>Meets National Electrical Code (NEC®) Article 250.21 and Canadian Electrical Code Part 1, Section 10-106 (2) requirements for ungrounded systems</td>
</tr>
<tr>
<td>Low-voltage remote LEDs</td>
<td>System voltage is not present at the remote LED location</td>
</tr>
<tr>
<td>Phase-voltage indication</td>
<td>Indicates the presence of voltage on both grounded and ungrounded systems</td>
</tr>
<tr>
<td>Output relay</td>
<td>Allows for remote ground-fault indication</td>
</tr>
</tbody>
</table>

Accessories

Remote LEDs
High-intensity 16-mm IP67 LED lamps available in red and green colors.

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>MOUNTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL3100-00</td>
<td>DIN, Surface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>RK-310X-0Y</td>
<td>Optional</td>
</tr>
</tbody>
</table>

Note: X=R for red LED and G for green LED Y=0 for no label and 1 for a ground-fault label

Specifications

<table>
<thead>
<tr>
<th>Input Voltage</th>
<th>Input L: 208/240 Vac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input H:</td>
<td>480/600 Vac</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 87.0 mm (3.43”); W 112.5 mm (4.43”)</td>
</tr>
<tr>
<td></td>
<td>D 56.0 mm (2.2”)</td>
</tr>
<tr>
<td>Approvals</td>
<td>CSA certified, UL Listed (E340889), RCM (Australia)</td>
</tr>
<tr>
<td>Conformally Coated</td>
<td>Standard feature</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
</tr>
<tr>
<td>Mounting</td>
<td>DIN, Surface</td>
</tr>
</tbody>
</table>

Littelfuse reserves the right to make product changes, without notice. Material in this document is as accurate as known at the time of publication. Visit Littelfuse.com for the most up-to-date information.
Ground-Fault Indication System

Description
The PGR-3100 indicates the presence of voltage on each phase of a three-phase system. The LEDs on the panel illuminate when voltage is present. When a ground-fault occurs, the voltage on the faulted phase reduces to ground potential, causing the LEDs for the faulted phase to dim and the LEDs for the unfaulted phases to become brighter. Ungrounded ac systems are required by the National Electrical Code (NEC®) Article 250.21(B) and the Canadian Electrical Code Part 1, Section 10-106 (2) to have ground detectors, such as the PGR-3100, installed on the system. External potential transformers (PTs) can be used to step down system voltage, allowing the PGR-3100 to be applied to any system voltage. PTs are not required for system voltages up to 600 V ac.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC® and CE Code compliant</td>
<td>Meets National Electrical Code (NEC) Article 250.21(B) and Canadian Electrical Code Part 1, Section 10-106 (2) requirements for ungrounded systems</td>
</tr>
<tr>
<td>Phase LEDs</td>
<td>Indicates presence of a ground fault and the faulted phase as well as phase-to-ground voltage on an energized bus</td>
</tr>
<tr>
<td>Redundant LEDs</td>
<td>Redundant long-life LEDs (two per phase) to ensure reliability</td>
</tr>
<tr>
<td>Lamp test button</td>
<td>Verifies LEDs are operating</td>
</tr>
</tbody>
</table>

Specifications

Input Voltage: Up to 600 V ac 50/60 Hz
Indicator Off Voltage: < 30 V ac line to ground
Dimensions: H 88.9 mm (3.5”); W 108 mm (4.3”); D 54 mm (2.1”)
Test Button: Local
Approvals: CSA certified, UL Listed
Conformally Coated: Standard feature
Warranty: 5 years
Mounting: Panel

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>MOUNTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGR-3100</td>
<td>Panel mount</td>
</tr>
</tbody>
</table>

Littelfuse reserves the right to make product changes, without notice. Material in this document is as accurate as known at the time of publication. Visit Littelfuse.com for the most up-to-date information.
Protection Relays
Ground-Fault Protection – Ungrounded AC System

**PGR-3200 SERIES**
Insulation Monitor

**Description**
The PGR-3200 detects ground faults by continuously monitoring the insulation integrity of ungrounded electrical systems. The relay monitors the insulation for damage and assists with predictive maintenance and troubleshooting of developing ground faults by providing two warning and an alarm level. The PGR-3200 operates on one- or three-phase ungrounded systems up to 6 kV.

The PGR-3200 can also be used on a grounded system to monitor the insulation for damage, while the power system is de-energized. The mode-of-operation terminals (27-28) are connected to the circuit breaker or contactor auxiliary contacts to toggle the relay off when the contactor or breaker is closed.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC® and CEC Code compliant</td>
<td>Meets National Electrical Code (NEC®) Article 250.21(B) and Canadian Electrical Code Part 1, Section 10-106 (2) requirements for ungrounded systems</td>
</tr>
<tr>
<td>Output contact (50 kΩ)</td>
<td>Form C output contact for alarming when the insulation resistance is below 50 kΩ</td>
</tr>
<tr>
<td>Output contact (10 kΩ)</td>
<td>Form C output contact for tripping when the insulation resistance is below 10 kΩ</td>
</tr>
<tr>
<td>Analog output (0-1 mA)</td>
<td>Provides means for connecting to an optional meter (PGA-0510) or control system</td>
</tr>
<tr>
<td>DIN-rail or surface mount</td>
<td>Flexible options for ease of installation</td>
</tr>
</tbody>
</table>

**Accessories**

- **PGH Series High-Tension Coupler**
  A PGH Series high-tension coupler is required for systems between 1,300 V and 6,000 V.

- **PGA-0510 Analog Ohm Meter**
  Optional PGA-0510 Analog Meter allows for metering of insulation resistance.

**Ordering Information**

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>CONTROL POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGR-3200</td>
<td>240 Vac(T)</td>
</tr>
<tr>
<td>PGR-3200-120</td>
<td>120 Vac</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGH Series</td>
<td>Required &gt;1,300 V</td>
</tr>
<tr>
<td>PGA-0510</td>
<td>Optional</td>
</tr>
</tbody>
</table>

**Specifications**

- **IEEE Device Numbers**
  - Undervoltage Relay (27)
  - Ground Detector Relay (64)
  - See ordering information

- **Input Voltage**
  - H 75 mm (3”)
  - W 100 mm (3.9”)
  - D 115 mm (4.5”)

- **Dimensions**
  - Insulation warning (30 kΩ and 50 kΩ)
  - Insulation alarm (10 kΩ)

- **Resistance Ratings**
  - Non-fail-safe
  - Local
  - Local and remote

- **Contact Operating Mode**
  - Two Form C
  - 0-1 mA

- **Test Button**
  - Consult factory
  - UL Listed (E183688)

- **Reset Button**
  - 5 years

- **Output Contacts**
  - DIN, Surface

---

Note: For optional conformal coating please consult factory. To convert to a resistance grounded system, see neutral-grounding-resistors packages.

(1) UL Not Available

© 2023 Littelfuse, Inc.
Description
The SE-601 is a microprocessor-based ground-fault relay for ungrounded dc systems. It provides sensitive ground-fault protection without the problems associated with nuisance tripping. Ground-fault current is sensed using an SE-GRM Series Ground-Reference Module—a resistor network that limits ground-fault current to 25 mA. The SE-601 is used on ungrounded dc systems ranging from industrial 24-Vdc control circuits to 1000-Vdc solar and transportation systems.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable pickup (1-20 mA)</td>
<td>Ten settings provide a wide range of low-level protection</td>
</tr>
<tr>
<td>Adjustable time delay (50 ms-2.5 s)</td>
<td>Adjustable trip delay allows quick protection or delayed response</td>
</tr>
<tr>
<td>Output contacts</td>
<td>Form A and Form B output contacts for operation of separate annunciation and trip circuits</td>
</tr>
<tr>
<td>Analog output (0-5 V)</td>
<td>Provides means for connecting to a meter (PGA-0500) or a control system</td>
</tr>
<tr>
<td>Non-volatile trip Memory</td>
<td>Retains trip state when de-energized to simplify troubleshooting</td>
</tr>
<tr>
<td>Selectable contact operating mode</td>
<td>Selectable fail-safe or non-fail-safe operating modes allow connection to shunt or undervoltage breaker coil</td>
</tr>
<tr>
<td>Microprocessor based</td>
<td>No calibration required saves on maintenance cost</td>
</tr>
</tbody>
</table>

Accessories

SE-GRM Series Ground-Reference Module
Required accessory, used to connect the SE-601 DC Ground-Fault Monitor to the DC bus.

PGA-0500 Analog % Current Meter
Optional panel-mounted analog meter displays ground-fault current as a percentage of 22 mA.

Specifications

<table>
<thead>
<tr>
<th>IEEE Device Numbers</th>
<th>DC Overcurrent Relay (76G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>See ordering information</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 75 mm (3.0&quot;), W 55 mm (2.2&quot;), D 115 mm (4.5&quot;)</td>
</tr>
<tr>
<td>Trip Level Settings</td>
<td>1-20 mA</td>
</tr>
<tr>
<td>Trip Time Settings</td>
<td>0.05-2.5 s</td>
</tr>
<tr>
<td>Output Contacts</td>
<td>Isolated Form A and Form B</td>
</tr>
<tr>
<td>Contact Operating Mode</td>
<td>Selectable fail-safe or non-fail-safe</td>
</tr>
<tr>
<td>Test Button</td>
<td>Local</td>
</tr>
<tr>
<td>Reset Button</td>
<td>Local and remote</td>
</tr>
<tr>
<td>Analog Output</td>
<td>0-5 V</td>
</tr>
<tr>
<td>Conformally Coated</td>
<td>Consult factory</td>
</tr>
<tr>
<td>Approvals</td>
<td>CSA certified, UL Listed (E340889), CE (European Union), C-Tick (Australian)</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
</tr>
<tr>
<td>Mounting</td>
<td>DIN, Surface (standard)</td>
</tr>
<tr>
<td></td>
<td>Panel (with PMA-55 or PMA-60 adapter)</td>
</tr>
</tbody>
</table>

Note: For optional conformal coating please consult factory.

© 2023 Littelfuse, Inc.
**Description**

The EL731 is a microprocessor-based AC/DC Sensitive Earth-Leakage Relay that offers complete coverage for all frequencies from 0 to 6,000 Hz. Two CTs are required for the entire frequency range, or one CT can be used for only low- or high-frequency detection. An RTD/PTC sensor input allows over-temperature protection for a motor or drive. The EL731 offers metering, password-protected alarm and trip settings and optional network communications. It is primarily used to add low-level ground-fault protection to variable-speed drives, and to dc circuits.

**Ordering Information**

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>CONTROL POWER</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL731-00-X0</td>
<td>120/240 Vac/Vdc</td>
<td>None</td>
</tr>
<tr>
<td>EL731-01-X0</td>
<td>120/240 Vac/Vdc</td>
<td>DeviceNet™</td>
</tr>
<tr>
<td>EL731-02-X0</td>
<td>120/240 Vac/Vdc</td>
<td>Profibus®</td>
</tr>
<tr>
<td>EL731-03-X0</td>
<td>120/240 Vac/Vdc</td>
<td>EtherNet/IP™</td>
</tr>
<tr>
<td>EL731-04-X0</td>
<td>120/240 Vac/Vdc</td>
<td>Modbus® TCP</td>
</tr>
<tr>
<td>EL731-10-X0</td>
<td>48 Vdc &amp; 24 Vac</td>
<td>None</td>
</tr>
<tr>
<td>EL731-11-X0</td>
<td>48 Vdc &amp; 24 Vac</td>
<td>DeviceNet™</td>
</tr>
<tr>
<td>EL731-12-X0</td>
<td>48 Vdc &amp; 24 Vac</td>
<td>Profibus®</td>
</tr>
<tr>
<td>EL731-13-X0</td>
<td>48 Vdc &amp; 24 Vac</td>
<td>EtherNet/IP™</td>
</tr>
<tr>
<td>EL731-14-X0</td>
<td>48 Vdc &amp; 24 Vac</td>
<td>Modbus® TCP</td>
</tr>
<tr>
<td>EL731-20-X0</td>
<td>24 Vdc</td>
<td>None</td>
</tr>
<tr>
<td>EL731-21-X0</td>
<td>24 Vdc</td>
<td>DeviceNet™</td>
</tr>
<tr>
<td>EL731-22-X0</td>
<td>24 Vdc</td>
<td>Profibus®</td>
</tr>
<tr>
<td>EL731-23-X0</td>
<td>24 Vdc</td>
<td>EtherNet/IP™</td>
</tr>
<tr>
<td>EL731-24-X0</td>
<td>24 Vdc</td>
<td>Modbus® TCP</td>
</tr>
</tbody>
</table>

**Accessories**

- **EFCT Series Earth-Fault Current Transformer**
  Required zero-sequence current transformer specifically designed for low level detection.

- **AC700-CUA Series Communication Adapter**
  Optional network-interface and firmware-upgrade communications adapters field-install in EL731.

- **AC700-SMK DIN-rail & Surface-mount Adapter**
  EL731 plugs into adapter for back-plane mounting.

**Note:** When building a part number, replace the “X” with “1” for AS/NZS 2081:2011 Compliant product, “0” otherwise.
Protection Relays
Ground-Fault Protection – AC/DC Earthed System

EL731 SERIES
AC/DC Sensitive Earth-Leakage Relay

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable pickup (30-5,000 mA)</td>
<td>Adjustable trip setting provides a wide range of low-level protection and system coordination</td>
</tr>
<tr>
<td>Frequency range (0-90 Hz, 20-6,000 Hz)</td>
<td>Operate in either AC or DC mode or both. Use single or combined ranges. Separate metering</td>
</tr>
<tr>
<td>32-char OLED display</td>
<td>Earth-leakage metering, setup and programming</td>
</tr>
<tr>
<td>Local LED indication</td>
<td>Visual Trip, Alarm, CT connection indication</td>
</tr>
<tr>
<td>CT-Loop monitoring</td>
<td>Alarms when CT is not connected</td>
</tr>
<tr>
<td>Analog output (4-20 mA)</td>
<td>Connect to DCS. Allows connection to an optional meter (PGA-0520) or control system</td>
</tr>
<tr>
<td>Adjustable time delay</td>
<td>Adjustable trip delay for quick protection and system coordination</td>
</tr>
<tr>
<td>Alarm and trip settings</td>
<td>Detect a deteriorating condition before damage occurs</td>
</tr>
<tr>
<td>Temperature-sensor input</td>
<td>Drive or motor temperature protection</td>
</tr>
<tr>
<td>Output contacts</td>
<td>3 programmable: Operate 2 alarm and 1 trip circuit</td>
</tr>
<tr>
<td>Network communication</td>
<td>Optional connection to plant network</td>
</tr>
<tr>
<td>Harmonic filtering</td>
<td>Eliminates nuisance tripping due to harmonic noise</td>
</tr>
<tr>
<td>Microprocessor based</td>
<td>No required calibration saves maintenance cost</td>
</tr>
<tr>
<td>Universal power supply</td>
<td>Provides flexibility for numerous applications</td>
</tr>
</tbody>
</table>

Wiring Diagram

Specifications

<table>
<thead>
<tr>
<th>IEEE Device Numbers</th>
<th>AC ground fault (50G/N, 51G/N), DC ground fault (79G), PTC overtemperature (49), RTD temperature (38, 49)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>120/240 Vac/Vdc, 24 Vdc, 48 Vdc/24 Vac</td>
</tr>
<tr>
<td>Trip Level Settings</td>
<td>30-5,000 mA AC and DC</td>
</tr>
<tr>
<td>Alarm Level Settings</td>
<td>30-5,000 mA AC and DC</td>
</tr>
<tr>
<td>Trip Delay</td>
<td>0.05-2 s</td>
</tr>
<tr>
<td>Output Contacts</td>
<td>3 Form C (programmable)</td>
</tr>
<tr>
<td>Contact Operating Mode</td>
<td>Fail-safe &amp; non-fail-safe</td>
</tr>
<tr>
<td>Reset</td>
<td>Front panel and remote</td>
</tr>
<tr>
<td>Freq. Response, CT1</td>
<td>0-90 Hz</td>
</tr>
<tr>
<td>Freq. Response, CT2</td>
<td>20-6,000, 190-6,000, 20-90, 20-3,000 Hz; selectable</td>
</tr>
<tr>
<td>Current Transformer</td>
<td>EFCT-x series</td>
</tr>
<tr>
<td>CT Detection</td>
<td>Open &amp; short detection</td>
</tr>
<tr>
<td>Terminals</td>
<td>Plug-in, wire clamping, 24 to 12 AWG (0.2-2.5 mm²)</td>
</tr>
<tr>
<td>Communications</td>
<td>EtherNet/IP™, DeviceNet™, Profibus®</td>
</tr>
<tr>
<td>Analog Output</td>
<td>Modbus® TCP (optional)</td>
</tr>
<tr>
<td>Conformal Coating</td>
<td>4-20 mA (selectable 0-5 A or 0-100% trip-level setting)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Standard feature</td>
</tr>
<tr>
<td>Approvals</td>
<td>H 48 mm (1.9&quot;), W 96 mm (3.8&quot;), D 129 mm (5.0&quot;)</td>
</tr>
<tr>
<td>Warranty</td>
<td>UL Listed (E340889), CSA, RCM (Australia), CE</td>
</tr>
<tr>
<td>Mounting</td>
<td>5 years</td>
</tr>
<tr>
<td>Panel, Surface and DIN (with optional AC700-SMK)</td>
<td></td>
</tr>
</tbody>
</table>

Littelfuse reserves the right to make product changes, without notice. Material in this document is as accurate as known at the time of publication. Visit Littelfuse.com for the most up-to-date information.
Description
The SE-701 is a microprocessor-based ground-fault relay for resistance- and solidly-grounded systems. In addition to common systems, it is uniquely suited for use on systems with significant harmonic content. The SE-701 can provide main-plant protection, feeder-level protection, or individual-load protection. Proper current transformer selection provides the desired pickup range. The output contacts can be connected for use in protective tripping circuits or in alarm indication circuits. The analog output can be used with a PLC or a meter.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable pickup (1-99%)</td>
<td>Trip setting based on input CT primary, allows use with any CT. Minimum 50 mA with EFCT Series.</td>
</tr>
<tr>
<td>Adjustable time delay (50 ms - 2.5 s)</td>
<td>Adjustable trip delay allows quick protection and system coordination</td>
</tr>
<tr>
<td>Output contacts</td>
<td>Form A and Form B ground-fault output contacts for operation of separate annunciation and trip circuits</td>
</tr>
<tr>
<td>Analog output (0-5 V)</td>
<td>Allows for connecting an optional meter (PGA-0500) or a control system</td>
</tr>
<tr>
<td>CT-Loop monitoring</td>
<td>Alarms when CT is not connected</td>
</tr>
<tr>
<td>Selectable DFT or peak detection filtering</td>
<td>Compatible with variable-speed drives</td>
</tr>
<tr>
<td>Harmonic filtering</td>
<td>Eliminates nuisance tripping</td>
</tr>
<tr>
<td>Non-volatile trip memory</td>
<td>Retains trip state while de-energized to simplify troubleshooting</td>
</tr>
<tr>
<td>Microprocessor based</td>
<td>No calibration required, saves on maintenance cost</td>
</tr>
<tr>
<td>Universal power supply</td>
<td>Allows operation in application where one side of PT is faulted, provides flexibility for numerous applications</td>
</tr>
</tbody>
</table>

Accessories
- **Ground-Fault Current Transformer**: Required current transformer model depends on application. We offer a variety of sensitive CTs with 5- and 30-A primaries.
- **PGA-0500 Analog % Current Meter**: Optional panel-mounted analog meter displays ground-fault current as a percentage of the CT primary rating.

Specifications
- **IEEE Device Numbers**: Ground fault (50G/N, 51G/N)
- **Input Voltage**: See ordering information
- **Dimensions**: H 75 mm (3.0"), W 55 mm (2.2"), D 115 mm (4.5"
- **Trip Level Settings**: 1-99% CT-Primary Rating
- **Trip Time Settings**: 0.05-2.5 s
- **Contact Operating Mode**: Selectable fail-safe or non-fail-safe
- **Harmonic Filtering**: Standard feature
- **Test Button**: Standard feature
- **Reset Button**: Standard feature
- **CT-Loop Monitoring**: Isolated Form A and Form B
- **Output Contacts**: No conformal coating required, saves on maintenance cost
- **Approvals**: CSA certified, UL Listed (E340889), CE (European Union), C-Tick (Australian)
- **Analog Output**: 0-5 V
- **Conformally coated**: Consult factory
- **Warranty**: 5 years
- **Mounting**: DIN, Surface (standard), Panel (with PMA-55 or PMA-60 adapter)

Note: For optional conformal coating please consult factory.
Protection Relays
Ground-Fault Protection – Solidly Grounded Systems

SE-703 SERIES
Earth-Leakage Monitor

Description
The SE-703 is a microprocessor-based earth-fault relay for resistance- and solidly earthed systems. It offers sensitive earth-fault detection as low as 25 mA and can be used on systems with significant harmonic content. The SE-703 provides feeder-level protection or individual-load protection. The output contacts can be connected for use in protective tripping circuits or in alarm indication circuits. The analog output can be used with a PLC or a meter. The SE-703 is specifically designed to be AS/NZS 2081:2011 compliant to either 2011 or 2002 (see ordering options).

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable pickup (25-500 mA)</td>
<td>Adjustable trip setting provides a wide range of low-level protection and system coordination</td>
</tr>
<tr>
<td>Adjustable time delay (INST-500 ms)</td>
<td>Adjustable trip delay allows quick protection and system coordination</td>
</tr>
<tr>
<td>Output contacts</td>
<td>2 Form C ground-fault output contacts for operation of separate annunciation and trip circuits</td>
</tr>
<tr>
<td>Analog output (0-5 V)</td>
<td>Allows for connecting an optional meter (PGA-0500) or control system</td>
</tr>
<tr>
<td>CT-Loop monitoring</td>
<td>Alarms when CT is not connected</td>
</tr>
<tr>
<td>Contact operating mode</td>
<td>Fail-safe operating mode for undervoltage applications, optional non-fail-safe mode available</td>
</tr>
<tr>
<td>Harmonic filtering</td>
<td>Eliminates nuisance tripping</td>
</tr>
<tr>
<td>Non-volatile trip memory</td>
<td>Retains trip state while de-energized to simplify troubleshooting</td>
</tr>
<tr>
<td>Microprocessor based</td>
<td>No calibration required, saves maintenance cost</td>
</tr>
<tr>
<td>Universal power supply</td>
<td>Allows operation in application where one side of PT is faulted, provides flexibility for numerous applications</td>
</tr>
<tr>
<td>Global certifications</td>
<td>Compliant with US, Canadian, European, and Australian standards for applications in almost any country</td>
</tr>
</tbody>
</table>

Accessories

- **EFCT Series Ground-Fault Current Transformer**
  Required zero-sequence current transformer specifically designed for low-level detection.

- **PGA-0500 Analog % Current Meter**
  Optional panel-mounted analog meter displays ground-fault current as a percentage of the set-point or 5 A.

- **PMA-60 Series – Mounting Adapter**
  Optional panel mounting for AS/NZS 2081:2011 compliance.

Specifications

- **IEEE Device Numbers**
  Ground fault (50G/N, 51G/N)
- **Input Voltage**
  H 75 mm (3.0”); W 55 mm (2.2”); D 115 mm (4.5”)
- **Dimensions**
  25-500 mA
- **Trip Level Settings**
  INST-500 ms
- **Contact Operating Mode**
  Fail-safe (x=0 models) or selectable (x=2 models)
- **Harmonic Filtering**
  Standard feature
- **Test Button**
  Standard feature
- **Reset Button**
  Standard feature
- **CT-Loop Monitoring**
  Standard feature
- **Output Contacts**
  Two isolated Form C contacts
- **Approvals**
  CSA certified, UL Listed [E340889], CE (European Union), RCM (Australian)
- **Compliance**
  AS/NZS 2081:2011 (x=0 models) or AS/NZS 2081:2002 (x=2 models)
- **Analog Output**
  0-5 V
- **Conformally coated**
  Yes
- **Warranty**
  5 years
- **Mounting**
  DIN, Surface (standard) Panel (with PMA-55 or PMA-60 adapter)

© 2023 Littelfuse, Inc.
Littelfuse.com/se-703
**SE-704 SERIES (PGR-4704)**

**Earth-Leakage Monitor**

**Description**

The SE-704 is a microprocessor-based ground-fault relay for resistance- and solidly-grounded systems. It offers very sensitive ground-fault detection as low as 10 mA and can be used on systems with significant harmonic content. The output contacts can be connected for use in protective tripping circuits (such as for marina or boatyard feeder circuits) or in alarm indication circuits. The analog output can be used with a PLC or a meter. The SE-704 can be integrated with a shunt trip circuit breaker to meet CE code C22.1-21 Section 78-052(2) and NEC article 555.35(A)(11), 555.35(3), and 555.53 for marina applications.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable pickup (10 mA – 5 A)</td>
<td>Adjustable trip setting provides a wide range of low-level protection and system coordination</td>
</tr>
<tr>
<td>Adjustable time delay (30 ms – 2.0 s)</td>
<td>Adjustable trip delay allows quick protection and system coordination</td>
</tr>
<tr>
<td>Output contacts</td>
<td>Form A and Form B ground-fault output contacts for operation of separate annunciation and trip circuits</td>
</tr>
<tr>
<td>Analog output (0–5 V &amp; 0–1 mA)</td>
<td>Allows for connecting an optional meter (PGA-0500) or control system</td>
</tr>
<tr>
<td>CT-Loop monitoring</td>
<td>Alarms when CT is not connected</td>
</tr>
<tr>
<td>Selectable contact operating mode</td>
<td>Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil</td>
</tr>
<tr>
<td>Harmonic filtering</td>
<td>Eliminates nuisance tripping</td>
</tr>
<tr>
<td>Non-volatile trip memory</td>
<td>Retains trip state when de-energized to simplify troubleshooting</td>
</tr>
<tr>
<td>Microprocessor based</td>
<td>No calibration required saves maintenance cost</td>
</tr>
<tr>
<td>Universal power supply</td>
<td>Allows operation in application where one side of PT is faulted, provides flexibility for numerous applications</td>
</tr>
</tbody>
</table>

**Accessories**

- **ELCT30 or SE-CS30 Series Current Transformer**
  Required zero-sequence current transformer specifically designed for low level detection. Flux conditioner is included to prevent saturation.

- **PGA-0500 Analog % Current Meter**
  Optional panel-mounted analog meter displays ground-fault current as a percentage of the set-point or 5 A.

**Specifications**

- **IEEE Device Numbers**: Ground fault (50G/N, 51G/N)
- **Input Voltage**: See ordering information
- **Dimensions**: H 75 mm (3.0”), W 55 mm (2.2”), D 115 mm (4.5”)
- **Trip Level Settings**: 10 mA – 5.0 A
- **Trip Time Settings**: 30–2000 ms
- **Contact Operating Mode**: Selectable fail-safe or non-fail-safe
- **Harmonic Filtering**: Standard feature
- **Test Button**: Standard feature
- **Reset Button**: Standard feature
- **CT-Loop Monitoring**: Standard feature
- **Output Contacts**: Isolated Form A and Form B
- **Approvals**: UL Listed (E340889), CSA, CE (European Union) RCM (Australian)
- **Analog Output**: 0–5 V & 0–1 mA
- **Conformally coated**: Optional
- **Warranty**: 5 years
- **Mounting**: DIN, Surface (standard) Panel (with PMA-55 or PMA-60 adapter)

**Ordering Information**

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>CONTROL POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-704-0U</td>
<td>120/240 Vac/Vdc</td>
</tr>
<tr>
<td>SE-704-0D</td>
<td>12/24 Vdc</td>
</tr>
<tr>
<td>SE-704-0T</td>
<td>48 Vdc</td>
</tr>
<tr>
<td>SE-704-03</td>
<td>24 Vac</td>
</tr>
</tbody>
</table>

**ACCESSORIES**

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-CS30 Series</td>
<td>Required</td>
</tr>
<tr>
<td>PGA-0500</td>
<td>Optional</td>
</tr>
<tr>
<td>PMA-55, PMA-60</td>
<td>Optional</td>
</tr>
</tbody>
</table>

*Note: For optional conformal coating please consult factory.*
Description

Special-Purpose Ground-Fault Circuit Interrupter (SPGFCl), Class C and Class D

Industrial Shock Block (ISB) is a personnel protection device designed to meet the requirements for special-purpose GFCIs defined by UL 943C. This standard outlines GFCI classes specifically designed for use in industrial facilities. Class C GFCIs are intended to be used on three-phase systems where the line-to-line voltage is 480 V or less with a trip level of 20 mA, while Class D GFCIs are intended to be used on 600 V systems. The Industrial Shock Block includes DFT harmonic filtering, an automatic self-test feature and is compliant to the UL 1998 Software in Programmable Components standard.

Ground-Fault Circuit Interrupter (GFCI), Class A

The Shock Block is available as a 208 V Class A GFCI, allowing commercial kitchens, construction sites, and other non-dwelling units with wet areas to meet NEC 210.8(B) for their three-phase loads up to 60 A.

Equipment Ground-Fault Protective Device (EGFPD)

Industrial Shock Block is also available with adjustable protection settings as an EGFPD. The EGFPD models can be set to trip at 6 mA or from 10–100 mA in increments of 10 mA. This offers more flexibility since GFCI devices are not allowed to have an adjustable trip level.

Ratings and Models

Industrial Shock Block (GFCI & EGFPD) is available for three-phase voltages from 208 to 600 V with a maximum full load current of either 32 or 60 A. The power system can be either solidly or high-resistance grounded and the load must be three phase without a neutral.

The standard enclosure is IP 69K/NEMA 4X and outdoor rated, suitable for all industrial environments including high-temperature washdown used in food production. A Class II, Division 2 option is also available for applications where explosive dust may be present (future option).

Ground Wire (Load-Ground) Monitor

The Industrial Shock Block also monitors the ground wire (load-ground) connection between the Industrial Shock Block and load. This is a required feature for Class C and D GFCI devices and is recommended for Class A GFCI and EGFPD devices. If the ground-return path is broken, the Industrial Shock Block will trip and provide an alarm by changing the state of the alarm contacts. This monitoring circuit includes an extra wire (pilot wire) between the Industrial Shock Block and load. At the load, the pilot wire is connected to a termination device. The other end of the termination device is connected to the load ground (typically the enclosure).
**SB5000 SERIES**

### Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>LOAD RATING (A)</th>
<th>VOLTAGE (V)</th>
<th>TRIP LEVEL (MA)</th>
<th>UL CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB5032-00x-0</td>
<td>32</td>
<td>208</td>
<td>20 (Fixed)</td>
<td>UL 943C Class C SPGFCI</td>
</tr>
<tr>
<td>SB5032-20x-0</td>
<td>600</td>
<td>480</td>
<td>20 (Fixed)</td>
<td>UL 943C Class D SPGFCI</td>
</tr>
<tr>
<td>SB5032-30x-0</td>
<td>600</td>
<td>480</td>
<td>6, 10–100 in increments of 10 (Selectable)</td>
<td>UL 943/UL 1053 EGFPD</td>
</tr>
<tr>
<td>SB5032-01x-0</td>
<td>600</td>
<td>208</td>
<td>6 (Fixed)</td>
<td>UL 943 Class A GFCI</td>
</tr>
<tr>
<td>SB5032-21x-0</td>
<td>600</td>
<td>208</td>
<td>6, 10–100 in increments of 10 (Selectable)</td>
<td>UL 943/UL 1053 EGFPD</td>
</tr>
<tr>
<td>SB5032-31x-0</td>
<td>600</td>
<td>208</td>
<td>6 (Fixed)</td>
<td>UL 943 Class A GFCI</td>
</tr>
<tr>
<td>SB5032-02x-0</td>
<td>600</td>
<td>208</td>
<td>6 (Fixed)</td>
<td>UL 943 Class A GFCI</td>
</tr>
<tr>
<td>SB5060-00x-0</td>
<td>60</td>
<td>208</td>
<td>20 (Fixed)</td>
<td>UL 943C Class C SPGFCI</td>
</tr>
<tr>
<td>SB5060-20x-0</td>
<td>60</td>
<td>480</td>
<td>20 (Fixed)</td>
<td>UL 943C Class D SPGFCI</td>
</tr>
<tr>
<td>SB5060-30x-0</td>
<td>60</td>
<td>480</td>
<td>6, 10–100 in increments of 10 (Selectable)</td>
<td>UL 943/UL 1053 EGFPD</td>
</tr>
<tr>
<td>SB5060-01x-0</td>
<td>60</td>
<td>208</td>
<td>6 (Fixed)</td>
<td>UL 943 Class A GFCI</td>
</tr>
<tr>
<td>SB5060-21x-0</td>
<td>60</td>
<td>208</td>
<td>6, 10–100 in increments of 10 (Selectable)</td>
<td>UL 943/UL 1053 EGFPD</td>
</tr>
<tr>
<td>SB5060-31x-0</td>
<td>60</td>
<td>208</td>
<td>6 (Fixed)</td>
<td>UL 943 Class A GFCI</td>
</tr>
<tr>
<td>SB5060-02x-0</td>
<td>60</td>
<td>208</td>
<td>6 (Fixed)</td>
<td>UL 943 Class A GFCI</td>
</tr>
</tbody>
</table>

Note: Replace x with 1 for IP 69K/NEMA 4X Enclosure; replace with 2 to add Class II, Division 2 rating (future option).

### Accessories

**1N5339B - Termination Device**
Axial-lead ground-check termination, included with SB5000 series

**SE-TA6 - Termination Assembly**
Optional termination assembly with terminals and mounting holes

**SE-TA6-SM Stud-Mount Termination Assembly**
Optional ground-check termination for submersible pumps

**SE-TA6ASF-WL Series - Termination Assembly**
Compact 12 W ground-check termination assembly

### Connection Diagram

The SB5000 is installed in-line between incoming power or existing overcurrent protection device and the load.

### Specifications

- **Voltage Rating**: 208 V, 480 V, 600 V
- **Current Rating**: 32 or 60 A (continuous) 10,000 A
- **System Type**: Three-phase, 3-wire (no neutral), 60 Hz
- **Short-Circuit Current Rating**: 10,000 A
- **Trip Level Settings**: Fixed at 6 mA (Class A models) Fixed at 20 mA (Class C/D models) Selectable 6, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 mA (EGFPD models)
- **Trip Time Setting**: Inverse time curve according to UL 943
- **Ground Monitoring Circuit**: Selectable short or Zener termination; Fail-safe; CSA M421 compliant
- **Enclosure**: IP 69K and NEMA 4X (Outdoor), Polycarbonate, Lockable
- **Operating Temperature**: -35 °C (-31 °F) to 40 °C (104 °F), up to 60 °C (151 °F) with derating
- **Approvals**: cULus Listed Class A GFCI (UL 943) UL Listed Class C, D SPGFCI (UL 943C) cULus Listed EGFPD (UL 943/UL 1053) All models CSA Certified UL 1998
- **Dimensions**: H 285.6 mm (11.25 in.); W 244.4 mm (9.62 in.); D 119.6 mm (4.71 in.)
Industrial Shock Block (ISB) is a personnel protection device designed to meet the requirements for special-purpose GFCIs defined by UL 943C. This standard outlines GFCI classes specifically designed for use in industrial facilities. Class C GFCIs are intended to be used on three-phase systems where the line-to-line voltage is 480 V or less with a trip level of 20 mA, while Class D GFCIs are intended to be used on 600 V systems. The Industrial Shock Block includes an automatic self-test feature and is compliant to the UL 1998 Software in Programmable Components standard.

**Ground-Fault Circuit Interrupter (GFCI), Class A**
The Shock Block is available as a Class A GFCI, allowing commercial kitchens and commercial establishments with wet areas to meet NEC 210.8(B) for their 3-phase loads up to 100 A.

**Equipment Ground-Fault Protective Device (EGFPD)**
Industrial Shock Block is also available with adjustable protection settings as an EGFPD. The EGFPD models can be set to trip at 6 mA or from 10-100 mA in increments of 10 mA. This offers more flexibility since GFCI devices are not allowed to have an adjustable trip level.

**Rating and Models**
Industrial Shock Block (GFCI & EGFPD) is available for three-phase voltages from 208 to 600 V with a maximum full load current of 100 A, and a built-in overcurrent protection supplied by Littelfuse Class T fuses. The load must be 3-phase, however, cannot have a neutral. The power system can either be solidly-grounded or high-resistance grounded.

Two options for enclosures are available: UL-recognized open-chassis models are available for installation in existing electrical enclosures and UL-listed enclosed models include a NEMA-4X enclosure for stand-alone installations.

**Ground Wire (Load-Ground) Monitor**
The Industrial Shock Block also monitors the ground wire (load-ground) connection between the Industrial Shock Block and load. This is a required feature for Class C and D GFCI devices and is recommended for Class A and EGFPD devices devices. If the connection is broken, the Industrial Shock Block will trip and provide an alarm by changing the state of the alarm contacts. This monitoring circuit includes an extra wire (pilot wire) between the Industrial Shock Block and load (since the monitoring current is low, only a small wire is required). At the load, the pilot wire is connected to a termination device. The other end of the termination device is connected to the load ground (typically the enclosure).

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 943 inverse time trip curve</td>
<td>Detects and interrupts to protect people and reduce the probability of nuisance tripping</td>
</tr>
<tr>
<td>Minimum trip time &lt; 20 msec</td>
<td>Reduces the risk of ventricular fibrillation for leakage current of 250 mA and above</td>
</tr>
<tr>
<td>Fixed 6 mA (UL 943) or 20 mA (UL 943C) trip level</td>
<td>Personnel protection for industrial and commercial systems on loads up to 100 A</td>
</tr>
<tr>
<td>Selectable trip levels (EGFPD)</td>
<td>Provides extra safety when a customer is able to operate with a setting below 20 mA (GFCI) and the settings above 20 mA can reduce nuisance tripping on systems with high leakage current</td>
</tr>
<tr>
<td>UL 943C ground monitor/ interrupt</td>
<td>Protects from shock by tripping if continuity of ground wire between Industrial Shock Block and load is broken</td>
</tr>
<tr>
<td>Undervoltage, brownout, chatter detection</td>
<td>Ensures proper operation and prolongs the internal contactor lifetime</td>
</tr>
<tr>
<td>3 x Class T, 600 V incoming fuses</td>
<td>The fuses provide overcurrent protection for a 100 A circuit and a higher short-circuit current rating (SCCR) of 50 kA</td>
</tr>
<tr>
<td>Conformal coating</td>
<td>Internal circuits are conformally coated to protect against corrosion and moisture, yet still repairable</td>
</tr>
<tr>
<td>Operator Interface</td>
<td>Shows unit status, alarm types, percentage of leakage current, and allows for Test and Reset capabilities</td>
</tr>
<tr>
<td>Auxiliary Contact</td>
<td>Provides a normally-open contact for remote indication</td>
</tr>
<tr>
<td>Automatic Self-Test</td>
<td>All units include an automatic self-test feature including an automatic self-test feature</td>
</tr>
<tr>
<td>Motor Starter</td>
<td>Allows the user to start and stop the motor from the interface</td>
</tr>
</tbody>
</table>
**Accessories**

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
<th>PAGE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC6000-OPI-00</td>
<td>Included</td>
<td>N/A</td>
</tr>
<tr>
<td>1N5339B</td>
<td>Included</td>
<td>120</td>
</tr>
<tr>
<td>SE-TA6</td>
<td>Optional</td>
<td>120</td>
</tr>
<tr>
<td>SE-TA6-SM</td>
<td>Optional</td>
<td>120</td>
</tr>
<tr>
<td>SE-TA6ASF-WL</td>
<td>Optional</td>
<td>120</td>
</tr>
<tr>
<td>AC6000-CART-00</td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td>AC6000-MNT-00</td>
<td>Optional</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Connection Diagram**

The SB6100 is installed in-line between incoming power or existing overcurrent protection device and the load.

The open-chassis SB6100 can be installed in electrical equipment and the enclosed version is typically wall-mounted.

---

**Specifications**

- **Voltage Rating**: See ordering information
- **Current Rating**: 100 A (continuous)
- **System Type**: 3-phase, 3-wire (no neutral), 60 Hz
- **Short-Circuit Current Rating**: 50,000 A
- **Trip Level Settings**: Selectable (6, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 mA), fixed at 6 mA, or fixed at 20 mA
- **Trip Time Setting**: Inverse time trip curve
- **Enclosure**: NEMA 4X, Polyester, Lockable
- **Operating Temperature**: –35 °C (–31 °F) to + 40 °C (104 °F), up to + 66 °C (151 °F) with derating
- **Wiring Requirements**: 2/0 AWG (maximum)
- **Approval**: GFCI: UL Listed (enclosed models) and UL Recognized Component (open-chassis models)
  EGFPD: cULus Listed (enclosed models) and cURus Recognized Component (open-chassis models); UL1998 Compliant (revision 01 or higher); All models except SB6100-02x-0 CSA Certified
- **Dimensions**: Enclosed: H 453.8 mm (17.9”); W 406.2 mm (16.0”); D 223.3 mm (8.8”)  Open-chassis: H 455.0 mm (17.9”); W 340.7 mm (13.4”); D 174.9 mm (6.8”)
- **Warranty**: 1 year

---

**Ordering Information - Accessories**

- **AC6000-OPI-00**: Included
- **1N5339B**: Included
- **SE-TA6**: Optional
- **SE-TA6-SM**: Optional
- **SE-TA6ASF-WL**: Optional
- **AC6000-CART-00**: Optional
- **AC6000-MNT-00**: Optional

*Page in Protection Relay & Controls Catalog*
PGR-4300 SERIES (GFA300)

Generator Ground-Fault Relay

Description
The PGR-4300 Generator Ground-Fault Relay provides a simple method for detecting a ground-fault condition on generators without the need for current transformers (CTs). This greatly simplifies the installation. In addition, it is compatible with both three- and four-pole transfer switches. This relay also monitors the neutral-to-ground path for continuity. The PGR-4300 is ideal for any generator or application where there is not sufficient space to install CTs.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CTs required</td>
<td>Saves space and simplifies installation</td>
</tr>
<tr>
<td>Adjustable pickup (100-1200 A)</td>
<td>Adjustable trip setting provides a wide range of protection and allows system coordination</td>
</tr>
<tr>
<td>Adjustable time delay (0-1.0 s)</td>
<td>Adjustable trip delay allows quick protection and system coordination</td>
</tr>
<tr>
<td>Output contacts</td>
<td>Form C ground-fault output contacts for alarming or tripping purposes</td>
</tr>
<tr>
<td>Analog output (0-1 mA)</td>
<td>Provides means for connecting to an optional meter (PGA-0500) or control system</td>
</tr>
<tr>
<td>N-G continuity alarm</td>
<td>Monitors neutral-to-ground integrity and alarms if ground path becomes open circuit</td>
</tr>
<tr>
<td>Passive filtering</td>
<td>Eliminates nuisance tripping</td>
</tr>
</tbody>
</table>

Accessories

PGA-0500 Analog % Current Meter
Optional panel-mounted analog meter displays ground-fault current as a percentage of the set-point.

Specifications

IEEE Device Numbers: Ground Fault (50G/N, 51G/N)
Input Voltage: See ordering information
Dimensions: H 75 mm (3.0”); W 55 mm (2.2”); D 115 mm (4.5”)
Trip Level Settings: 100-1200 A
Trip Time Delay Settings: 0-1.0 s
Contact Operating Mode: Non-fail-safe
Test Button: Local
Reset Button: Local and remote
Output Contacts: Form C
Analog Output: 0-1 mA
Conformally Coated: Consult factory
Approvals: UL Listed (E183688)
Warranty: 5 years
Mounting: DIN, Surface (standard); Panel (with PMA-55 or PMA-60 adapter)

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>CONTROL POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGR-4300-12</td>
<td>12 Vdc</td>
</tr>
<tr>
<td>PGR-4300-24</td>
<td>24 Vdc</td>
</tr>
<tr>
<td>PGR-4300-120</td>
<td>120 Vac</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGA-0500</td>
<td>Optional</td>
</tr>
<tr>
<td>PMA-55</td>
<td>Optional</td>
</tr>
<tr>
<td>PMA-60</td>
<td>Optional</td>
</tr>
</tbody>
</table>

Note: For optional conformal coating please consult factory.
GROUND-CONDUCTOR MONITORING

Continuously monitor the integrity of the ground conductor to protect portable equipment from hazardous voltages caused by ground faults.

SE-105 / SE-107 Series  Ground-Fault Ground-Check Monitor....... 60
SE-134C / SE-135 Series  Ground-Fault Ground-Check Monitor....... 61
SE-105 / SE-107 SERIES

Ground-Fault Ground-Check Monitor

Description
The SE-105/SE-107 is a combination ground-wire monitor and ground-fault relay for resistance-grounded systems. It continuously monitors the integrity of the ground conductor to protect portable equipment from hazardous voltages caused by ground faults. The SE-105/SE-107 is an excellent choice for trailing cables 5 kV and under in underground mining applications. For higher voltages or long-cable applications, see the SE-134C/SE-135.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable pickup (0.5, 2.0, 4.0 A)</td>
<td>Unit can be used on a wide variety of trailing cable applications</td>
</tr>
<tr>
<td>Adjustable time delay (0.1 - 2.0 s)</td>
<td>Adjustable trip delay for quick protection and system coordination</td>
</tr>
<tr>
<td>Harmonic filter</td>
<td>Prevents false operation</td>
</tr>
<tr>
<td>Zener-characteristic termination assembly</td>
<td>Provides reliable ground-check loop verification</td>
</tr>
<tr>
<td>Fail-safe ground-check circuit</td>
<td>Ensures ground-check circuit remains safe even in the event of equipment failure</td>
</tr>
<tr>
<td>Conformal coating</td>
<td>Additional coating protects circuit boards against harsh environment</td>
</tr>
<tr>
<td>SE-105: selectable UV- or shunt-trip mode</td>
<td>Provides flexibility for different applications</td>
</tr>
<tr>
<td>SE-107: UV-trip mode only</td>
<td>Eliminates chance of unauthorized change to trip circuit</td>
</tr>
</tbody>
</table>

Accessories

- **CT200 Series Current Transformer**
  Required CT detects ground-fault current.

- **1N5339B Termination Device**
  5 W axial-lead ground-check termination; included with SE-105/SE-107.

- **SE-TA6 Termination Assembly**
  Optional termination assembly with convenient terminals and mounting holes.

- **SE-TA6-SM Stud-Mount Termination Assembly**
  Optional 50 W ground-check termination that is robust and compact for submersible pumps. Wire lead simplifies installation.

Specifications

<table>
<thead>
<tr>
<th>IEEE Device Numbers</th>
<th>Checking or Interlocking Relay (3GC), Ground Fault (50G/N, 51G/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>H 150 mm (5.9 in); W 109 mm (4.3 in); D 100 mm (4.0 in)</td>
</tr>
<tr>
<td>Trip Level Settings</td>
<td>0.5, 2.0, 4.0 A</td>
</tr>
<tr>
<td>Trip Time Settings</td>
<td>0.1 - 1.0 s</td>
</tr>
<tr>
<td>Contact Operating Mode</td>
<td>Selectable fail-safe or non-fail-safe (SE-105)</td>
</tr>
<tr>
<td>Harmonic Filtering</td>
<td>Standard feature</td>
</tr>
<tr>
<td>Reset Button</td>
<td>Local and remote</td>
</tr>
<tr>
<td>Output Contacts</td>
<td>Isolated Form A</td>
</tr>
<tr>
<td>Approvals</td>
<td>CSA certified, UL Listed (E340889), C-Tick (Australian)</td>
</tr>
<tr>
<td>Conformally Coated</td>
<td>Standard feature</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
</tr>
<tr>
<td>Mounting</td>
<td>Surface</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>CONTROL POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-105</td>
<td>120 Vac</td>
</tr>
<tr>
<td>SE-105D</td>
<td>120 Vac/Vdc</td>
</tr>
<tr>
<td>SE-105E</td>
<td>240 Vac</td>
</tr>
<tr>
<td>SE-107</td>
<td>120 Vac</td>
</tr>
<tr>
<td>SE-107D</td>
<td>120 Vac/Vdc</td>
</tr>
<tr>
<td>SE-107E</td>
<td>240 Vac</td>
</tr>
</tbody>
</table>

Consult manual online for additional ordering options.

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT200 Series</td>
<td>Required</td>
</tr>
<tr>
<td>1N5339B</td>
<td>Included</td>
</tr>
<tr>
<td>SE-TA6, SE-TA6-SM</td>
<td>Optional</td>
</tr>
<tr>
<td>SE-TA6A Series</td>
<td>Optional</td>
</tr>
<tr>
<td>RK-102, RK-105, RK-105I</td>
<td>Optional</td>
</tr>
<tr>
<td>RK-13</td>
<td>Optional</td>
</tr>
<tr>
<td>PPI-600V</td>
<td>Optional</td>
</tr>
</tbody>
</table>
Ground-Conductor Monitoring

**SE-134C / SE-135 SERIES**

**Description**

The SE-134C/SE-135 is a microprocessor-based, combination ground-wire monitor and ground-fault relay for resistance-grounded or solidly grounded systems. It continuously monitors the integrity of the ground conductor to protect portable equipment from hazardous voltages caused by ground faults. The SE-134C/SE-135 is field proven in monitoring trailing cables on large mobile equipment such as drag-lines, mining shovels, shore-to-ship power cables, dock-side cranes, stacker-reclaimers, submersible pumps, and portable conveyors.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable pickup</td>
<td>Unit can be used on a wide variety of trailing cable applications</td>
</tr>
<tr>
<td>(0.5 - 12.5 A for SE-CS10)</td>
<td></td>
</tr>
<tr>
<td>(2 - 50 A for SE-CS40)</td>
<td></td>
</tr>
<tr>
<td>Adjustable time delay</td>
<td>Adjusted trip delay for quick protection and system coordination</td>
</tr>
<tr>
<td>(0.1 - 2.5 s)</td>
<td></td>
</tr>
<tr>
<td>Output contacts</td>
<td>Separate annunciation of ground-fault and ground-check faults</td>
</tr>
<tr>
<td>Ground-check LED indication</td>
<td>Indication of open or short ground-check wire makes it easier to find faults</td>
</tr>
<tr>
<td>CT-loop monitoring</td>
<td>Alarms when CT is not connected</td>
</tr>
<tr>
<td>High-induced-ac rejection</td>
<td>Makes unit suitable for applications with high voltages and long cables</td>
</tr>
<tr>
<td>DFT (Harmonic) filter</td>
<td>Prevents false operation</td>
</tr>
<tr>
<td>Zener-characteristic termination assembly</td>
<td>Provides reliable ground-check loop verification</td>
</tr>
<tr>
<td>Fail-safe circuits</td>
<td>Ensures ground-check and ground-fault circuits remain safe even in the event of equipment failure</td>
</tr>
<tr>
<td>Conformal coating</td>
<td>Additional coating protects circuit boards against harsh environment</td>
</tr>
<tr>
<td>XGC option</td>
<td>Increases maximum cable length for ground-check monitoring (10 km typical)</td>
</tr>
</tbody>
</table>

**Specifications**

- **IEEE Device Numbers** Checking or Interlocking Relay (3GC), Ground fault (50G/N, 51G/N) 65-265 Vac; 85-275 Vdc; 18-72 Vdc
- **Dimensions** H 213 mm (8.4”); W 99 mm (3.9”); D 132 mm (5.2”) 0.5 - 12.5 A for SE-CS10, 2 - 50 A for SE-CS40 0.1 - 2.5 s
- **Contact Operating Mode** Selectable fail-safe or non-fail-safe
- **Harmonic Filtering** Standard feature
- **Test Button** Standard feature
- **Reset Button** Standard feature
- **Output Contacts** Isolated Form A and Form B, Two Form C
- **Approvals** CSA certified, UL Listed (E340889), C-Tick (Australia)(1), CE(1)
- **Conformally Coated** Standard feature
- **Warranty** 5 years
- **Mounting** Panel, Surface
- **GC Trip Resistance** 280Ω (Standard), 45Ω (XGC Option)

**Accessories**

**SE-CS10 or SE-CS40 Series Ground-Fault Current Transformer**
Required zero-sequence current transformer detects ground-fault current.

**SE-TA6A Series, SE-TA12A Series Termination Assembly**
Required termination assembly; temperature compensated.

**Ordering Information**

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>OPTION</th>
<th>POWER SUPPLY</th>
<th>COMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-134C</td>
<td>Blank or XGC</td>
<td>0=120/240 Vac/Vdc</td>
<td>0=None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1=24/48 Vdc (1)</td>
<td></td>
</tr>
<tr>
<td>SE-135</td>
<td>Blank or XGC</td>
<td>0=120/240 Vac/Vdc</td>
<td>0=None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1=24/48 Vdc (1)(2)</td>
<td></td>
</tr>
</tbody>
</table>

**Accessories**

- **SE-CS10 Series** Required
- **SE-CS40 Series (for SE-135)** Optional
- **SE-TA6A Series (for SE-134C)** Required
- **SE-TA12A/SE-TA12B Combination (for SE-134C)** Optional
- **SE-TA12A Series (for SE-135)** Required
- **SE-IP65CVR-G** Optional
- **RK-132** Optional
- **PPI-600V** Optional

(1) CE/C-Tick not available.
(2) Not available with Ethernet option 3.
(3) See ordering information.

See Current Transformer Selection Guide and Accessory Information.
RESISTANCE GROUNDING/NGR MONITORING

Continuously monitoring the neutral-grounding resistor (NGR) and the neutral-to-ground path is critical to ensure the system operates as expected. Current-sensing ground-fault relays will not operate if the NGR or system ground is open circuit.

Neutral Grounding Resistor Sizing Chart

<table>
<thead>
<tr>
<th>System Voltage (Line-to-line)</th>
<th>NGR Let-Through Current and Resistance</th>
<th>Time Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>208 V</td>
<td>5 A / 24 Ohms</td>
<td>Continuous</td>
</tr>
<tr>
<td>480 V</td>
<td>5 A / 55 Ohms</td>
<td>Continuous</td>
</tr>
<tr>
<td>600 V</td>
<td>5 A / 69 Ohms</td>
<td>Continuous</td>
</tr>
<tr>
<td>2,400 V</td>
<td>5 A / 277 Ohms or 10 A / 139 Ohms</td>
<td>Continuous or 10 sec</td>
</tr>
<tr>
<td>4,160 V</td>
<td>5 A / 480 Ohms or 10 A / 240 Ohms</td>
<td>Continuous or 10 sec</td>
</tr>
<tr>
<td>13,800 V</td>
<td>10 A / 798 Ohms or 20 A / 40 Ohms</td>
<td>10 seconds</td>
</tr>
<tr>
<td>25,000 V</td>
<td>200 A / 72 Ohms or 400 A / 36 Ohms</td>
<td>10 seconds</td>
</tr>
<tr>
<td>34,500 V</td>
<td>200 A / 100 Ohms or 400 A / 50 Ohms</td>
<td>10 seconds</td>
</tr>
</tbody>
</table>

Note: The values shown are for any size transformer and are typical.

Note: The above table is for illustrative purposes only. Actual values may differ based on a variety of individual system considerations, such as capacitive charging current and co-ordination study results.

For More Information…
and to download our White Paper
Why NGRs Need Continuous Monitoring, visit
Littelfuse.com/TechnicalCenter
SE-325 SERIES (PGM-8325)
Neutral Grounding Resistor Monitor

Description
The SE-325 Neutral Grounding Resistor Monitor is used on resistance-grounded systems up to 25 kV to monitor the integrity of the neutral-to-ground path and to detect ground faults. It measures current and voltage in a transformer or generator neutral-to-ground connection and continuity of the neutral-grounding resistor (NGR). The SE-325 coordinates these three measurements to detect a loose connection, corrosion, ground fault, or NGR failure, and provides one alarm or trip output contact.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous NGR monitoring</td>
<td>Detects resistor failure within seconds, reduces transient-overvoltage risk, removes risk of ground-fault-detection failure</td>
</tr>
<tr>
<td>Ground-fault Detection</td>
<td>Main or backup protection to detect a ground fault anywhere on the monitored system</td>
</tr>
<tr>
<td>Adjustable pickup (0.5 - 4 A)</td>
<td>Select greatest sensitivity without false operation</td>
</tr>
<tr>
<td>Adjustable time delay (0.1 - 2 s)</td>
<td>Adjustable trip delay allows system coordination</td>
</tr>
</tbody>
</table>

Output contacts
Form A output contact

Selectable contact operating mode
Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil or alarm system

Accessories

ER Series Sensing Resistor
Required interface between the power system and the SE-325. Eliminates hazardous voltage levels at the monitor.

CT200 Series Current Transformer
Required CT detects ground-fault current.

RK Series Remote Indication and Reset
Optional panel-mounted remote indication and reset assemblies. Available in NEMA 1 or NEMA 4 configurations.

Specifications

IEEE Device Numbers
Ground Fault (50G/N, 51G/N), Overvoltage (59N), Lockout Relay (86), Checking Relay (3)

Input Voltage
See ordering information

Dimensions
H 150 mm (5.9"), W 109 mm (4.3"), D 100 mm (4.0"

GF Trip Level Settings
0.5 - 4.0 A

GF Trip Time Settings
0.1 - 2.0 s

RF Trip-Level Settings
20 - 400 Vac (≤5 kV systems)
100 - 2,000 Vac (>5 kV systems)

Contact Operating Mode
Selecteble fail-safe or non-fail-safe

Reset Button
Standard feature

Output Contacts
Form A

Approvals
CSA certified, UL Listed (E340889), C-Tick (Australian)

Conformally coated
Standard feature

Warranty
5 years

Mounting
Surface
Neutral Grounding Resistor Monitoring

Description
The SE-330 is an advanced ground-fault and neutral-grounding-resistor monitoring relay that is compliant with Rule 10-302 of the 2018 Canadian Electrical Code Part I (CE Code). It measures neutral current, neutral-to-ground voltage, and neutral-to-ground resistance. It provides continuous monitoring of the neutral-to-ground path to verify that the neutral-grounding resistor (NGR) is intact and that it has not been bypassed or shorted. An open NGR renders current-sensing ground-fault protection inoperative and could result in a false belief that the system is functioning properly. A shorted NGR results in higher-than-expected ground-fault current. The SE-330 can be used with low- and medium-voltage transformers and generators with low- or high-resistance grounding used in processing, manufacturing, chemical, pulp and paper, petroleum, and water-treatment facilities. For high-voltage applications, use the SE-330HV. For applications that require conformance to Australian standards, use the SE-330AU.

Resistor Monitoring
The SE-330 combines the measured values of resistance, current, and voltage to continuously determine that an NGR is intact. It is able to detect an open or shorted resistor with or without a ground fault present. Sensing resistors are matched to the system voltage and are used to monitor NGRs on systems up to 72 kV.

Ground-Fault Monitoring
The SE-330 uses an application-appropriate current transformer to reliably detect ground-fault currents as small as 100 mA. Discrete-Fourier Transform (DFT) filtering ensures that false trips due to harmonic noise from adjustable-speed drives do not occur. Should the resistor open and a ground fault subsequently occur, the SE-330 will detect the fault through voltage measurement, while other current-only sensing relays would be ineffective.

Pulsing Ground-Fault Location
The SE-330 is capable of controlling a pulsing contactor, which is used to switch the NGR resistance in a pulsing-compatible NGR package. The resulting ground-fault current is distinguishable from charging currents and noise and will only appear upstream of the ground fault, making fault location fast and easy, even without isolating feeders or interrupting loads.

Accessories
- **ER Series Sensing Resistor**
  Required interface between the power system and the SE-330/SE-330HV. Eliminates hazardous voltage levels at the relay.
- **ELCT5 Series Ground-Fault Current Transformer**
  Sensitive ground-fault current detection (5 A primary).
- **ELCT30 Series Ground-Fault Current Transformer**
  Sensitive ground-fault current detection (30 A primary).
- **Other Current Transformer**
  For low-resistance NGRs choose a CT primary approximately equal to the NGR rating. Inputs are provided for 1- and 5- A secondary CTs.
- **SE-IP65CVR-G Hinged Transparent Cover**
  Watertight cover, tamper resistant, IP65 protection.

For detailed wiring diagram, see adjacent page.
Neutral Grounding Resistor Monitor

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>IEEE #</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous NGR monitoring</td>
<td>3</td>
<td>Detects resistor failure within seconds, reduces transient-overvoltage risk, removes risk of ground-fault-detection failure</td>
</tr>
<tr>
<td>Shorted NGR detection</td>
<td>3</td>
<td>Detects a ground fault on the neutral that could bypass the resistor, ensures fault current is not higher than expected</td>
</tr>
<tr>
<td>Ground-fault detection 50G/N, 51G/N, 59N</td>
<td>5</td>
<td>Main or backup protection to detect a ground fault anywhere on the monitored system</td>
</tr>
<tr>
<td>Adjustable pickup (2–100 %)</td>
<td></td>
<td>Select greatest sensitivity without false operation, adjustable in 1% increments (MEM setting)</td>
</tr>
<tr>
<td>Universal CT compatibility</td>
<td></td>
<td>Allows the use of a CT that gives required ground-fault settings</td>
</tr>
<tr>
<td>Programmable output contacts</td>
<td></td>
<td>Two programmable Form C and One programmable Form A (Ground Fault, Resistor Fault, Unit Health)</td>
</tr>
<tr>
<td>Selectable contact operating mode</td>
<td></td>
<td>Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil or alarm circuit (K1, K2, K3 output contacts)</td>
</tr>
<tr>
<td>Analog output (4–20 mA)</td>
<td></td>
<td>Connect an optional PGA-0520 meter or control system</td>
</tr>
<tr>
<td>Pulsing output (SE-330 only)</td>
<td></td>
<td>Control the operation of a pulsing ground-fault-location circuit</td>
</tr>
<tr>
<td>Trip records</td>
<td></td>
<td>On-board 100-event (with date and time) recorder helps with system diagnostics</td>
</tr>
<tr>
<td>Harmonic filtering (DFT)</td>
<td></td>
<td>Eliminate false trips due to harmonic noise from ASDs</td>
</tr>
<tr>
<td>Local communications</td>
<td></td>
<td>Mini USB port to view measured values, configure settings, and check event records</td>
</tr>
<tr>
<td>Data logging</td>
<td></td>
<td>On-board microSD card (included) can be used for long-term data logging</td>
</tr>
</tbody>
</table>
| Network communications            |        | Remotely view measured values and event records, reset trips, and cause a remote trip Available Protocol Options: IEC 61850—with dual RJ45, SC Fiber and RJ45, or Dual SC Fiber Interface Modbus TCP and Ethernet/IP—with dual RJ45, SC Fiber and RJ45, or Dual SC Fiber Interface DeviceNet—with CAN interface Software PC-interface software (SE-MON330) is available at Littelfuse.com/RelaySoftware Selectable reset mode Selectable latching or auto-reset operation Unit-healthy output Verifies SE-330 is operating correctly, available as Form A or Form B output contact Conformal coating Internal circuits are conformally coated to protect against corrosion and moisture

Typical Values

<table>
<thead>
<tr>
<th>SYSTEM VOLTAGE (VOLTS)</th>
<th>NEUTRAL-GROUNDING RESISTOR</th>
<th>SENSING RESISTOR</th>
<th>GROUND-FAULT PICKUP LEVEL (AMPERES)</th>
<th>Vn PICKUP LEVEL (VOLTS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CURRENT (AMPERES)</td>
<td>RESISTANCE (OHMS)</td>
<td>MODEL</td>
<td>RESISTANCE (SWITCH S5 SETTING)</td>
</tr>
<tr>
<td></td>
<td>480</td>
<td>5</td>
<td>55</td>
<td>ER-600VC</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>5</td>
<td>69</td>
<td>ER-600VC</td>
</tr>
<tr>
<td></td>
<td>2,400</td>
<td>5</td>
<td>277</td>
<td>ER-600VC</td>
</tr>
<tr>
<td></td>
<td>4,160</td>
<td>5</td>
<td>480</td>
<td>ER-600VC</td>
</tr>
<tr>
<td></td>
<td>7,200</td>
<td>10</td>
<td>416</td>
<td>ER-15KV</td>
</tr>
<tr>
<td></td>
<td>14,400</td>
<td>15</td>
<td>554</td>
<td>ER-15KV</td>
</tr>
</tbody>
</table>

DISCLAIMER: The above table is for illustrative purposes only. Actual values may differ based on a variety of individual system considerations, such as capacitive charging current and coordination study results.

Wiring Diagram

Specifications

- **IEEE Device Numbers**
- **Input Voltage**
- **Dimensions** H 213 mm (8.4”); W 98 mm (3.9”); D 132 mm (5.2”)
- **GF Trip-Level Settings** 2–100 % of CT-Primary Rating in 1% increments
- **GF Trip-Time Settings** 0.1–10 s
- **Va Trip-Level Settings** 20–2,000 V ac (≤5 kV systems) 100-10,000 V ac (>5 kV systems)
- **Contact Operating Mode** Selectable fail-safe or non-fail-safe (K1, K2, K3)
- **Harmonic Filtering** Standard feature
- **Reset Button** Standard feature
- **Output Contacts** Two Form A and two Form C
- **Pulsing Circuit** 1.0–3.0 s in 0.2 s increments (SE-330 only)
- **Approvals** CSA certified, UL Listed (E340889), CE (European Union), RCM (Australian)
- **Communications** Mini USB (standard), DeviceNet (optional), Modbus TCP and EtherNet/IP (optional)
- **Analog Output** 4–20 mA, self or loop powered
- **Conforming Coated** Standard feature
- **Warranty** 5 years
- **Mounting** Panel and surface (optional)

Littelfuse reserves the right to make product changes, without notice. Material in this document is as accurate as known at the time of publication. Visit Littelfuse.com for the most up-to-date information.
Neutral Earthing Resistor Monitor

Description
The SE-330AU Series is an advanced earth-fault and earthing-resistor monitoring relay for low- and medium-voltage transformers and generators. It monitors neutral current, neutral-to-earth voltage, and neutral-to-earth resistance. It provides continuous monitoring of the neutral-to-earth path to verify that the neutral-earthing resistor (NER) is intact. This is of utmost importance—an open NER renders current-sensing earth-fault protection inoperative and could result in a false belief that the system is functioning properly. The SE-330AU earth-fault function complies with AS/NZS 2081:2002. Outputs include four relay outputs, and an analog output. A mini USB port is included to view measured values, configure settings, and check event records. An on-board micro SD card can be used for long-term data logging. Network communications options are available. For non-AS/NZS 2081 applications, see the SE-330 or SE-330HV Series.

Resistor Monitoring
The SE-330AU combines the measured values of resistance, current, and voltage to continuously determine that the NER is intact. It is able to detect a resistor failure with or without an earth fault present. Sensing resistors are matched to the system voltage and are used to monitor NGRs on systems up to 35 kV.

Earth-Fault Monitoring
The SE-330AU uses a 5- or 30-A-primary current transformer to provide a pickup-setting range of 0.125 to 5 A or 0.75 to 30 A to comply with AS/NZS 2081:2002. DFT filtering ensures that false trips due to harmonic noise from adjustable-speed drives do not occur. Open-CT detection is provided.

Accessories

**ER Series Sensing Resistor**
Required interface between the power system and the SE-330AU. Eliminates hazardous voltage levels at the relay.

**EFCT Series Earth-Fault Current Transformer**
Sensitive earth-fault current detection (5 A primary).

**SE-CS30 Series Earth-Fault Current Transformer**
Sensitive earth-fault current detection (30 A primary).

Specifications
- **Input Voltage**: See ordering information
- **Dimensions**: H 213 mm (8.4”); W 98 mm (3.9”); D 132 mm (5.2”)
- **GF Trip-Level Settings**: 0.125 to 30 A
- **GF Trip-Time Settings**: 0.1 to 0.5 s
- **Vn Trip-Level Settings**: 20-2,000 Vac (≤5 kV systems); 100-10,000 Vac (>5 kV systems)
- **Output Contacts**: Two Form A, Two Form C
- ** Operating Mode**: Fail-Safe
- **Harmonic Filtering**: Standard feature
- **Reset**: Front panel push button and remote input
- **Approvals**: C-Tick (Australian), CE
- **Communications**: Mini USB (standard), DeviceNet (optional), IEC 61850 (optional), Modbus TCP and EtherNet/IP (optional)
- **Analog Output**: 4-20 mA, self or loop powered
- **Conformal Coating**: Standard feature
- **Warranty**: 5 years
- **Mounting**: Panel, Surface (optional)
Neutral Grounding Resistor System

Description
High-resistance grounding prevents many of the problems that are associated with ungrounded and solidly grounded electrical distribution and utilization systems. High-resistance grounding can limit point-of-fault damage, eliminate transient overvoltages, reduce the arc-flash hazards, limit voltage exposure to personnel, and provide adequate tripping levels for selective current-based ground-fault detection and coordination.

The Littelfuse Neutral Grounding Resistor System is a neutral grounding resistor (NGR), current transformer, and sensing resistor installed in a NEMA 3R enclosure used to high-resistance ground transformers and generators. The NGR system is designed for use with Littelfuse Neutral Grounding Resistor Monitors for complete system grounding and grounding protection.

The NGR series – US systems are designed for use in US applications and all other parts of the world, not including Canada. For applications in Canada, please use the NGR series – Canada.

Applications
High-resistance grounding is applied on transformers and generators where safety and continuity of service are important. A faulted feeder may remain in operation until it is safe to repair the fault, where allowed by the local electrical code.

Features
Enclosure
The NGR Series – US comes pre-installed in a ventilated NEMA 3R galvanized steel enclosure and components are pre-wired to terminals for ease of installation. Back view shown on left.

ER Series Sensing Resistor
Use with the SE-325 or the SE-330 to continuously monitor the continuity of a neutral-grounding resistor and eliminate hazardous voltage levels at the relay.

- ER-600VC is designed for use on systems up to 600 V for indoor applications. Available in optional moisture-proof enclosure (shown on left) for outdoor applications.
- ER-5KV for use on systems up to 4160 V for indoor applications.
- ER-5WP is designed for use on systems up to 4160 V and comes with weather-protected terminals for outdoor installations.

Earth-Fault Current Transformer
Used with the SE-325 or the SE-330 to measure ac current flowing through the NGR for use with the continuity monitoring circuit and to detect ground faults.

- ELCT5-31 used with SE-330 for 5 A and 10 A NGRs.
- SE-CS10-2.5 used with SE-330 for 10 A and 15 A NGRs.
- CT200 used with the SE-325 for all applications.
- 5SHT-101-E (not shown) used with SE-330 for 25 A NGRs.

Benefits
- Eliminate phase-to-ground arc-flash incidents
- Eliminate transient overvoltages
- Reduce point-of-fault damage
- Can provide continuity of service during a ground fault
- Includes current transformer and ER series sensing resistor for use with Littelfuse monitoring relay and for ease of installation.
Note 1: Use minimum #8 AWG white or grey conductor insulated to system voltage to connect NGR to neutral.

Note 2: Use conductor insulated to system voltage (#14 AWG is typically used) and a separate lug at the X0 point to connect ER Series Sensing Resistor to neutral.

Note 3: Locate NGR system near transformer or generator.

Note 4: Two-conductor twisted cable required, shielded recommended.

Note 5: Voltage between ER Series Sensing Resistor terminals R and G is limited to 100 V by internal clamp.

Note 6: Use minimum #8 AWG green or bare conductor to connect NGR to ground.
<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>LINE-LINE VOLTAGE (V)</th>
<th>LET-THROUGH CURRENT (A)</th>
<th>IMPEDANCE (OHMS)</th>
<th>TIME RATING</th>
<th>CURRENT TRANSFORMER</th>
<th>CT PRIMARY RATING (A)</th>
<th>CT SECONDARY RATING (A)</th>
<th>SENSING RESISTOR</th>
<th>ENCLOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGRUS138</td>
<td>480</td>
<td>2</td>
<td>138</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS278</td>
<td>480</td>
<td>2</td>
<td>138</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-600VC</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS314</td>
<td>480</td>
<td>2</td>
<td>138</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS315</td>
<td>480</td>
<td>2</td>
<td>138</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS503</td>
<td>480</td>
<td>5</td>
<td>55.4</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS194</td>
<td>480</td>
<td>5</td>
<td>55.4</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-600VC</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS316</td>
<td>480</td>
<td>5</td>
<td>55.4</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS317</td>
<td>480</td>
<td>5</td>
<td>55.4</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS318</td>
<td>600</td>
<td>2</td>
<td>173.5</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS319</td>
<td>600</td>
<td>2</td>
<td>173.5</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS354</td>
<td>600</td>
<td>2</td>
<td>173.5</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS355</td>
<td>600</td>
<td>2</td>
<td>173.5</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-600VC</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS169</td>
<td>600</td>
<td>5</td>
<td>69.4</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS170</td>
<td>600</td>
<td>5</td>
<td>69.4</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-600VC</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS320</td>
<td>600</td>
<td>5</td>
<td>69.4</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS321</td>
<td>600</td>
<td>5</td>
<td>69.4</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS114</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS115</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS322</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>10 s</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS323</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>10 s</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS324</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS325</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS356</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>10s</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS357</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>10s</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS326</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS327</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
</tbody>
</table>
## Ordering Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>LINE-LINE VOLTAGE (V)</th>
<th>LET-THROUGH CURRENT (A)</th>
<th>IMPEDANCE (OHMS)</th>
<th>TIME RATING</th>
<th>CURRENT TRANSFORMER</th>
<th>CT PRIMARY RATING (A)</th>
<th>CT SECONDARY RATING (A)</th>
<th>SENSING RESISTOR</th>
<th>ENCLOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGRUS328</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>Continuous</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS329</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>Continuous</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS358</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>10s</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS359</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>10s</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS360</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS361</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS330</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS331</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS332</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>Continuous</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS333</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>Continuous</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS362</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>10s</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS363</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>10s</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS364</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS365</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS244</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>10s</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS334</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>10 s</td>
<td>SSHT-101-E</td>
<td>20**</td>
<td>1</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS335</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>10 s</td>
<td>SSHT-101-E</td>
<td>20**</td>
<td>1</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS336</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>Continuous</td>
<td>SSHT-101-E</td>
<td>20**</td>
<td>1</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS337</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>Continuous</td>
<td>SSHT-101-E</td>
<td>20**</td>
<td>1</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS366</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>10s</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
<tr>
<td>NGRUS367</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGRUS368</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>Continuous</td>
<td>CT200</td>
<td>200***</td>
<td>5.0</td>
<td>ER-5WP</td>
<td>NEMA 3R; Weather Protected Sensing Resistor</td>
</tr>
</tbody>
</table>

* Connect to SE-330 terminals 8 and 11  
** Connect to SE-330 terminals 9 and 11  
*** Connect to SE-325 terminals CT1 and CT2
Dimensions (in inches) and Mounting Diagrams

480 V & 600 V NGR Systems:

- NGRUS314
- NGRUS316
- NGRUS318
- NGRUS320

- NGRUS315
- NGRUS317
- NGRUS319
- NGRUS321
Dimensions (in inches) and Mounting Diagrams

4160 V NGR Systems:
- NGRUS322
- NGRUS323
- NGRUS326
- NGRUS327
- NGRUS330
- NGRUS331
- NGRUS344
- NGRUS345

- NGRUS324
- NGRUS325
Dimensions (in inches) and Mounting Diagrams

4160 V NGR Systems:
- NGRUS328
- NGRUS329
- NGRUS332
- NGRUS333

- NGRUS336
- NGRUS337
## Specifications: 480 V NGR Systems

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td>480 V line-to-line, 277 V line-to-neutral</td>
</tr>
<tr>
<td><strong>Let-Through Current</strong></td>
<td>2 A or 5 A</td>
</tr>
<tr>
<td><strong>Resistance</strong></td>
<td>138.5 Ω (2 A) or 55.4 Ω (5 A)</td>
</tr>
<tr>
<td><strong>Tolerance</strong></td>
<td>+/- 10 % resistance</td>
</tr>
<tr>
<td><strong>Duty Cycle</strong></td>
<td>Continuous rated</td>
</tr>
<tr>
<td><strong>Current Transformer</strong></td>
<td><strong>ELCT5-31</strong>: For use with SE-330 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Turn Ratio: 100:1</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 5.00.05 A</td>
</tr>
<tr>
<td></td>
<td>Primary Rating with SE-330: 5 A when connected to terminals 8 and 11</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 100 mA to 5 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 31 mm (1.22&quot;)</td>
</tr>
<tr>
<td></td>
<td><strong>CT200</strong>: For use with SE-325 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Turn Ratio: 200:5</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 200.5 A</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 0.5, 2.0, 4.0 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 56 mm (2.2&quot;)</td>
</tr>
<tr>
<td><strong>Sensing Resistor</strong></td>
<td>ER-600VC, Optional installation in NEMA 4 enclosure for outdoor applications</td>
</tr>
<tr>
<td><strong>Insulation Level</strong></td>
<td>11 KV BIL</td>
</tr>
<tr>
<td><strong>Temperature Rise</strong></td>
<td>385 °C (725 °F)</td>
</tr>
<tr>
<td><strong>Resistor Type</strong></td>
<td>Stainless steel wire wound</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>Refer to dimensions drawings</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>23 kg (50 lbs)</td>
</tr>
<tr>
<td><strong>Altitude</strong></td>
<td>0–2000 masl</td>
</tr>
<tr>
<td><strong>Enclosure Style</strong></td>
<td>NEMA 3R, galvanized steel</td>
</tr>
<tr>
<td><strong>Finish</strong></td>
<td>Powder coated</td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>ANSI 61 grey</td>
</tr>
<tr>
<td><strong>Mounting</strong></td>
<td>Floor mount</td>
</tr>
<tr>
<td><strong>Seismic Bracing</strong></td>
<td>Included</td>
</tr>
<tr>
<td><strong>Approvals</strong></td>
<td>cULus or CSA at customer request</td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>12 months in service or 18 months from the date of shipment whichever occurs first</td>
</tr>
</tbody>
</table>

## Specifications: 600 V NGR Systems

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td>600 V line-to-line, 347 V line-to-neutral</td>
</tr>
<tr>
<td><strong>Let-Through Current</strong></td>
<td>2 A or 5 A</td>
</tr>
<tr>
<td><strong>Resistance</strong></td>
<td>174.0 Ω (2 A) or 69.0 Ω (5 A)</td>
</tr>
<tr>
<td><strong>Tolerance</strong></td>
<td>+/- 10 % resistance</td>
</tr>
<tr>
<td><strong>Duty Cycle</strong></td>
<td>Continuous rated</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>50–60 Hz</td>
</tr>
<tr>
<td><strong>Current Transformer</strong></td>
<td><strong>ELCT5-31</strong>: For use with SE-330 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Turn Ratio: 100:1</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 5.00.05 A</td>
</tr>
<tr>
<td></td>
<td>Primary Rating with SE-330: 5 A when connected to terminals 8 and 11</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 100 mA to 5 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 31 mm (1.22&quot;)</td>
</tr>
<tr>
<td></td>
<td><strong>CT200</strong>: For use with SE-325 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Turn Ratio: 200:5</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 200.5 A</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 0.5, 2.0, 4.0 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 56 mm (2.2&quot;)</td>
</tr>
<tr>
<td><strong>Sensing Resistor</strong></td>
<td>ER-600VC, Optional installation in NEMA 4 enclosure for outdoor applications</td>
</tr>
<tr>
<td><strong>Insulation Level</strong></td>
<td>11 KV BIL</td>
</tr>
<tr>
<td><strong>Temperature Rise</strong></td>
<td>385 °C (725 °F)</td>
</tr>
<tr>
<td><strong>Resistor Type</strong></td>
<td>Stainless steel wire wound</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>Refer to dimensions drawings</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>23 kg (50 lbs)</td>
</tr>
<tr>
<td><strong>Altitude</strong></td>
<td>0–2000 masl</td>
</tr>
<tr>
<td><strong>Enclosure Style</strong></td>
<td>NEMA 3R, galvanized steel</td>
</tr>
<tr>
<td><strong>Finish</strong></td>
<td>Powder coated</td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>ANSI 61 grey</td>
</tr>
<tr>
<td><strong>Mounting</strong></td>
<td>Floor mount</td>
</tr>
<tr>
<td><strong>Seismic Bracing</strong></td>
<td>Included</td>
</tr>
<tr>
<td><strong>Approvals</strong></td>
<td>cULus or CSA at customer request</td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>12 months in service or 18 months from the date of shipment whichever occurs first</td>
</tr>
</tbody>
</table>
### Specifications: 4160 V NGR Systems

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td>4160 V line-to-line, 2400 V line-to-neutral</td>
</tr>
<tr>
<td><strong>Let-Through Current</strong></td>
<td>5 A, 10 A, 15 A, or 25 A</td>
</tr>
<tr>
<td><strong>Resistance</strong></td>
<td>480 Ω (5 A), 240 Ω (10 A), 160 Ω (15 A), or 96 Ω (25 A)</td>
</tr>
<tr>
<td><strong>Tolerance</strong></td>
<td>+/- 10 % resistance</td>
</tr>
<tr>
<td><strong>Duty Cycle</strong></td>
<td>Continuous-duty or 10-second-duty rating</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>50-60 Hz</td>
</tr>
<tr>
<td><strong>Current Transformer</strong></td>
<td><strong>ELCT5-31:</strong> For use with SE-330 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Turns Ratio: 100:1</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 5:0.05 A</td>
</tr>
<tr>
<td></td>
<td>Primary Rating with SE-330: 5 A when connected to terminals 8 and 11</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 100 mA to 5 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 31 mm (1.22&quot;)</td>
</tr>
<tr>
<td><strong>SE-CS10-2.5:</strong></td>
<td>For use with SE-330 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Turns Ratio: 200:1</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 12.5:0.0625 A</td>
</tr>
<tr>
<td></td>
<td>Primary Rating with SE-330: 10 A when connected to terminals 8 and 11</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 200 mA to 10 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 63.5 mm (2.5&quot;)</td>
</tr>
<tr>
<td></td>
<td>Turn Ratio: 100:5</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 100:5 A</td>
</tr>
<tr>
<td></td>
<td>Primary Rating with SE-330: 20 A when connected to terminals 9 and 11</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 400 mA to 20 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 40 mm (1.56&quot;)</td>
</tr>
<tr>
<td><strong>CT200:</strong></td>
<td>For use with SE-325 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Turns Ratio: 200:5</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 200:5 A</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 0.5, 2.0, 4.0 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 56 mm (2.2&quot;)</td>
</tr>
<tr>
<td><strong>Sensing Resistor</strong></td>
<td>Optional ER-5KV for outdoor applications</td>
</tr>
<tr>
<td><strong>Insulation Level</strong></td>
<td>75 KV BIL</td>
</tr>
<tr>
<td><strong>Temperature Rise</strong></td>
<td>Continuous-duty rated: 385 °C (725 °F)</td>
</tr>
<tr>
<td></td>
<td>10-second-duty rated: 760 °C (1400 °F)</td>
</tr>
<tr>
<td><strong>Resistor Type</strong></td>
<td>Stainless Steel Wire Wound</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>Refer to dimensions drawings</td>
</tr>
<tr>
<td><strong>Weights</strong></td>
<td></td>
</tr>
<tr>
<td>5 A, continuous-duty rated</td>
<td>192 kg (424 lbs)</td>
</tr>
<tr>
<td>10 A, continuous-duty rated</td>
<td>235 kg (519 lbs)</td>
</tr>
<tr>
<td>15 A, continuous-duty rated</td>
<td>258 kg (568 lbs)</td>
</tr>
<tr>
<td>25 A, continuous-duty rated</td>
<td>320 kg (705 lbs)</td>
</tr>
<tr>
<td>5 A, 10-second-duty rated</td>
<td>136 kg (300 lbs)</td>
</tr>
<tr>
<td>10 A, 10-second-duty rated</td>
<td>136 kg (300 lbs)</td>
</tr>
<tr>
<td>15 A, 10-second-duty rated</td>
<td>136 kg (300 lbs)</td>
</tr>
<tr>
<td>25 A, 10-second-duty rated</td>
<td>136 kg (300 lbs)</td>
</tr>
<tr>
<td><strong>Altitude</strong></td>
<td>0-1000 masl</td>
</tr>
<tr>
<td><strong>Enclosure Style</strong></td>
<td>NEMA 3R, galvanized steel</td>
</tr>
<tr>
<td><strong>Finish</strong></td>
<td>Powder coated</td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>ANSI 61 grey</td>
</tr>
</tbody>
</table>

### Accessories

**SE-325 Neutral Grounding Resistor Monitor**
- Basic ground-fault and neutral-grounding resistor monitoring relay that measures neutral current, neutral-to-ground voltage, and neutral-to-ground continuity.

**SE-330 Neutral Grounding Resistor Monitor**
- Advanced ground-fault and neutral-grounding resistor monitoring relay that measures neutral current, neutral-to-ground voltage, and neutral-to-ground resistance.

**NGRM-ENC Enclosed Neutral Grounding Resistor (NGR) Monitor**
- Type 4X enclosure housing a Littelfuse Startco SE-325 or SE-330 Neutral Grounding Resistor Monitor and optional accessories that include a 480/600 V control power transformer (CPT), faulted-phase indication (FPI), implemented with an EL3100 Ground-Fault & Phase-Voltage Indicator, earth-leakage panel meter, pulse-enable control, and mounting options. Appropriate fusing is included and field wiring is to terminal blocks.

### Custom NGR Systems

Additional custom NGR systems are also available from Littelfuse. For NGR systems not listed on this sheet please contact Littelfuse by emailing NGRquotes@Littelfuse.com
**Protection Relays**  
Neutral Grounding Resistor System

**NGR SERIES – CANADA**

Neutral Grounding Resistor System

---

**Description**

High-resistance grounding prevents many of the problems that are associated with ungrounded and solidly grounded electrical distribution and utilization systems. High-resistance grounding can limit point-of-fault damage, eliminate transient overvoltages, reduce the arc-flash hazards, limit voltage exposure to personnel, and provide adequate tripping levels for selective current-based ground-fault detection and coordination.

The Littelfuse Neutral Grounding Resistor System is a neutral grounding resistor (NGR), current transformer, and sensing resistor installed in a NEMA 3R enclosure used to high-resistance ground transformers and generators. The NGR system is designed for use with Littelfuse Neutral Grounding Resistor Monitors for complete system grounding and grounding protection.

The NGR series – Canada systems are specifically designed for use in Canadian applications. For applications in the US and other parts of the world, please use the NGR series – US.

**Applications**

High-resistance grounding is applied on transformers and generators where safety and continuity of service are important. A faulted feeder may remain in operation until it is safe to repair the fault, where allowed by the local electrical code.

---

**Features**

**Enclosure**

The NGR Series - Canada comes pre-installed in a ventilated NEMA 3R galvanized steel enclosure and components are pre-wired to terminals for ease of installation. Back view shown on left.

**ER Series Sensing Resistor**

Use with the SE-330 to continuously monitor the continuity of a neutral-grounding resistor and eliminate hazardous voltage levels at the relay.

- ER-600VC is designed for use on systems up to 600 V for indoor applications. Available in optional moisture-proof enclosure (shown on left) for outdoor applications.
- ER-5KV for use on systems up to 4160 V for indoor applications.
- ER-5WP is designed for use on systems up to 4160 V and comes with weather-protected terminals for outdoor installations.

**Earth-Fault Current Transformer**

Used with the SE-330 to measure ac current flowing through the NGR for use with the continuity monitoring circuit and to detect ground faults.

- ELCT5-31 used with SE-330 for 5 A and 10 A NGRs.
- SE-CS10-2.5 used with SE-330 for 10 A and 15 A NGRs.
- 5SHT-101-E used with SE-330 for 25 A NGRs.

**Benefits**

- Eliminate phase-to-ground arc-flash incidents
- Eliminate transient overvoltages
- Reduce point-of-fault damage
- Can provide continuity of service during a ground fault
- Includes current transformer and ER series sensing resistor for use with Littelfuse monitoring relay and for ease of installation.
Simplified Circuit Diagram with Littelfuse Neutral Grounding Resistor Monitor

Note 1: Use minimum #8 AWG white or grey conductor insulated to system voltage to connect NGR to neutral.

Note 2: Use conductor insulated to system voltage (#14 AWG is typically used) and a separate lug at the X0 point to connect ER Series Sensing Resistor to neutral.

Note 3: Locate NGR system near transformer or generator.

Note 4: Two-conductor twisted cable required, shielded recommended.

Note 5: Voltage between ER Series Sensing Resistor terminals R and G is limited to 100 V by internal clamp.

Note 6: Use minimum #8 AWG green or bare conductor to connect NGR to ground.
### Ordering Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>LINE-LINE VOLTAGE (V)</th>
<th>LET-THROUGH CURRENT (A)</th>
<th>IMPEDANCE (OHMS)</th>
<th>TIME RATING</th>
<th>CURRENT TRANSFORMER</th>
<th>CT PRIMARY RATING (A)</th>
<th>CT SECONDARY RATING (A)</th>
<th>SENSING RESISTOR</th>
<th>ENCLOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGR1050</td>
<td>480</td>
<td>2</td>
<td>138</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1041</td>
<td>480</td>
<td>2</td>
<td>138</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1036</td>
<td>480</td>
<td>5</td>
<td>55.4</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1051</td>
<td>480</td>
<td>5</td>
<td>55.4</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1052</td>
<td>480</td>
<td>2</td>
<td>173.5</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1053</td>
<td>600</td>
<td>2</td>
<td>173.5</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1038</td>
<td>600</td>
<td>5</td>
<td>69.4</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1045</td>
<td>600</td>
<td>5</td>
<td>69.4</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1066</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-600VC</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1067</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1068</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>Continuous</td>
<td>ELCT5-31</td>
<td>5*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1069</td>
<td>4160</td>
<td>5</td>
<td>480.9</td>
<td>Continuous</td>
<td>SE-CS10-2.5</td>
<td>5*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1070</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1071</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1072</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1073</td>
<td>4160</td>
<td>10</td>
<td>240.5</td>
<td>Continuous</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1074</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1075</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>10 s</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1076</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>Continuous</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1077</td>
<td>4160</td>
<td>15</td>
<td>160.3</td>
<td>Continuous</td>
<td>SE-CS10-2.5</td>
<td>10*</td>
<td>0.05</td>
<td>ER-5WP</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1078</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>10 s</td>
<td>5SHT-101-E</td>
<td>20**</td>
<td>1</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1079</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>10 s</td>
<td>5SHT-101-E</td>
<td>20**</td>
<td>1</td>
<td>ER-5WP</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1080</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>Continuous</td>
<td>5SHT-101-E</td>
<td>20**</td>
<td>1</td>
<td>ER-5KV</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>NGR1081</td>
<td>4160</td>
<td>25</td>
<td>96.2</td>
<td>Continuous</td>
<td>5SHT-101-E</td>
<td>20**</td>
<td>1</td>
<td>ER-5WP</td>
<td>NEMA 3R</td>
</tr>
</tbody>
</table>

* Connect to SE-330 terminals 8 and 11
** Connect to SE-330 terminals 9 and 11
**Protection Relays**

Neutral Grounding Resistor System

---

**Dimensions and Mounting Diagrams**

For 480 V NGR Systems:

**For 600 V NGR Systems:**

---

**Notes**

## Specifications: 480 V NGR Systems

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>480 V line-to-line, 277 V line-to-neutral</td>
</tr>
<tr>
<td>Let-Through Current</td>
<td>2 A or 5 A</td>
</tr>
<tr>
<td>Resistance</td>
<td>138.5 Ω (2 A) or 55.4 Ω (5 A)</td>
</tr>
<tr>
<td>Tolerance</td>
<td>+/- 10 % resistance</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>Continuous rated</td>
</tr>
<tr>
<td>Current Transformer</td>
<td>ELCT5-31: For use with SE-330 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Current Rating: 5 A</td>
</tr>
<tr>
<td></td>
<td>Primary Rating with SE-330: 5 A when connected to terminals B and 11</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 100 mA to 5 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 31 mm (1.22&quot;)</td>
</tr>
<tr>
<td>Sensing Resistor</td>
<td>ER-600VC, Optional installation in NEMA 4 enclosure for outdoor apps</td>
</tr>
<tr>
<td>Insulation Level</td>
<td>11 KV BIL</td>
</tr>
<tr>
<td>Temperature Rise</td>
<td>385 °C (725 °F)</td>
</tr>
<tr>
<td>Resistor Type</td>
<td>Stainless steel wire wound</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 324 mm (12.75”); W 558 mm (22.00”)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>D 558 mm (22.00”)</td>
</tr>
<tr>
<td>Weight</td>
<td>23 kg (50 lbs)</td>
</tr>
<tr>
<td>Altitude</td>
<td>0–2000 masl</td>
</tr>
<tr>
<td>Enclosure Style</td>
<td>NEMA 3R, galvanized steel</td>
</tr>
<tr>
<td>Finish</td>
<td>Powder coated</td>
</tr>
<tr>
<td>Color</td>
<td>ANSI 61 grey</td>
</tr>
<tr>
<td>Mounting</td>
<td>Floor mount</td>
</tr>
<tr>
<td>Seismic Bracing</td>
<td>Included</td>
</tr>
<tr>
<td>Approvals</td>
<td>cULus</td>
</tr>
<tr>
<td>Warranty</td>
<td>12 months in service or 18 months from the date of shipment whichever occurs first</td>
</tr>
</tbody>
</table>

## Specifications: 600 V NGR Systems

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>600 V line-to-line, 347 V line-to-neutral</td>
</tr>
<tr>
<td>Let-Through Current</td>
<td>2 A or 5 A</td>
</tr>
<tr>
<td>Resistance</td>
<td>174.0 Ω (2 A) or 69.0 Ω (5 A)</td>
</tr>
<tr>
<td>Tolerance</td>
<td>+/- 10 % resistance</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>Continuous rated</td>
</tr>
<tr>
<td>Frequency</td>
<td>50–60 Hz</td>
</tr>
<tr>
<td>Current Transformer</td>
<td>ELCT5-31: For use with SE-330 NGR Monitor</td>
</tr>
<tr>
<td></td>
<td>Turns Ratio: 100:1</td>
</tr>
<tr>
<td></td>
<td>Primary Rating with SE-330: 5 A when connected to terminals B and 11</td>
</tr>
<tr>
<td></td>
<td>GF Trip Range: 100 mA to 5 A</td>
</tr>
<tr>
<td></td>
<td>Window Diameter: 31 mm (1.22&quot;)</td>
</tr>
<tr>
<td>Sensing Resistor</td>
<td>ER-600VC, Optional installation in NEMA 4 enclosure for outdoor apps</td>
</tr>
<tr>
<td>Insulation Level</td>
<td>11 KV BIL</td>
</tr>
<tr>
<td>Temperature Rise</td>
<td>385 °C (725 °F)</td>
</tr>
<tr>
<td>Resistor Type</td>
<td>Stainless steel wire wound</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 324 mm (12.75”); W 558 mm (22.00”)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>D 558 mm (22.00”)</td>
</tr>
<tr>
<td>Weight</td>
<td>23 kg (50 lbs)</td>
</tr>
<tr>
<td>Altitude</td>
<td>0–2000 masl</td>
</tr>
<tr>
<td>Enclosure Style</td>
<td>NEMA 3R, galvanized steel</td>
</tr>
<tr>
<td>Finish</td>
<td>Powder coated</td>
</tr>
<tr>
<td>Color</td>
<td>ANSI 61 grey</td>
</tr>
<tr>
<td>Mounting</td>
<td>Floor mount</td>
</tr>
<tr>
<td>Seismic Bracing</td>
<td>Included</td>
</tr>
<tr>
<td>Approvals</td>
<td>cULus</td>
</tr>
<tr>
<td>Warranty</td>
<td>12 months in service or 18 months from the date of shipment whichever occurs first</td>
</tr>
</tbody>
</table>
Specifications: 4160 V NGR Systems

- **Voltage**: 4160 V line-to-line, 2400 V line-to-neutral
- **Let-Through Current**
  - 5 A, 10 A, 15 A, or 25 A
  - 480 Ω (5 A), 240 Ω (10 A), 160 Ω (15 A), or 96 Ω (25 A)
- **Tolerance**: +/- 10% resistance
- **Duty Cycle**: Continuous-duty or 10-second-duty rating
- **Frequency**: 50-60 Hz
- **Current Transformer**
  - **ELCT5-31**: For use with SE-330 NGR Monitor
    - Turns Ratio: 100:1
    - Current Rating: 5:0.05 A
    - Primary Rating with SE-330: 5 A when connected to terminals 8 and 11
    - GF Trip Range: 100 mA to 5 A
    - Window Diameter: 31 mm (1.22“)
  - **SE-CS10-2.5**: For use with SE-330 NGR Monitor
    - Turns Ratio: 200:1
    - Current Rating: 12.5:0.0625 A
    - Primary Rating with SE-330: 10 A when connected to terminals 8 and 11
    - GF Trip Range: 200 mA to 10 A
    - Window Diameter: 63.5 mm (2.5“)
- **Sensing Resistor**: ER-5KV
- **Insulation Level**: 75 KV BIL
- **Temperature Rise**
  - Continuous-duty rated: 385 °C (725 °F)
  - 10-second-duty rated: 760 °C (1400 °F)
- **Resistor Type**: Stainless Steel Wire Wound
- **Weights and Dimensions**:
  - **5 A, continuous-duty rated**:
    - H 1226 mm (48.28“); W 1143 mm (45.00“);
    - D 940 mm (37.00“); 192 kg (424 lbs)
  - **10 A, continuous-duty rated**:
    - H 1214 mm (47.78“); W 1270 mm (50.00“);
    - D 1143 mm (45.00“); 235 kg (519 lbs)
  - **15 A, continuous-duty rated**:
    - H 1214 mm (47.78“); W 1270 mm (50.00“);
    - D 1143 mm (45.00“); 258 kg (568 lbs)
  - **25 A, continuous-duty rated**:
    - H 1283 mm (50.50“); W 1575 mm (62.00“);
    - D 1143 mm (45.00“); 320 kg (705 lbs)
  - **5 A, 10-second-duty rated**:
    - H 749 mm (29.50“); W 1143 mm (45.00“);
    - D 940 mm (37.00“); 136 kg (300 lbs)
  - **10 A, 10-second-duty rated**:
    - H 749 mm (29.50“); W 1143 mm (45.00“);
    - D 940 mm (37.00“); 136 kg (300 lbs)
  - **15 A, 10-second-duty rated**:
    - H 749 mm (29.50“); W 1143 mm (45.00“);
    - D 940 mm (37.00“); 136 kg (300 lbs)
  - **25 A, 10-second-duty rated**:
    - H 749 mm (29.50“); W 1143 mm (45.00“);
    - D 940 mm (37.00“); 136 kg (300 lbs)

---

**Accessories**

- **SE-330 Neutral Grounding Resistor Monitor**
  - Advanced ground-fault and neutral-grounding resistor monitoring relay that measures neutral current, neutral-to-ground voltage, and neutral-to-ground resistance.

- **NGRM-ENC Enclosed Neutral Grounding Resistor (NGR) Monitor**
  - Type 4X enclosure housing a Littelfuse Startco SE-330 Neutral Grounding Resistor Monitor and optional accessories that include a 480/600 V control power transformer (CPT), faulted-phase indication (FPI; implemented with an EL3100 Ground-Fault & Phase-Voltage Indicator), earth-leakage panel meter, pulse-enable control, and mounting options. Appropriate fusing is included and field wiring is to terminal blocks.

**Custom NGR Systems**

Additional custom NGR systems are also available from Littelfuse. For NGR systems not listed on this sheet please contact Littelfuse by emailing NGRquotes@Littelfuse.com
**Neutral Grounding Resistor Monitoring**

The NGRM-ENC Enclosed Neutral-Grounding-Resistor (NGR) Monitor series is a Type 4X enclosure housing a Littelfuse Startco SE-325 or SE-330 Neutral-Grounding-Resistor Monitor and optional accessories that include a 480/600-V control power transformer (CPT), faulted-phase indication (FPI; implemented with an EL3100 Ground-Fault & Phase-Voltage Indicator), earth-leakage panel meter, pulse-enable control, and mounting options. Appropriate fusing is included and field wiring is to terminal blocks.

**Options**

- **SE-325 Neutral-Grounding-Resistor Monitor**: Measures current and voltage in a transformer or generator neutral-to-ground connection and continuity of the neutral-grounding resistor. For applications in Canada use the SE-330 to meet 2018 CEC 22.1 requirements.
- **SE-330 Neutral-Grounding-Resistor Monitor**: Advanced ground-fault and neutral-grounding resistor monitoring relay that measures neutral current, neutral-to-ground voltage, and neutral-to-ground resistance.
- **EL3100 Ground-Fault & Phase-Voltage Indicator**: Three panel-mounted LEDs indicate the ground-faulted phase.
- **Panel Meter**: Panel-mounted meter displays earth leakage current as a percentage of the ground-fault-CT-primary rating.
- **RK-332/RK-302 Remote Indication and Reset**: Panel-mounted remote indication and reset assemblies are included with SE-325 and surface-mounted SE-330 configurations.

**Ordering Information**

The following options are available with a faster delivery time and are commonly stock items:

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>PROTECTION RELAY OPTION</th>
<th>NGR MONITOR MOUNTING OPTION</th>
<th>AMMETER &amp; PULSE CONTROL OPTION</th>
<th>COMMS</th>
<th>CONTROL-POWER TRANSFORMER OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGRM-ENC-000-00</td>
<td>SE-325</td>
<td>Surface Mount</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-200-00</td>
<td>SE-330 (N.O. K4)</td>
<td>Surface Mount</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
## Ordering Information

The following options are built to order:

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>PROTECTION RELAY OPTION</th>
<th>NGR MONITOR MOUNTING OPTION</th>
<th>AMMETER &amp; PULSE CONTROL OPTION</th>
<th>COMMS</th>
<th>CONTROL-POWER TRANSFORMER OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGRM-ENC-000-01</td>
<td>SE-325</td>
<td>Surface Mount</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-200-01</td>
<td>SE-330 (N.O. K4)</td>
<td>Surface Mount</td>
<td>None</td>
<td>None</td>
<td>CPT</td>
</tr>
<tr>
<td>NGRM-ENC-200-10</td>
<td>SE-330 (N.O. K4)</td>
<td>Surface Mount</td>
<td>Earth leakage Panel Meter</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-200-20</td>
<td>SE-330 (N.O. K4)</td>
<td>Surface Mount</td>
<td>Earth leakage Panel Meter &amp; Pulse Enable Switch</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-201-00</td>
<td>SE-330 (N.O. K4)</td>
<td>Panel Mount</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-201-10</td>
<td>SE-330 (N.O. K4)</td>
<td>Panel Mount</td>
<td>Earth leakage Panel Meter</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-201-20</td>
<td>SE-330 (N.O. K4)</td>
<td>Panel Mount</td>
<td>Earth leakage Panel Meter &amp; Pulse Enable Switch</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-201-21</td>
<td>SE-330 (N.O. K4)</td>
<td>Panel Mount</td>
<td>Earth leakage Panel Meter &amp; Pulse Enable Switch</td>
<td>None</td>
<td>CPT</td>
</tr>
<tr>
<td>NGRM-ENC-230-00</td>
<td>SE-330 (N.O. K4)</td>
<td>Surface Mount</td>
<td>None</td>
<td>Ethernet, dual RJ45</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-231-01</td>
<td>SE-330 (N.O. K4)</td>
<td>Panel Mount</td>
<td>None</td>
<td>Ethernet, dual RJ45</td>
<td>CPT</td>
</tr>
<tr>
<td>NGRM-ENC-241-00</td>
<td>SE-330 (N.O. K4)</td>
<td>Panel Mount</td>
<td>None</td>
<td>Ethernet, 1 RJ45 &amp; 1 Fiber</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-331-01</td>
<td>SE-330 (N.O. K4) &amp; Voltage Indication</td>
<td>Panel Mount</td>
<td>None</td>
<td>Ethernet, dual RJ45</td>
<td>CPT</td>
</tr>
<tr>
<td>NGRM-ENC-401-00</td>
<td>SE-330 (N.C. K4)</td>
<td>Panel Mount</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-401-20</td>
<td>SE-330 (N.C. K4)</td>
<td>Panel Mount</td>
<td>Earth leakage Panel Meter &amp; Pulse Enable Switch</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-430-00</td>
<td>SE-330 (N.C. K4)</td>
<td>Surface Mount</td>
<td>None</td>
<td>Ethernet, dual RJ45</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-431-21</td>
<td>SE-330 (N.C. K4)</td>
<td>Panel Mount</td>
<td>Earth leakage Panel Meter &amp; Pulse Enable Switch</td>
<td>Ethernet, dual RJ45</td>
<td>CPT</td>
</tr>
<tr>
<td>NGRM-ENC-530-11</td>
<td>SE-330 (N.C. K4) &amp; Voltage Indication</td>
<td>Surface Mount</td>
<td>Earth leakage Panel Meter</td>
<td>Ethernet, dual RJ45</td>
<td>CPT</td>
</tr>
<tr>
<td>NGRM-ENC-540-00</td>
<td>SE-330 (N.C. K4) &amp; Voltage Indication</td>
<td>Surface Mount</td>
<td>None</td>
<td>Ethernet, 1 RJ45 &amp; 1 Fiber</td>
<td>None</td>
</tr>
<tr>
<td>NGRM-ENC-540-10</td>
<td>SE-330 (N.C. K4) &amp; Voltage Indication</td>
<td>Surface Mount</td>
<td>Earth leakage Panel Meter</td>
<td>Ethernet, 1 RJ45 &amp; 1 Fiber</td>
<td>None</td>
</tr>
</tbody>
</table>
FEEDER PROTECTION

Protect feeder circuits from overcurrents, earth faults, phase loss and other detrimental conditions in critical applications and processes. They provide essential data for predictive and preventive maintenance, extending the life of equipment, enhancing safety and maximizing efficiency.

FPU-32 Series  Feeder Protection Unit ........................................... 86
FPS Series  Feeder Protection System ........................................... 87

For More Information…
and to download datasheets and manuals on our Feeder Protection Relays, click Technical Resources at Littelfuse.com/FeederProtection
**FPU-32 SERIES (PGR-7200)**

**Feeder Protection Unit**

**Description**

The FPU-32 Feeder Protection Unit provides integrated protection, metering, and data-logging functions. It is an excellent choice for retrofitting and upgrading older relays because of its compact size and ability to use existing CTs. The FPU-32 is used to protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC &amp; IEEE overcurrent protection curves</td>
<td>Definite and inverse time settings for system coordination; prevents catastrophic failures</td>
</tr>
<tr>
<td>Two setpoint groups</td>
<td>Create distinctive settings for maintenance or for two different loads</td>
</tr>
<tr>
<td>Reduced overcurrent mode</td>
<td>Maintenance mode setting to reduce the risk of arc-flash hazards</td>
</tr>
<tr>
<td>Data logging</td>
<td>On-board 100-event recorder and remote data logging helps with system diagnostics</td>
</tr>
<tr>
<td>Overload</td>
<td>Thermal protection for connected load</td>
</tr>
<tr>
<td>Phase loss/Phase reverse (current)</td>
<td>Detects unhealthy supply conditions</td>
</tr>
<tr>
<td>Unbalance (current)</td>
<td>Prevents overheating due to unbalanced phases</td>
</tr>
<tr>
<td>Communications</td>
<td>Remotely view measured values, event records &amp; reset trips</td>
</tr>
</tbody>
</table>

**Accessories**

- **Phase Current Transformers**
  - Phase CTs are required to detect phase currents.

- **Ground-Fault Transformer**

**Specifications**

**Protective Functions (IEEE #)**

- Overload (49, 51)
- Definite-time overcurrent (50, 51)
- Phase sequence (46)
- Inverse-time overcurrent (50, 51)
- Unbalance (46)
- Ground fault (50G/N, 51G/N)
- Phase loss (46)
- RTD/PTC temperature (49)

**Input Voltage**

- 65-265 Vac, 30 VA; 80-275 Vdc, 25 W

**Power-Up Time**

- 800 ms at 120 vac

**Ride-Through Time**

- 100 ms minimum

**24-Vdc Source**

- 400 mA maximum

**AC Measurements**

- True RMS and DFT, Peak 32 samples/cycle and positive and negative sequence of fundamental

**Frequency**

- 50, 60 Hz

**Output Contacts**

- Three Form C

**Approvals**

- CSA certified, CE, C-Tick (Australian), UL Recognized

**Communications**

- TIA-232 (standard); TIA-485, DeviceNet™, Ethernet (optional)

**Analog Output**

- 4-20 mA, programmable

**Conformally Coated**

- Standard feature

**Warranty**

- 10 years

**Mounting**

- (Control Unit) Panel (standard)
- (Current Input Module) DIN, Surface

**Ordering Information**

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPU-32-00-00</td>
<td>TIA-232</td>
</tr>
<tr>
<td>FPU-32-01-00</td>
<td>TIA-232 &amp; RS-485</td>
</tr>
<tr>
<td>FPU-32-02-00</td>
<td>TIA-232 &amp; DeviceNet™</td>
</tr>
<tr>
<td>FPU-32-04-00</td>
<td>TIA-232 &amp; Ethernet</td>
</tr>
</tbody>
</table>

**NOTE:** One of the following is required: MPU-CIM-00-00 Current Input Module, or MPU-CTI-RT-00 Current Input Module with ring-tongue terminals.

**Accessories**

- **Phase CTs**
  - Recommended
- **Ground-Fault CT**
  - Optional
- **MPU-16A-Y92A-96N**
  - Optional

**Specifications**

**Phase Current Transformers**

- Phase CTs are required to detect phase currents.

**Ground-Fault Transformer**


**Accessories**

- **Phase CTs**
  - Recommended
- **Ground-Fault CT**
  - Optional
- **MPU-16A-Y92A-96N**
  - Optional

**Specifications**

**Protective Functions (IEEE #)**

- Overload (49, 51)
- Definite-time overcurrent (50, 51)
- Phase sequence (46)
- Inverse-time overcurrent (50, 51)
- Unbalance (46)
- Ground fault (50G/N, 51G/N)
- Phase loss (46)
- RTD/PTC temperature (49)

**Input Voltage**

- 65-265 Vac, 30 VA; 80-275 Vdc, 25 W

**Power-Up Time**

- 800 ms at 120 vac

**Ride-Through Time**

- 100 ms minimum

**24-Vdc Source**

- 400 mA maximum

**AC Measurements**

- True RMS and DFT, Peak 32 samples/cycle and positive and negative sequence of fundamental

**Frequency**

- 50, 60 Hz

**Output Contacts**

- Three Form C

**Approvals**

- CSA certified, CE, C-Tick (Australian), UL Recognized

**Communications**

- TIA-232 (standard); TIA-485, DeviceNet™, Ethernet (optional)

**Analog Output**

- 4-20 mA, programmable

**Conformally Coated**

- Standard feature

**Warranty**

- 10 years

**Mounting**

- (Control Unit) Panel (standard)
- (Current Input Module) DIN, Surface
Description
The FPS Feeder Protection System monitors voltage and current to provide a comprehensive package of 17 protective functions. The FPS is a modular system with integrated protection, breaker control, metering, and data-logging functions.

1 Operator Interface (FPS-OPI)
- Large, bright, 4 x 20 vacuum-fluorescent display
- Display metered values
- Access set points
- Powered by Control Unit
- Panel mount or attach directly to Control Unit
- Remote mounting (1.2 km or 4000 ft maximum loop length)
- 1/2 DIN size
- Hazardous-location certified

2 Control Unit (FPS-CTU)
- Current inputs—5-A or 1-A secondary phase current transformers
- Voltage inputs—up to 600 V without PTs
- Earth-leakage input—5-A or 1-A secondary or sensitive transformer
- 8 digital inputs, 5 relay outputs, 1 analog input and output
- 24-Vdc supply for OPI and RTD modules, and for digital inputs
- IRIG-B time-code input
- 1/2 DIN size, surface mount
- RS-485 network communications (Standard)
- DeviceNet™, Profibus® or Ethernet communications available

Accessories

A Phase Current Transformers
Phase CTs are required to detect phase currents.

B Ground-Fault Current Transformer

C MPS-RTD Temperature Input Module
Optional module provides 8 inputs to connect Pt100, Ni100, Ni120, and Cu10 RTDs.

SE-IP65CVR-M Cover
Optional gasketed, transparent cover for limited access and IP65 protection for an Operator Interface Module.

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPS-CTU-01-00</td>
<td>RS-485</td>
</tr>
<tr>
<td>FPS-CTU-02-00</td>
<td>RS-485 &amp; DeviceNet™</td>
</tr>
<tr>
<td>FPS-CTU-03-00</td>
<td>RS-485 &amp; Profibus®</td>
</tr>
<tr>
<td>FPS-CTU-04-00</td>
<td>RS-485 &amp; Ethernet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPS-OPI-01-00</td>
<td>Recommended</td>
</tr>
<tr>
<td>SE-IP65CVR-M</td>
<td>Optional</td>
</tr>
<tr>
<td>Phase CTs</td>
<td>Required</td>
</tr>
<tr>
<td>Ground-Fault CT</td>
<td>Recommended</td>
</tr>
<tr>
<td>MPS-RTD-01-00</td>
<td>Optional</td>
</tr>
</tbody>
</table>
**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>IEEE #</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload</td>
<td>49, 51</td>
<td>Long-time overcurrent provides thermal protection for feeder or load</td>
</tr>
<tr>
<td>Inverse-time overcurrent</td>
<td>50, 51</td>
<td>Coordination using IEEE and IEC Curves</td>
</tr>
<tr>
<td>Definite-time overcurrent</td>
<td>50, 51</td>
<td>Instantaneous overcurrent to detect catastrophic failure</td>
</tr>
<tr>
<td>Current unbalance/Phase loss/Phase reverse</td>
<td>46</td>
<td>Detects an open or high-impedance phase</td>
</tr>
<tr>
<td>Ground fault</td>
<td>50G/N, 51G/N</td>
<td>Inverse and definite time. Early insulation-failure detection.</td>
</tr>
<tr>
<td>RTD temperature</td>
<td>38, 49</td>
<td>Optional protection (MPS-RTD module) for load-temperature monitoring</td>
</tr>
<tr>
<td>Overvoltage</td>
<td>59</td>
<td>Limits stress to insulation</td>
</tr>
<tr>
<td>Undervoltage</td>
<td>27</td>
<td>Detects a damaging brown-out condition</td>
</tr>
<tr>
<td>Voltage unbalance</td>
<td>47</td>
<td>Detects unhealthy supply voltage</td>
</tr>
<tr>
<td>Two setting groups</td>
<td></td>
<td>Minimizes Arc-Flash hazards during maintenance</td>
</tr>
<tr>
<td>Breaker control</td>
<td></td>
<td>Allows local and remote operation; reduces component count</td>
</tr>
<tr>
<td>Metering</td>
<td></td>
<td>Displays the measured and calculated parameters</td>
</tr>
<tr>
<td>Data logging</td>
<td></td>
<td>On-board 64-event recorder helps with system diagnosis</td>
</tr>
<tr>
<td>Communications</td>
<td></td>
<td>Remotely view measured values, event records, &amp; reset trips</td>
</tr>
<tr>
<td>Conformal coating</td>
<td></td>
<td>Internal circuits are conformally coated to protect against corrosion and moisture</td>
</tr>
</tbody>
</table>

**Wiring Diagram**

**Specifications**

**Protective Functions (IEEE Device Numbers)**
- Overload (49, 51)
- Unbalance (current) (46)
- Phase reverse (current) (46)
- Phase loss (voltage) (47)
- Overfrequency (81)
- Phase loss (current) (46)
- Overcurrent (50, 51)
- Undervoltage (27)
- Ground fault (50G/N, 51G/N)
- Unbalance (voltage) (47)
- Phase reverse (voltage) (47)
- Power factor (55)
- RTD temperature (38, 49)

| Input Voltage | 65-265 Vac, 25 VA; 80-275 Vdc, 25 W |
| Power-Up Time | 800 ms at 120 Vac |
| Ride-Through Time | 100 ms minimum |
| 24-Vdc Source | 100 mA maximum |
| AC Measurements | True RMS and DFT, Peak, 16 samples/cycle, and positive and negative sequence of fundamental |
| Frequency | 50 or 60 Hz |
| Inputs | Phase current, Earth-leakage current, Phase voltage, 7 digital, 1 analog |
| Output Contacts | 5 contacts — See Product Manual |
| Approvals | CSA certified, C-Tick (Australian) |
| Communications | Allen-Bradley® DFI and Modbus® RTU (Standard); DeviceNet™, Profibus®, Ethernet (Optional) |
| Conformal Coating | Standard feature |
| Warranty | 10 years |
| Mounting: Control Unit | Surface |
| Operator Interface | Panel, Control-Unit mounted |
ARC-FLASH PROTECTION

Rapidly detects developing Arc-Flash incidents and sends a trip signal to interrupt power before significant damage occurs.

D0920 Arc Detection Unit ........................................... 90
PGR-8800 Series Arc-Flash Relay .............................................. 91
AF0500 Series Arc-Flash Relay .............................................. 93
AF0100 Series Arc-Flash Relay .............................................. 95
A0220 Series Light Sensor .................................................... 96
PGA-1100 Diode Logic ....................................................... 97

For More Information…
and to download our White Paper on Key Considerations for Selecting an Arc-Flash Relay or our Arc-Flash Energy Reduction Workbook, visit Littelfuse.com/ArcFlash
D0920 ARC DETECTION UNIT

Arc Detection Unit

Description
The D0920 Arc-Flash relay provides a simple and cost effective solution for Arc-Flash monitoring. Two light sensors can be connected directly to one relay.

Light Sensors react to light and have a 180° detection zone. Sensors are supplied with 10 or 15 m of cable. 1-2 sensors are recommended per cubicle or drawer.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact module</td>
<td>Fits into wide range of Arc-Flash applications</td>
</tr>
<tr>
<td>Trip time &lt;1 ms</td>
<td>Limits Arc-Flash damage and risk of injury</td>
</tr>
<tr>
<td>Two optical sensor cable lengths</td>
<td>Point sensors with 10 or 15 m of cable</td>
</tr>
<tr>
<td>Inputs for two sensors</td>
<td>Single Arc-Flash relay can monitor 2 sensors</td>
</tr>
<tr>
<td>Adjustable light sensitivity</td>
<td>Allows operation in bright environments and maximum sensitivity in dark environments</td>
</tr>
<tr>
<td>Service mode</td>
<td>Allows relay and sensor test without tripping system</td>
</tr>
</tbody>
</table>

Accessories

- **A0220 Light Sensors**
  Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Available with 10 or 15 m cable.

- **PGA-1100/D1100 Diode Logic Unit**
  For tripping one circuit breaker with multiple D0920 Relays

Specifications

- **Supply Voltage**
  230 V AC +15%, -30%

- **Thyristor Output**
  325 V DC from charged capacitor, nominal energy 3.5 J

- **Sensitivity**
  Adjustable 2 - 24 klux

- **Number of Sensors**
  Max. 2

- **Response Time**
  Less than 1 ms

- **Power Consumption**
  3.5 VA

- **Ambient Temperature**
  -25°C to 70°C

- **Dimensions**
  H 90 mm (3.5”); W 105 mm (4.1”); D 61 mm (2.4”)

- **Certification**
  CE, CCC

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0920.0060</td>
<td>230 V AC +15%, -30%, remains powered on after trip, slide switch instead of key switch, electronic reset button instead of mechanical reset button, CCC approved</td>
</tr>
</tbody>
</table>

Accessories

- **A0033.0010 Detector cable**
  2 x 0.25 mm² w/screen, 100 m
  Optional

- **A0220.0010 Arc Detector V-Type; 10 m cable**
  Required: At least one sensor per monitored zone

- **A0220.0020 Arc Detector V-Type; 15 m cable**
  Optional

- **PGA-1100/D1100 Diode Logic Unit**
  Optional
Arc-Flash Relay

Description
The PGR-8800 Series is a microprocessor-based relay that limits arc-fault damage by detecting the light from an arc flash and rapidly tripping. Phase-current-transformer inputs are provided for current-constrained arc-flash protection and, when so equipped, a programmable definite-time overcurrent function can be enabled. An optical sensor on the PGR-8800 and adjustable trip level reduce the chance of nuisance tripping by setting a threshold for ambient light. Sensors, inputs, and connections are monitored to ensure fail-safe operation. A secondary solid-state trip circuit provides a redundant trip path. A USB port is used for configuration and access to event logs and graphs.

Optical Sensors
The PGR-8800 accepts both PGA-LS10 and PGA-LS20/PGA-LS30 optical sensors, designed to collect light over a wide angle and with high sensitivity. For fast fault location, front-panel and sensor LED’s indicate sensor health and which sensor detected an arc fault.

Sensor Placement
The PGR-8800 Arc-Flash Relay and sensors are easily installed in retrofit projects and new switchgear with little or no re-configuration. Even elaborate systems with multiple power sources take minutes to configure using the relay’s built-in USB interface software.

Generally, it is recommended to mount 1 or 2 sensors per cubicle to cover all horizontal and vertical bus bars, breaker compartments, drawers, and anywhere that there is potential for an arc-fault. Threading a fiber-optic sensor through the cabinets and in areas where point-sensor coverage is uncertain results in complete coverage and an added level of redundancy. Even if policy is to only work on de-energized systems, all maintenance areas should be monitored to prevent potential damage and additional cost. At least one sensor should have visibility of an arc fault if a person blocks the other sensor(s).

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGR-8800-00 (UL, CE, CSA, RCM)</td>
<td>Arc-Flash Relay</td>
</tr>
<tr>
<td>PGR-8800-00-CC (UL, CE, CSA, RCM)</td>
<td>Arc-Flash Relay, Conformally Coated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGA-LS10</td>
<td>Required*</td>
</tr>
<tr>
<td>PGA-LS20, PGA-LS30</td>
<td>Required*</td>
</tr>
<tr>
<td>PGA-1100</td>
<td>Optional</td>
</tr>
<tr>
<td>Current Transformer</td>
<td>Recommended</td>
</tr>
</tbody>
</table>

*At least one sensor is required. However, the exact number of sensors for proper coverage depends on the application.
Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc-Flash trip time &lt;1 ms</td>
<td>Limits arc-flash damage and risk of injury</td>
</tr>
<tr>
<td>Multiple sensors (up to 24)</td>
<td>Single module can monitor 6 sensors. Up to 4 PGR-8800 units can be linked into one system</td>
</tr>
<tr>
<td>Fail-safe system</td>
<td>Continuous monitoring of optical sensors and inputs ensures protection</td>
</tr>
<tr>
<td>Redundant trip circuit</td>
<td>Solid-state backup arc-detection circuit adds a second layer of safety</td>
</tr>
<tr>
<td>Adjustable light sensitivity</td>
<td>Allows for operation in bright environments and maximum sensitivity in dark environments</td>
</tr>
<tr>
<td>LED indication (on unit and each sensor)</td>
<td>18 LEDs provide at-a-glance status for module and I/O state</td>
</tr>
<tr>
<td>Current detection</td>
<td>Phase-CT inputs provide overcurrent protection and prevent nuisance trips</td>
</tr>
<tr>
<td>Optical detection</td>
<td>Point and fiber-optic sensors provide wide detection area with sensor health trip indication</td>
</tr>
<tr>
<td>Digital inputs (6)</td>
<td>Two each: remote trip, inhibit, and reset inputs</td>
</tr>
<tr>
<td>Service mode</td>
<td>Allows for system test without tripping</td>
</tr>
<tr>
<td>Trip coil contact</td>
<td>Solid-state 24-300 Vdc/24-300 Vac IGBT</td>
</tr>
<tr>
<td>Indication contacts</td>
<td>Form C and status outputs</td>
</tr>
<tr>
<td>USB interface</td>
<td>Data logging and configuration software uses a USB interface with no drivers or software installation</td>
</tr>
<tr>
<td>Built-in sensor</td>
<td>Can be used in single-sensor systems, as a seventh sensor, and for calibration</td>
</tr>
<tr>
<td>Universal power supply/Battery backup</td>
<td>100-240 Vac, 14-48 Vdc, or 110-250 Vdc supply accepted. Ability to charge and run off an external, user-supplied 24 Vdc battery</td>
</tr>
<tr>
<td>Data logging</td>
<td>On-board event recorder helps with system diagnostics</td>
</tr>
<tr>
<td>Modbus</td>
<td>Remotely view measured values, event records &amp; reset trips</td>
</tr>
<tr>
<td>Upstream Tripping</td>
<td>Ability to trip upstream device if the local breaker fails to clear the fault</td>
</tr>
</tbody>
</table>

Wiring Diagram

Accessories

A PGA-LS10 Point Sensor
Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Sensor health and trip indication. Dimensions: See PGR-8800 Manual

B PGA-LS20/PGA-LS30 Fiber-Optic Sensor
360° light sensor for tricky installations with many shadows or to run along bus bars. Sensor health and trip indication. Dimensions: See PGR-8800 Manual

C PGA-1100 Diode Logic Unit
This module allows multiple PGR-8800 relays to trip the same breaker, for example an upstream or a tie-breaker. Dimensions: H 80mm (3.15”); W 20mm (0.79”); D 70mm (2.76”)

D Current Transformers
Eliminate nuisance arc-flash trips and use for overcurrent protection.

Specifications

<table>
<thead>
<tr>
<th>IEEE Device Numbers</th>
<th>Input Voltage</th>
<th>Dimensions</th>
<th>Optical Trip Settings</th>
<th>Current Trip Setting (A)</th>
<th>Indication Contact Mode</th>
<th>Trip Coil Voltage</th>
<th>Trip Coil Contact Mode</th>
<th>Redundant Trip Circuit</th>
<th>Input Monitoring</th>
<th>USB Interface</th>
<th>Trip, Reset, Service Buttons</th>
<th>Expandable System</th>
<th>Warranty</th>
<th>Mounting</th>
<th>Approvals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>100-240 Vac, 14-48 Vdc, and 110-250 Vdc</td>
<td>H 130 mm (5.1”); W 200 mm (7.9”); D 54 mm (2.1”)</td>
<td>Programmable</td>
<td>Fail-safe</td>
<td>24-300 Vdc, 24-300 Vac</td>
<td>Selectable fail-safe or non-fail-safe</td>
<td>Standard feature</td>
<td>Standard feature</td>
<td>Link up to 4 PGR-8800 units</td>
<td>Standard feature</td>
<td>5 years</td>
<td>Surface, DIN (with D0050 adapter clips)</td>
<td>UL, CE, CSA, RCM, FCC, DNV type approval, ABS type approval</td>
<td></td>
</tr>
</tbody>
</table>

NOTE (1) - Contact Littelfuse for trip coil voltages higher than 300 Vdc/Vac.

Littelfuse reserves the right to make product changes, without notice. Material in this document is as accurate as known at the time of publication. Visit Littelfuse.com for the most up-to-date information.
**Description**

The AF0500 is a microprocessor-based arc-flash relay that limits arc-fault damage by detecting the light from an arc flash and rapidly tripping the feeder breaker. The unit is well suited for switchgear, transformer and power converter applications.

Sensors, inputs, and connections are health monitored to ensure fail-safe operation. A secondary solid-state trip circuit provides a redundant trip path. A USB port is used for configuration and access to event logs.

AF0500 includes an Ethernet interface and supports Modbus® TCP communication. Zone tripping, upstream breaker tripping and tie breaker tripping applications can be easily configured.

A number of control inputs allows interconnection of multiple AF0500 units to form a system.

**Optical Sensors**

The AF0500 accepts both PGA-LS10 point sensors and PGA-LS20/PGA-LS30 fiber-optical sensors. Thus any combination of fiber or point sensors is supported.

For fast fault location, front-panel and sensor LEDs indicate sensor health and which sensor detected an arc fault.

**Sensor Placement**

The AF0500 Arc-Flash Relay and sensors are easily installed in retrofit projects and new switchgear with little or no re-configuration. Simple applications work straight out of the box with no need of PC configuration. More complex systems with multiple power sources are configured using the relay’s built-in USB interface software.

Generally, it is recommended to mount 1 or 2 sensors per cubicle to cover all horizontal and vertical bus bars, breaker compartments, drawers, and anywhere that there is a risk for an arc fault. Threading a fiber-optic sensor through the cabinets and in areas where point-sensor coverage is uncertain results in complete coverage and an added level of redundancy. Even if policy is to only work on de-energized systems, all maintenance areas should be monitored to prevent potential damage and additional cost.
Applications

Zone Tripping
AF0500 can trip 2 separate zones. Sensors can be assigned to the zones individually through PC configuration.

Tie Breaker Tripping
In case of an arc in one section of the switchboard, the AF0500 can trip both the incoming feeder and the tie breaker simultaneously. Thus the affected part of the switchboard is isolated from the non-affected part.

Upstream Breaker Tripping
In case of failure of the local circuit breaker to open, another trip command is sent after a short delay to an upstream breaker to clear the fault.

Accessories

PGA-LS10 Point Sensor
Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Includes Sensor health and trip indication.

PGA-LS20/PGA-LS30 Fiber-Optic Sensor
360° light sensor to run along bus bars. Sensor health and trip indication.

PGA-1100 Diode Logic Unit
This module allows multiple arc-flash relays to trip a common breaker, for example a tie-breaker.

Specifications

**Power Supply**
- Universal: 100 to 240 Vac (+10%, -15%) 50/60 Hz, 20 VA, 110 to 250 Vdc (+10%, -20%) 8 W
- Low Voltage: 24 to 48 Vdc (+10%, -20%), 4 W
- Sensor Inputs: 4 light sensor inputs for PGA-LS10, PGA-LS20 and PGA-LS30 sensors
- Trip Outputs: 2 IGBT switches
- UL Rating: 120/240 Vac, 1800 VA, 0.75 A maximum continuous, 125/250 Vdc, 138 VA, 0.75 A maximum continuous

**Supplemental Rating**
- Make/Carry: 30 A for 0.2 s
- Voltage Rating: 24 to 300 Vac, 24 to 300 Vdc
- Current Rating: 20 A for 2 s, 10 A for 5 s

**Communication**
- Ethernet, 2 ports with internal Ethernet switch, Modbus® TCP

**Dimensions**
- H: 130 mm (5.1”), W: 200 mm (7.9”), D: 54 mm (2.1”)

**Shipping Weight**
- 0.9 kg (2 lb)

**Operating Temp.**
- –40°C to +70°C (–40°F to 158°F)

**Approvals**
- UL Listed (UL508), CE, RCM, FCC, CSA

**Warranty**
- 5 years

**Mounting**
- Surface, DIN (with optional DO050 adapter clips)
Description

The AF0100 Series arc-flash relay is a cost-effective solution that reduces arc-fault damage by detecting the light from an arc flash and rapidly tripping. Two remote light sensors can be connected to one relay and multiple AF0100 and/or AF0500 relays can be connected to monitor additional sensors, providing complete coverage for a wide range of applications. The compact, DIN-rail or surface-mountable body makes this an ideal solution for equipment manufacturers.

Two isolated Form-C contacts are provided for applications with multiple devices that must be tripped. This is especially useful for generator applications where the generator and breaker need to be tripped in case of an arc flash.

The AF0100 accepts PGA-LS10 point sensors and PGA-LS20/PGA-LS30 fiber-optic sensors in any combination. Sensor health is continuously monitored to ensure fail-safe operation. A solid-state redundant trip circuit provides an internal fail-safe mechanism and fast arc-flash response during power up.

Front-panel and sensor LEDs indicate sensor health and fault location.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact</td>
<td>Fits into a wide range of arc-flash applications</td>
</tr>
<tr>
<td>Two optical sensor types</td>
<td>Point sensors or fiber-optic sensors can be used in any combination for coverage flexibility</td>
</tr>
<tr>
<td>Dual sensor inputs</td>
<td>One relay can monitor two arc-flash sensors</td>
</tr>
<tr>
<td>Adjustable light sensitivity</td>
<td>Allows for operation in bright environments and maximum sensitivity in dark environments</td>
</tr>
<tr>
<td>Discrete wire networking</td>
<td>Multiple AF0100 or AF0500 units can be interconnected to form a system</td>
</tr>
<tr>
<td>Fail-safe system</td>
<td>Continuous monitoring of optical sensors and inputs ensures protection</td>
</tr>
<tr>
<td>USB interface</td>
<td>Configuration software is easy to use with no drivers or software installation</td>
</tr>
<tr>
<td>Unit health</td>
<td>Ensures continuous protection with self-diagnostic and remote unit-healthy indication</td>
</tr>
<tr>
<td>LED Indication</td>
<td>Trip and sensor status indication both on relay and sensors</td>
</tr>
</tbody>
</table>

Specifications

| Input Voltage | AF0100-00: 100-240 Vac/Vdc, AF0100-10: 24-48 Vdc |
| Dimensions | H 90 mm (3.5”); W 128 mm (5.0”); D 60 mm (2.4”) |
| Trip, Error Relays | Form C, 250 Vac/30 Vdc, 6 A resistive |
| Sensitivity | 10-25 klux programmable |
| Mounting | Surface, DIN rail |
| Operating Temperature | -40°C to +70°C (-40°F to 158°F) |
| Shipping Weight | 1.0 kg (2.2 lb) |
| Certifications | Contact factory |
| Warranty | 5 years |

Accessories

PGA-LS10 Point Sensor
Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Includes sensor health and trip indication.

PGA-LS20/PGA-LS30 Fiber-Optic Sensor
360° light sensor to run along bus bars. Includes sensor health and trip indication.
**Description**

The A0220 Arc Detector is a photo electric sensor. It has a sensitive area of 180°. Sensor signal is a mA current signal of 0.5 mA/klux. The sensor includes 10 m of shielded two-wire electrical cable which can easily be shortened or extended to a maximum of 50 m. Use Belden 85240 or equivalent cable (2 x 0.50 mm²).

The sensor is compatible with the D0920, D1000 and PGR-8800 Littelfuse Arc Flash Relays.

**A0220 Sensor Installation**

The sensors include an adhesive-backed drill template for easy surface or panel-mount installation. All dimensions are shown in millimetres.

Affix the drill template where the sensor is to be mounted. Either M4 or M5 screws or pop rivets (4 mm or 5 mm) can be used.

Mounting screws are M4 for the top holes. This template matches the mounting dimensions for the A1000 or PGA-LS10 sensor.

The bottom mounting holes are either for 5mm self-drilling screws (3.5mm drill) or for M5 (4.2 mm drill). This template matches the mounting dimensions for the A0200 and A0300 sensors.

For placement of sensors please refer to the relay manual.

**Specifications**

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>0.5 mA/klux</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range for D0920</td>
<td>2 klux to 30 klux</td>
</tr>
<tr>
<td>Range for PGR-8800</td>
<td>10 klux to 30 klux</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25°C to +70°C</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP65</td>
</tr>
</tbody>
</table>

**Type Selection Table:**
A0220 Arc Detector includes 10m cable
Diode Logic

Description
The PGA-1100 Diode Logic module is an optional accessory for the Littelfuse Arc-Flash Relays.

It is used in installations with more than one breaker and more than one Arc-Flash Relay. Purpose of the unit is to separate the trip paths, so the breakers can be tripped independently from each other.

Typical applications are a switchboards with two incoming feeders and one tie breaker or switchboards with several protected zones and tripping of a common upstream circuit breaker.

The unit has three input diodes to handle the outputs of three Arc-Flash relays and three output diodes to handle the trip coils of three circuit breakers. If more than three relays/circuit breakers are needed, more units can be added by connecting terminal 8 of one box to terminal 4 of the next one, thus increasing the number of inputs and outputs with multiples of three.

For more application information please refer to the arc-flash relay manuals.

Specifications
- **Diodes**: 1000V reverse voltage, 3A continuous, 25A for 1 second
- **Certification**: CE
- **Dimensions**: H 70 mm (2.76"), W 20 mm (0.79"), D 80 mm (3.15")

Simplified Circuit Diagram

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGA-1100.0010</td>
<td>Diode logic unit</td>
</tr>
</tbody>
</table>
SWITCHING RELAYS & CONTROLS

Simple controls perform a specific function such as changing lamp intensity; vary the speed of a motor; or manage temperature of a heater.

- PHS Series  Phase Control ............................................................. 100
- SIR Series  Solid-State Relay - Isolated ........................................ 102
- SLR Series  Solid-State Relay - Non-Isolated ............................... 104
- TCR9C     Temperature Controller ................................. 106
Description
The PHS Series is an ideal method of changing lamp intensity, varying the speed of a fan/motor, or controlling the temperature of a heater. The effective output voltage is adjusted with an accessory external potentiometer suitable for line voltage applications.

Operation
Upon application of input voltage, effective output voltage can be varied by changing the external resistance value. As the external resistance increases, the effective output voltage decreases. The inverse is also true.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>External adjustment - 230VAC rated potentiometer</td>
<td>Allows control of heavy loads directly, solid state design will provide long life</td>
</tr>
<tr>
<td>Up to 20A steady state - 200A inrush</td>
<td>Allows control of heavy loads directly, solid state design will provide long life</td>
</tr>
<tr>
<td>Single hole surface mounting</td>
<td>Provides quick and easy installation</td>
</tr>
</tbody>
</table>

Accessories

P1004-174 (100kΩ 1W), P1004-175 (200kΩ 2W)
Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHS120A10</td>
<td>120VAC</td>
<td>10A</td>
</tr>
<tr>
<td>PHS120A20</td>
<td>120VAC</td>
<td>20A</td>
</tr>
<tr>
<td>PHS120A6</td>
<td>120VAC</td>
<td>6A</td>
</tr>
<tr>
<td>PHS230A10</td>
<td>230VAC</td>
<td>10A</td>
</tr>
<tr>
<td>PHS230A20</td>
<td>230VAC</td>
<td>20A</td>
</tr>
<tr>
<td>PHS230A6</td>
<td>230VAC</td>
<td>6A</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Specifications

<table>
<thead>
<tr>
<th>Output Type</th>
<th>Steady State (100% On)</th>
<th>Inrush*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>10A</td>
<td></td>
</tr>
<tr>
<td>6A</td>
<td>60A</td>
<td></td>
</tr>
<tr>
<td>10A</td>
<td>100A</td>
<td></td>
</tr>
<tr>
<td>20A</td>
<td>200A</td>
<td></td>
</tr>
</tbody>
</table>

| Minimum Load Current | 100mA               |
| Voltage Drop         | ≅ 2.0V at rated current |

| Input Voltage       | 120 or 230VAC       |
| Tolerance           | ±20%                |
| AC Line Frequency   | 50/60Hz             |

| Protection          | Dielectric Breakdown ≥ 2000V RMS terminals to mounting surface |
| Insulation Resistance | ≥100MΩ             |

| Mechanical Mounting * | Surface mount with one #10 (M5 x 0.8) screw |
| Dimensions           | H 50.8 mm (2”), W 50.8 mm (2”); D 38.4 mm (1.51”) |
| Termination          | 0.25 in. (6.35 mm) male quick connect terminals |

| Environmental Operating/Storage Temperature | -20° to 60°C / -40° to 85°C |
| Humidity | 95% relative, non-condensing |
| Weight   | 1A: ≅ 2.4 oz (68 g) |
|          | 6, 10, & 20A: ≅ 3.9 oz (111 g) |

| External Adjustment Potentiometer | 120VAC 100KΩ rated at 1W |
|                                   | 230VAC 200KΩ rated at 2W |

*Units rated ≥ 6A must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.
SIR SERIES
Solid-State Relay - Isolated

Description
The SIR Series is designed for industrial applications requiring rugged reliable operation. Provides an optically isolated, high capacity, solid-state output, with power switching capability up to 20A steady state, 200A inrush. Zero voltage switching SIR2 extends the life of an incandescent lamp up to 10 times. Random switching SIR1 is ideal for inductive loads. When fully insulated female terminals are used on the connection wires, the system meets the requirements for touch-proof connections.

Operation
The solid-state output is located between terminals 1 and 3, and is normally open or normally closed without control voltage applied to terminals 4 and 5. When control voltage is applied to terminals 4 and 5, the solid-state output opens or closes respectively.

Reset: Removing control voltage resets the output. The unit is also reset if output voltage is removed.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact design measures 2 in. (50.8mm) square</td>
<td>Perfect for OEM applications where space is limited</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration and humidity</td>
</tr>
<tr>
<td>Up to 20A, 200A inrush output rating</td>
<td>Provides direct control of heavy inductive, incandescent or resistive loads</td>
</tr>
<tr>
<td>Switching output is optically isolated from the control input</td>
<td>Provides the ability to interface between 2 different electrical circuits</td>
</tr>
<tr>
<td>SIR1 models provide random switching</td>
<td>Designed for use with resistive and incandescent loads, extending lamp life up to 10 times</td>
</tr>
<tr>
<td>SIR2 models provide zero voltage switching</td>
<td>Perfect for resistive and incandescent loads</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SWITCHING</th>
<th>CONTROL VOLTAGE</th>
<th>RATING</th>
<th>OUTPUT FORM</th>
<th>OUTPUT VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIR1A1A4</td>
<td>Random</td>
<td>9 to 30VAC or DC</td>
<td>3A</td>
<td>Normally open</td>
<td>120VAC</td>
</tr>
<tr>
<td>SIR1A20A4</td>
<td>Random</td>
<td>9 to 30VAC or DC</td>
<td>20A</td>
<td>Normally open</td>
<td>120VAC</td>
</tr>
<tr>
<td>SIR1B6B4</td>
<td>Random</td>
<td>90 to 150VAC or DC</td>
<td>6A</td>
<td>Normally closed</td>
<td>120VAC</td>
</tr>
<tr>
<td>SIR1C20B6</td>
<td>Random</td>
<td>190 to 290VAC or DC</td>
<td>20A</td>
<td>Normally closed</td>
<td>230VAC</td>
</tr>
<tr>
<td>SIR2A20A4</td>
<td>Zero voltage</td>
<td>9 to 30VAC or DC</td>
<td>20A</td>
<td>Normally open</td>
<td>120VAC</td>
</tr>
<tr>
<td>SIR2B20A4</td>
<td>Zero voltage</td>
<td>9 to 150VAC or DC</td>
<td>20A</td>
<td>Normally open</td>
<td>120VAC</td>
</tr>
<tr>
<td>SIR2B20B4</td>
<td>Zero voltage</td>
<td>90 to 150VAC or DC</td>
<td>20A</td>
<td>Normally closed</td>
<td>120VAC</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848

Wiring Diagram

For dimensional drawing see: Appendix, page 512, Figure 19.
### Specifications

**Output**
- **Type**: Optical isolation, totally solid state
- **Form**: SPST, NO or NC
- **Voltage**: 24, 120, or 230VAC
- **Tolerance**: ±20%

**Ratings**
- **Steady State**
  - Output Device
  - 3A: 30A Triac
  - 6A: 60A Triac
  - 10A: 100A Triac
  - 20A: 200A Triac
- **Inrush**
  - 50mA
- **Output Device**
  - Voltage Drop: ≅ 2.0V at rated current
  - Leakage Current (Open State): ≅ 6mA

**Input**
- **Type**: Optical isolation LED/photo transistor
- **Control Voltage**: 9 to 290VAC/DC in 3 ranges
- **Power Consumption**: ≤ 0.5W

**Protection**
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**:
  - H: 50.8 mm (2.0”)
  - W: 50.8 mm (2.0”)
  - D: 38.4 mm (1.51”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- **Operating/Storage Temperature**: -40° to 60°C / -55° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 3.9 oz (111 g)

*Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.*

### Function Diagram

![Function Diagram](image)

- **V** = Voltage
- **CV** = Control Voltage
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **R** = Reset
- **Undefined Time**

### Accessories

- **P1015-13** (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
  - These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  - Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

---

© 2023 Littelfuse, Inc.
SLR SERIES
Solid-State Relay - Non-Isolated

Description
The SLR Series has no isolation between the control switch input and the solid-state output. Select the SLR for applications where the control switch is the same voltage source as the load. Provides the noiseless, reliability and long life of a solid-state relay, without the cost of isolation circuitry. The SLR Series offers random switching and is normally used for inductive loads. When fully insulated female terminals are used on the connection wires, the system meets the requirements for touch-proof connections.

Operation
The solid-state output is located between terminals 1 and 2 and can be ordered as either normally open or normally closed, when voltage is applied and S1 is open. When S1 is closed, the solid-state output between terminals 1 and 2 closes (or opens). If S1 is opened, the solid-state output will open (or close).

Reset: Opening S1 resets the output to its original state. Reset is also accomplished by removing input voltage.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact design measures 2 in. (50.8mm) square</td>
<td>Perfect for OEM applications where space is limited</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Up to 20A steady, 200A inrush output rating</td>
<td>Provides direct control of heavy inductive, resistive, or incandescent loads</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
</tbody>
</table>

Accessories

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SWITCHING</th>
<th>INPUT VOLTAGE</th>
<th>OUTPUT RATING</th>
<th>OUTPUT FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLR1420A</td>
<td>Random</td>
<td>120VAC</td>
<td>20A</td>
<td>Normally open</td>
</tr>
<tr>
<td>SLR1610A</td>
<td>Random</td>
<td>230VAC</td>
<td>10A</td>
<td>Normally open</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 19.
SLR SERIES

Specifications

Output (Contact)

Type: Non-isolated solid state
Form: SPST, NO or NC
Voltage: 24, 120, or 230VAC
Tolerance: ±20%

<table>
<thead>
<tr>
<th>Steady State</th>
<th>Inrush*</th>
<th>Output Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>10A</td>
<td>SCR &amp; Bridge Rectifier</td>
</tr>
<tr>
<td>6A</td>
<td>60A</td>
<td>Triac</td>
</tr>
<tr>
<td>10A</td>
<td>100A</td>
<td>Triac</td>
</tr>
<tr>
<td>20A</td>
<td>200A</td>
<td>Triac</td>
</tr>
</tbody>
</table>

Minimum Load Current: ≅ 50mA
Voltage Drop: ≅ 2.0V - 6, 10, & 20A units; ≅ 2.5V - 1A units
Leakage Current (Open State): ≤ 5mA
Initiate Switch Voltage: Same as the output voltage
Power Consumption: ≤ 0.5W

Protection
Circuitry: Encapsulated
Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
Insulation Resistance: ≥ 100MΩ

Mechanical
Mounting*: Surface mount with one #10 (M5 x 0.8) screw
Dimensions: H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 38.4 mm (1.51”)
Termination: 0.25 in. (6.35 mm) male quick connect terminals

Environmental
Operating/Storage Temperature: -20° to 60°C / -40° to 85°C
Humidity: 95% relative, non-condensing
Weight: 1A units: ≅ 2.4 oz (68 g); 6, 10, 20A units: ≅ 3.9 oz (111 g)

Function Diagram

V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
R = Reset
= Undefined Time

*Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.
Description
The TCR9C of solid-state temperature control is a low cost modular approach to accurate control of temperature. The high power output is available in 20 amperes and provides setpoint temperature control. The efficient mounting surface allows for utilization of equipment as the heat sink. Designed for use with resistive loads.

Operation
Setpoint Control: TCR9C is a single setpoint temperature controller. When the thermistor resistance is high (above the setpoint), the solid-state output is ON. When the thermistor resistance decreases (temperature increases) to setpoint or below, the output turns OFF. It must be recognized that temperature differential (under and overshoot) is largely due to the system as a whole. The mass of the system, size of the heaters and sensor all play an important part. Single setpoint control is best when there is little or no lag time between heater and sensor, and when the heater is not oversized.

Features & Benefits
- NTC thermistor sensing for low cost setpoint control
- Solid-state output to control resistive heaters
- External adjustment of the setpoint
- Small package, encapsulated, single-screw mounting
- Metal mounting surface utilizes equipment as heat sink

Accessories
- P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

Specifications
Control Type
- Single setpoint, negative temperature coefficient resistance sensing

Sensor Type
- Thermistor, negative temperature coefficient (customer supplied)
- Electrically insulated for 1500V RMS min.

Adjustment
- Temperature setpoint selected by means of an external resistance
- \( \leq 5\% \) of the setpoint resistance
- Add the tolerance of the NTC thermistor and the drift of the adj. pot over temp. range

Setpoint vs. Ambient Temperature and Operating Voltage
- \( \pm 5\% \) of setpoint resistance
- \( \leq 150\text{ms} \)

Input
- Voltage: 120 - 240VAC
- Tolerance: \( \pm 15\% \)
- AC Line Frequency: 50/60 Hz
### TCR9C

**Output**
- Type: Solid state
- Form: Non-isolated, single pole, zero voltage switching

**Rating**
- Model: C
- Steady State: 20A
- Inrush*: 200A*

**Minimum Load Current**
- 100mA

**Voltage Drop**
- 2V at rated current
- 5mA @ 230VAC

**Off State Leakage Current**
- ≤2000 volts terminals to mounting surface
- ≥100mΩ

**Protection**
- Dielectric Breakdown: ≥2000 volts terminals to mounting surface
- Isolation Voltage: ≥100mΩ

**Circuitry**
- Encapsulated

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 38.4 mm (1.51”)
- Termination: 0.25 in. (6.35mm) male quick connect terminals

**Termination**
- Environmental
- Operating/Storage Temperature: -40° to 60°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: 2.7 oz (77 g)

* Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush non-repetitive for 16ms.

### Function Diagram

- V = Voltage
- L = Load
- NTC = Negative Temperature Coefficient Thermistor
- SP = Setpoint

### Adjustment vs. Thermistor Resistance

![Adjustment vs. Thermistor Resistance Graph](chart)

Note: If R<sub>T</sub> value exceeds 13kOhms, the output will not energize.
Prevent damage to motors caused by overloads, jams, phase loss or unbalance, heat from non-electric sources, heavy start-ups and excessive operational cycles. Dynamic thermal curves, as well as integrated protection, metering, and data-logging functions extend motor life and maximize process efficiency.

PGR-6100 Series  Motor Ground-Fault & Insulation Relay .... 110  
PGR-6101-120 Motor Ground-Fault & Insulation Relay .... 111  
MPU-32 Series Motor Protection Unit ......................... 112  
MPS Series Motor Protection System .......................... 114  
MPU-32-X69X Series Motor Protection Relay Retrofit Kit ...... 116  
MPS-469X Series Motor Protection Relay Retrofit Kit ...... 116  
111-Insider-P / 231-Insider-P Single-Phase Pump Monitor ......... 117  
232-Insider Single-Phase Pump Monitor ....................... 120  
111P / 233P / 233P-1.5 Series Single-Phase Pump Monitor ........ 122  
234-P Single-Phase Pump Monitor .............................. 124  
235P Single-Phase Pump Monitor .............................. 126  
MP8000 Series Bluetooth Current & Voltage Monitor ........ 128  
777 Series 3-Phase Current & Voltage Monitor ............. 132  
777 / 77C Series Single-Phase Current & Voltage Monitor .. 134  
777-KW/HP-P2 Series 3-Phase Current & Voltage Monitor ..... 136  
777-AccuPower 3-Phase Current & Voltage Monitor .......... 139  
77C-KW/HP Series Single-Phase Current & Voltage Monitor .. 140  
S10-RTD-02-00 Temperature Input Monitor ..................... 144

For More Information… and to download our Motor Protection Brochure or White Paper, click on Technical Resources at Littelfuse.com/MotorProtection

*Bluetooth is a trademark of its respective owner.
Description
The PGR-6100 combines the features of a ground-fault protection relay and insulation monitor into one unit. It protects against ground faults by monitoring insulation resistance when the motor is de-energized and by monitoring ground-fault current when the motor is energized. The PGR-6100 features two separate analog outputs for optional current and ohm meters, and two separate alarm relays. It operates on one- or three-phase solidly grounded, resistance-grounded and ungrounded systems up to 6 kV.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable GF pickup (10 mA - 3 A)</td>
<td>Trip setting provides a wide range of low-level protection and system coordination</td>
</tr>
<tr>
<td>Adjustable insulation pickup (250 kΩ - 2 MΩ)</td>
<td>Customizable insulation resistance setpoints for maximum protection</td>
</tr>
<tr>
<td>Adjustable time delay (50 ms - 1.0 s)</td>
<td>Adjustable trip delay for quick protection and system coordination</td>
</tr>
<tr>
<td>Output contacts</td>
<td>Two Form C output contacts for ground fault and insulation-resistance fault</td>
</tr>
<tr>
<td>Analog outputs (0 - 1 mA)</td>
<td>Two analog outputs indicate insulation resistance and ground-fault current</td>
</tr>
<tr>
<td>CT-Loop monitoring</td>
<td>Alarms when CT is not connected</td>
</tr>
<tr>
<td>Selectable contact operating mode</td>
<td>Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil</td>
</tr>
</tbody>
</table>

Accessories

- SE-CS30 Series Ground-Fault CTs
  Required zero-sequence current transformer specifically designed for low level detection. Flux conditioner is included to prevent saturation.

- PGH Family High Tension Couplers
  Required (for systems >1,300 V) PGH Family high-tension coupler must be connected between the phase conductor and the PGR-6100.

- PGA-0500 Analog % Current Meter PGA-0510 Analog Ohm Meter
  Optional panel-mounted meters display ground-fault current as a percentage of the set-point and insulation resistance.

Specifications

<table>
<thead>
<tr>
<th>IEEE Device Numbers</th>
<th>Ground Fault (50G/N, 51G/N), Ground detector (64), Alarm Relay (74)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>See ordering information</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 75 mm (3”), W 100 mm (3.9”), D 115 mm (4.5”)</td>
</tr>
<tr>
<td>Response delay</td>
<td>&lt; 50 ms</td>
</tr>
<tr>
<td>Contact Operating Mode</td>
<td>Selectable fail-safe or non-fail-safe</td>
</tr>
<tr>
<td>Harmonic Filtering</td>
<td>Standard feature</td>
</tr>
<tr>
<td>Test Button</td>
<td>Standard feature</td>
</tr>
<tr>
<td>Reset Button</td>
<td>Standard feature</td>
</tr>
<tr>
<td>CT-Loop Monitoring</td>
<td>Standard feature</td>
</tr>
<tr>
<td>Output Contacts</td>
<td>Two Form C</td>
</tr>
<tr>
<td>Analog Output</td>
<td>0-1 mA</td>
</tr>
<tr>
<td>Approvals</td>
<td>UL Listed (E183688)</td>
</tr>
<tr>
<td>Warranty</td>
<td>5 years</td>
</tr>
<tr>
<td>Mounting</td>
<td>DIN, Surface</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>CONTROL POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGR-6100-120</td>
<td>120 Vac</td>
</tr>
<tr>
<td>PGR-6100-240(1)</td>
<td>240 Vac</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-CS30 Series</td>
<td>Required</td>
</tr>
<tr>
<td>PGH Family</td>
<td>Required &gt;1300 V</td>
</tr>
<tr>
<td>PGA-0500</td>
<td>Optional</td>
</tr>
<tr>
<td>PGA-0510</td>
<td>Optional</td>
</tr>
</tbody>
</table>

Note (1) - PGR-6100-240 ordering option is not UL Listed. For optional conformal coating please consult factory.
Description

The PGR-6101-120 combines the features of a ground-fault protection relay and insulation monitor into one unit. It protects against ground faults by monitoring insulation resistance when the motor is de-energized and by monitoring ground-fault current when the motor is energized. The PGR-6101-120 features two separate analog outputs for optional current and ohm meters, and two separate alarm relays. It operates on one- or three-phase solidly grounded, resistance grounded and ungrounded systems up to 6 kV.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable GF pickup (30-200 mA)</td>
<td>Trip setting provides a wide range of low-level protection and system coordination</td>
</tr>
<tr>
<td>Adjustable insulation pickup (60-600 kΩ)</td>
<td>Customizable insulation resistance setpoints for maximum protection</td>
</tr>
<tr>
<td>Adjustable time delay (50-250 ms)</td>
<td>Adjustable trip delay for quick protection and system coordination</td>
</tr>
<tr>
<td>Output contacts</td>
<td>Two Form C output contacts for ground fault and insulation-resistance fault</td>
</tr>
<tr>
<td>Analog outputs (0-1 mA)</td>
<td>Two analog outputs indicate insulation resistance and ground-fault current</td>
</tr>
<tr>
<td>CT-Loop monitoring</td>
<td>Alarms when CT is not connected</td>
</tr>
<tr>
<td>Selectable contact operating mode</td>
<td>Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil</td>
</tr>
</tbody>
</table>

Accessories

- **SE-CS30 Series Ground-Fault Transformers**
  Required zero-sequence current transformer specifically designed for low level detection. Flux conditioner is included to prevent saturation.

- **PGH Family High Tension Couplers**
  Required (for systems >1,300 V) PGH Family high-tension coupler must be connected between the phase conductor and the PGR-6101-120.

- **PGA-0500 Analog % Current Meter**
  Optional panel-mounted meters display ground-fault current as a percentage of the set-point and insulation resistance.

Specifications

- **IEEE Device Numbers**
  Ground Fault (50G/N, 51G/N), Ground detector (64), Alarm Relay (74)
- **Input Voltage**
  120 Vac
- **Dimensions**
  H 75 mm (3”), W 100 mm (3.9”), D 115 mm (4.5”) < 50 ms
- **Response delay**
  Selectable fail-safe or non-fail-safe
- **Contact Operating Mode**
  Standard feature
- **Harmonic Filtering**
  Standard feature
- **Test Button**
  Standard feature
- **Reset Button**
  Standard feature
- **CT-Loop Monitoring**
  Standard feature
- **Output Contacts**
  Two Form C
- **Analog Output**
  0-1 mA
- **Approvals**
  UL Listed (E183688)
- **Warranty**
  5 years
- **Mounting**
  DIN, Surface

Ordering Information

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-CS30 Series</td>
<td>Required</td>
</tr>
<tr>
<td>PGH Family</td>
<td>Required &gt;1300 V</td>
</tr>
<tr>
<td>PGA-0500</td>
<td>Optional</td>
</tr>
<tr>
<td>PGA-0510</td>
<td>Optional</td>
</tr>
</tbody>
</table>

For optional conformal coating please consult factory.
Motor Protection – Advanced

MPU-32 SERIES (PGR-6200)
Motor Protection Unit

Description
The MPU-32 Motor Protection Unit is used to provide current- and temperature-based protection, metering, and data logging for three-phase low-voltage medium-horsepower induction motors. This relay is ideal for retrofitting and upgrading obsolete or aging motor protection using existing CTs. See the PMA Family of Panel Mount Adapter Kits to replace common obsolete relays.

Motor Protection Unit
- Three ac-current inputs
- Earth-leakage-CT input
- Programmable digital input
- 24-Vdc source for digital input
- Programmable 4-20-mA analog output
- On-board temperature-sensor input,
- 100-Ω-Platinum RTD or PTC
- Three programmable output relays
- Local RS-232 communications, optional Network Communications
- PC-interface software (SE-Comm-RIS)
- 4 line x 20 character backlit LCD display
- Keypad for programming and display selection
- 4 LEDs; 1 user programmable

Current Input Module (MPU-CIM)
The MPU-CIM Current Input Module is the interface between the MPU-32 relay and the 5-A-secondary, 1-A-secondary, and sensitive current transformers. The MPU-CIM is ordered separately from the MPU-32 and can be surface or DIN-rail mounted. Wire-clamping terminals are standard, but the MPU-CTI is available for those who require ring-tongue terminals.

Accessories

Phase Current Transformers
Phase CTs are required to detect phase currents. For upgrade applications, existing CTs can be used.

Ground-Fault Current Transformer
Optional zero-sequence current transformer detects ground-fault current. Available with 5-A and 30-A primary ratings for low-level pickup.

MPS-RTD Temperature Input Module
Optional module provides 8 inputs to connect Pt100, Ni100, Ni120, and Cu10 RTDs.

MPS-DIF Differential Current Module
Optional motor differential protection, compatible with core balance and summation current transformer connections.

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>COMMUNICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPU-32-00-00</td>
<td>TIA-232</td>
</tr>
<tr>
<td>MPU-32-01-00</td>
<td>TIA-232 &amp; TIA-485</td>
</tr>
<tr>
<td>MPU-32-02-00</td>
<td>TIA-232 &amp; DeviceNet™</td>
</tr>
<tr>
<td>MPU-32-04-00</td>
<td>TIA-232 &amp; EtherNet/IP™ &amp; Modbus® TCP</td>
</tr>
</tbody>
</table>

NOTE: One of the following is required: MPU-CIM-00-00 Current Input Module, or MPU-CTI-RT-00 Current Input Module with ring-tongue terminals.

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase CTs</td>
<td>Required</td>
</tr>
<tr>
<td>MPS-RTD-01-00</td>
<td>Optional</td>
</tr>
<tr>
<td>MPS-DIF-01-00</td>
<td>Optional</td>
</tr>
<tr>
<td>MPU-32-SMK</td>
<td>Optional</td>
</tr>
<tr>
<td>CA-945</td>
<td>Optional</td>
</tr>
<tr>
<td>MPU-16A-Y92A-96N</td>
<td>Optional</td>
</tr>
</tbody>
</table>

Simplified Circuit Diagram
Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>IEEE #</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload</td>
<td>49, 51</td>
<td>Extends motor life and prevents insulation failures and fires</td>
</tr>
<tr>
<td>Dynamic thermal model</td>
<td></td>
<td>Provides protection through starting, running, and cooling cycles</td>
</tr>
<tr>
<td>Communications</td>
<td></td>
<td>Remotely view measured values and event records, reset trips, and access setpoints</td>
</tr>
<tr>
<td>Ground fault</td>
<td>50G/N, 51G/N</td>
<td>Prevents catastrophic failures and fires</td>
</tr>
<tr>
<td>Current unbalance/Phase loss/Phase reverse</td>
<td>46</td>
<td>Prevents overheating due to unbalanced phases</td>
</tr>
<tr>
<td>RTD temperature</td>
<td>38, 49</td>
<td>RTD temperature protection (MPS-RTD module) for high-ambient or loss-of-ventilation protection</td>
</tr>
<tr>
<td>Phase loss/Phase reverse (current)</td>
<td>46</td>
<td>Detects unhealthy supply conditions</td>
</tr>
<tr>
<td>Overcurrent</td>
<td>50, 51</td>
<td>Prevents catastrophic failures and fires; extends motor life</td>
</tr>
<tr>
<td>Jam</td>
<td></td>
<td>Prevents motor damage by detecting mechanical jams or excessive loading</td>
</tr>
<tr>
<td>Undercurrent</td>
<td>37</td>
<td>Detects low level or no-load conditions</td>
</tr>
<tr>
<td>PTC overtemperature</td>
<td>49</td>
<td>Overtime (PTC) protection for high-ambient or loss-of-ventilation detection</td>
</tr>
<tr>
<td>Starts per hour</td>
<td>66</td>
<td>Limits the motor starts per hour to prevent overheating</td>
</tr>
<tr>
<td>Differential</td>
<td>87</td>
<td>Optional MPS-DIF module for sensitive winding-fault protection</td>
</tr>
<tr>
<td>Reduced overcurrent mode</td>
<td></td>
<td>Minimizes arc-flash hazards during maintenance</td>
</tr>
<tr>
<td>Metering</td>
<td></td>
<td>View measured and calculated parameters with on-board display</td>
</tr>
<tr>
<td>MPU-CIM</td>
<td></td>
<td>Separate current input module to reduce risk of open-CT hazard and for convenient installation</td>
</tr>
<tr>
<td>Analog output</td>
<td></td>
<td>Provides means for metering selectable parameters</td>
</tr>
<tr>
<td>Data logging</td>
<td></td>
<td>On-board 100-event recorder for data logging</td>
</tr>
<tr>
<td>Conformal coating</td>
<td></td>
<td>Internal circuits are conformally coated to protect against corrosion and moisture</td>
</tr>
</tbody>
</table>

Specifications

Protective Functions
(IEEE Device Numbers)
- Overload (49, 51)
- RTD temperature (38, 49)
- Phase reverse (current) (46)
- Unbalance (current) (46)
- Overcurrent (50, 51)
- Starts per hour (66)
- Jam
- Differential (87)
- Ground fault (50G/N, 51G/N)
- PTC overtemperature (49)
- Phase loss (current) (46)
- Undercurrent (37)

- Power-Up Time: 800 ms at 120 Vac
- Ride-Through Time: 100 ms minimum
- 24-Vdc Source: 100 mA maximum
- AC Measurements: True RMS and DFT, Peak, 16 samples/cycle, and positive and negative sequence of fundamental
- Frequency: 50, 60 Hz or ASD
- Output Contacts: Three Form C programmables
- Communications: TIA-232 (standard), TIA-485, DeviceNet™, Ethernet (optional)
- Analog Output: 4-20 mA, programmable
- Conformally Coated: Standard feature
- Warranty: 10 years
- Mounting: Panel (standard)
- (Control Unit) Surface (with MPU-32-SMK converter kit)
- (Current Input Module) DIN, Surface
- Approvals: CSA certified, CE (European Union), UL Recognized, C-Tick (Australian)
Motor Protection System

Description
The MPS Motor Protection System monitors voltage, current, and temperature to provide a comprehensive package of 22 protective functions. The MPS is a modular system with integrated protection, motor control, metering, and data-logging functions. This system is typically used to provide protection for three-phase low- and medium-voltage, medium- to high-horsepower induction motors.

1 Operator Interface (MPS-OPI)
- Large, bright, 4 x 20 vacuum-fluorescent display
- Display metered values
- Access set points
- Powered by Control Unit
- Panel mount or attach directly to Control Unit
- Remote mounting (1.2 km or 4000 ft maximum loop length)
- ½ DIN size
- Hazardous-location certified

2 Control Unit (MPS-CTU)
- Current inputs—5-A or 1-A secondary phase current transformers
- Voltage inputs—up to 600 V without PTs
- Earth-leakage input—5-A or 1-A secondary or sensitive transformer
- Tachometer (high-speed pulse) input
- 8 digital inputs, 5 relay outputs, 1 analog input and output
- 24-Vdc supply for OPI and RTD modules, and for digital inputs
- IRIG-B time-code input
- ½ DIN size, surface mount
- RS-485 network communications (Standard)
- DeviceNet™, Profinet®, or Ethernet communications available

Accessories

- **Phase Current Transformers**
  - Phase CTs are required to detect phase currents.

- **Ground-Fault Current Transformer**
  - Required zero-sequence current transformer detects ground-fault current. Available with 5-A and 30-A primary ratings for low-level pickup.

- **MPS-RTD Temperature Input Module**
  - Optional module provides 8 inputs to connect Pt100, Ni100, Ni120, and Cu10 RTDs.

- **MPS-DIF Differential Current Module**
  - Optional motor differential protection, compatible with core balance and summation current transformer connections.
Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>IEEE #</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload</td>
<td>49, 51</td>
<td>Extends motor life and prevents insulation failures and fires</td>
</tr>
<tr>
<td>Current unbalance/Phase loss/Phase reverse</td>
<td>46</td>
<td>Prevents overheating and extends motor life</td>
</tr>
<tr>
<td>Overcurrent/Jam</td>
<td>50, 51</td>
<td>Prevents catastrophic failures and fires and extends motor life</td>
</tr>
<tr>
<td>Undercurrent</td>
<td>37</td>
<td>Detects low-level or no-load conditions</td>
</tr>
<tr>
<td>Ground fault</td>
<td>50G/N, 51G/N</td>
<td>Prevents catastrophic failures and fires</td>
</tr>
<tr>
<td>RTD temperature</td>
<td>38, 49</td>
<td>Optional RTD temperature protection (MPS-RTD module) for high ambient or loss of ventilation protection</td>
</tr>
<tr>
<td>Overvoltage</td>
<td>59</td>
<td>Prevents stress to insulation</td>
</tr>
<tr>
<td>Undervoltage</td>
<td>27</td>
<td>Prevents a start attempt when it will damage the motor</td>
</tr>
<tr>
<td>Voltage unbalance</td>
<td>47</td>
<td>Detects unhealthy supply voltage</td>
</tr>
<tr>
<td>Phase differential</td>
<td>87</td>
<td>Provides sensitive protection for high-resistance winding faults</td>
</tr>
<tr>
<td>Dynamic thermal mode</td>
<td></td>
<td>Provides protection through starting, running, overload, and cooling cycles</td>
</tr>
<tr>
<td>Reduced overcurrent mode</td>
<td></td>
<td>Minimizes Arc-Flash hazards during maintenance</td>
</tr>
<tr>
<td>Starter control</td>
<td></td>
<td>Simplifies the installation by reducing component count</td>
</tr>
<tr>
<td>Metering</td>
<td></td>
<td>Displays the measured and calculated motor parameters</td>
</tr>
<tr>
<td>Data logging</td>
<td></td>
<td>On-board 64-event recorder helps with system diagnosis</td>
</tr>
<tr>
<td>Communications</td>
<td></td>
<td>Remotely view measured values, event records &amp; reset trips</td>
</tr>
<tr>
<td>Conformal coating</td>
<td></td>
<td>Internal circuits are conformally coated to protect against corrosion and moisture</td>
</tr>
</tbody>
</table>

Specifications

- **Protective Functions (IEEE Device Numbers):**
  - Overload (49, 51)
  - Unbalance (current) (46)
  - Phase reverse (current) (46)
  - Underfrequency (81)
  - Overfrequency (81)
  - Overcurrent (50, 51)
  - Phase loss (voltage) (47)
  - Jam (50, 51)
  - Overvoltage (59)
  - Underfrequency (81)
  - Differential (87)
  - Ground fault (50G/N, 51G/N)
  - Phase loss (current) (46)
  - Undercurrent (37)
  - Undervoltage (27)
  - Unbalance (voltage) (47)
  - Phase reverse (voltage) (47)
  - Failure to accelerate (RTD temperature (38, 49), Power factor (55))

- **Input Voltage:** 65-265 Vac, 25 VA; 80-275 Vdc, 25 W
- **Power-Up Time:** 800 ms at 120 Vac
- **Ride-Through Time:** 100 ms minimum
- **24-Vdc Source:** 100 mA maximum
- **AC Measurements:** True RMS and DFT, Peak, 16 samples/cycle, and positive and negative sequence of fundamental 50, 60 Hz or ASD
- **Frequency Inputs:** Phase current, Earth-leakage current, Phase voltage, 7 digital, tachometer, 1 analog
- **Output Contacts:** 5 contacts — See Product Manual
- **Approvals:** CSA Certified, RCM (Australian), UL Recognized
- **Communications:** Allen-Bradley® DFI and Modbus® RTU (Standard); DeviceNet™, Profinet®, Ethernet (Optional)
- **Conformal Coating:** Standard feature
- **Warranty:** 10 years
- **Mounting (Control Unit):** Surface
- **Mounting (Operator Interface):** Panel, Control-Unit mounted
## MOTOR & PUMP PROTECTION

### MPU-32-X69X (PGR-6210) SERIES / MPS-469X (PGR-6310) SERIES

### Motor Protection Retrofit Kits

**1 MPU-32-X69X**

Littelfuse Startco retrofit kits are an excellent choice for upgrading motor protection, providing current- and temperature-based protection, metering, and data logging.

The MPU-32-X69X Motor Protection Retrofit Kit is designed to replace GE Multilin 169, 269, and 369 relays. It includes the MPU-32 Motor Protection Relay, MPU-CIM Current Input Module, and optional MPS-RTD Temperature Input Modules, which are pre-wired on a panel. The kit fits in the existing space and typically can utilize existing current transformers and wiring to simplify the upgrade procedure.

**2 MPS-469X**

The MPS-469X Motor Protection Retrofit Kit replaces the GE Multilin 469 relay. It includes the MPS Motor Protection System and optional RTD and differential modules mounted on a panel that can be installed in the existing 469 cutout. Existing current transformer and wiring can be utilized, simplifying the upgrade procedure.

### Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting</td>
<td>Fits in existing mounting holes and panel openings</td>
</tr>
<tr>
<td>Quick installation</td>
<td>Existing CTs and RTDs can be used to reduce installation time</td>
</tr>
<tr>
<td>Factory tested</td>
<td>100% factory-tested, pre-assembled components ensure reliability</td>
</tr>
<tr>
<td>Communications</td>
<td>Add communications capability to older switchgear and improve system performance</td>
</tr>
<tr>
<td>Microprocessor based</td>
<td>No calibration required saves on maintenance cost</td>
</tr>
<tr>
<td>Reduced overcurrent mode</td>
<td>Maintenance mode setting to reduce the risk of Arc-Flash Hazards</td>
</tr>
<tr>
<td>Conformal coating</td>
<td>Protects circuit boards against corrosion and moisture</td>
</tr>
<tr>
<td>Additional protection</td>
<td>Additional protective functions, including dynamic thermal model and ability to match existing overcurrent curves</td>
</tr>
</tbody>
</table>

### MPU-32-X69X Ordering Information

<table>
<thead>
<tr>
<th>RTD INPUTS</th>
<th>MPU-32 COMMUNICATIONS</th>
<th>GROUND-FAULT CT</th>
<th>FUTURE OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPU-32-X69X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>0</td>
<td>One Platinum 100 Ω</td>
<td>0 = TIA232</td>
<td>0 = Wired for Sensitive Ground-Fault CT (50 mA Secondary)</td>
</tr>
<tr>
<td>1</td>
<td>One Platinum 100 Ω and 8-input MPS-RTD Module</td>
<td>1 = TIA232 &amp; TIA485</td>
<td>1 = Wired for 1- or 5-A Secondary Ground-Fault CT</td>
</tr>
<tr>
<td>2</td>
<td>TIA232 &amp; DeviceNet</td>
<td>2 = TIA232 &amp; DeviceNet</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>TIA232 &amp; Ethernet</td>
<td>4 = TIA232 &amp; Ethernet</td>
<td></td>
</tr>
</tbody>
</table>

### MPS-469X Ordering Information

<table>
<thead>
<tr>
<th>MODULE CONFIGURATION</th>
<th>MPS COMMUNICATIONS</th>
<th>FUTURE OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPS-469X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>0</td>
<td>None</td>
<td>1 = RS485</td>
</tr>
<tr>
<td>1</td>
<td>One MPS-RTD Module</td>
<td>2 = RS485 &amp; DeviceNet</td>
</tr>
<tr>
<td>2</td>
<td>Two MPS-RTD Modules</td>
<td>3 = RS485 &amp; Profibus</td>
</tr>
<tr>
<td>3</td>
<td>One MPS-DIF Module</td>
<td>4 = RS485 &amp; Ethernet</td>
</tr>
<tr>
<td>4</td>
<td>One MPS-RTD Module and One MPS-DIF Module</td>
<td></td>
</tr>
</tbody>
</table>
Motor and Pump Protection

111-INSIDER-P / 231-INSIDER-P

Single-Phase Pump Monitor

**Description**

The Littelfuse 111-Insider-P single-phase products fit inside 1/3 and 1/2, 115V control boxes and the 231-Insider-P fits inside 1/3 1/2, 3/4, and 1 hp, 230V control boxes. Both models are designed to protect single-phase pumps from dry-well, dead-head, jammed impeller, rapid-cycle, overvoltage, and undervoltage conditions.

A calibration adjustment allows the Insider to be calibrated to your specific pumping applications, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations, overcurrent, and undercurrent. When an abnormality, such as loss of suction is detected, the product deactivates its output relay and directly disconnects the pump motor. The unit then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the unit reacts activate its output relay and turns the pump back on. By leaving the restart delay knob in the reset position, the unit will operate in manual reset mode.

The Insider communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults. An IR Kit-12 (12” fiber optic kit) is included with each Insider, allowing the Informer to access these parameters even when the Insider is enclosed in a control box. This is valuable for troubleshooting the pump while it is running.

**Accessories**

- **Informer**
  A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system. Includes the Informer IR Kit-12

- **Informer IR Kit-12**
  12” infrared adapter cable attaches to the face of the unit to provide remote diagnostics without opening the panel. Included with the Informer

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of voltage and current protects pumps from dry-well, dead-head, jammed impeller, rapid cycling, and voltage faults</td>
</tr>
<tr>
<td>Onboard sensitivity adjustment</td>
<td>Allows user to adjust the current sensitivity for the dry-well / dead-head trip point from 70% - 90% of the full load</td>
</tr>
<tr>
<td>Adjustable restart delay</td>
<td>Allows user to select well recovery time delay after a dry-well condition occurs, or to select manual reset</td>
</tr>
<tr>
<td>Built in IR communications link</td>
<td>Used with the Informer, allows user to see stored faults, run time, and also troubleshoot the pump while it’s running</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides status and diagnostics for troubleshooting</td>
</tr>
</tbody>
</table>

**Wiring Diagrams**

See next page.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>111-Insider-P</td>
<td>115VAC</td>
<td>1/3 - 1/2 hp, includes IR Kit-12</td>
</tr>
<tr>
<td>231-Insider-P</td>
<td>230VAC</td>
<td>1/3 - 1 hp, includes IR Kit-12</td>
</tr>
</tbody>
</table>
Specifications

Functional Specifications
Adjustments/Settings
Overcurrent 125% of calibration point
Underload (dry-well) Adjustable (70 to 90% of calibrated run power)
Overvoltage
111-Insider-P 132.5VAC
231-Insider-P 265VAC
Undervoltage
111-Insider-P 95VAC
231-Insider-P 190VAC
Number of restarts allowed in a 60-sec. period
(rapid-cycling) 4
Trip Delay Times
Overcurrent 5 seconds
Dry-well 4 seconds
Restart Delay Times
Over/Undervoltage 2 seconds
All other faults Manual, 2-225 minutes

Input Characteristics
Supply Voltage
111-Insider-P 115VAC
231-Insider-P 230VAC
Load Range
111-Insider-P ½ – ½ hp
231-Insider-P ½ – 1 hp
Frequency
50*/60Hz

Output Characteristics
Output Contact Rating-SPST
111-Insider-P ½hp@120VAC (17 amps max.)
231-Insider-P 1hp@ 240VAC (17 amps max.)

General Characteristics
Operating Temperature
-40° to 60° C (-40° to 140° F)
Maximum Input Power 5 W
Safety Marks
UL508, C22.2 No. 14
Weight
10 oz.
Mounting Methods
Inside a Pentek®, Franklin™, CentriPro™, Flint and Walling™, and Grundfos®*** control box

Input Characteristics
Supply Voltage
111-Insider-P 115VAC
231-Insider-P 230VAC
Load Range
111-Insider-P ½ – ½ hp
231-Insider-P ½ – 1 hp
Frequency
50*/60Hz

Output Characteristics
Output Contact Rating-SPST
111-Insider-P ½hp@120VAC (17 amps max.)
231-Insider-P 1hp@ 240VAC (17 amps max.)

General Characteristics
Operating Temperature
-40° to 60° C (-40° to 140° F)
Maximum Input Power 5 W
Safety Marks
UL508, C22.2 No. 14
Weight
10 oz.
Mounting Methods
Inside a Pentek®, Franklin™, CentriPro™, Flint and Walling™, and Grundfos®*** control box

Wiring Diagrams

PENTEK® CONTROL BOX WIRING DIAGRAM

FRANKLIN™ CONTROL BOX WIRING DIAGRAM

*Note: 50Hz will increase all delay timers by 20%

**The 111-Insider-P and 231-Insider-P are approved by UL for use in the Franklin™, Pentek®, and CentriPro™ type 3R control boxes when installed as described in the installation instructions. The 111-Insider-P and 231-Insider-P are not intended to provide overload protection, and should be used with thermally or impedance protected motors only.

***Grundfos control boxes manufactured after mid 2014.
MOTOR & PUMP PROTECTION

119-INSIDER-P / 231-INSIDER-P

**CENTRIPRO™ CONTROL BOX WIRING DIAGRAM**

- **ORANGE**
- **BLUE**
- **BLACK**
- **RED**
- **YELLOW**

**FLINT AND WALLING™ CONTROL BOX WIRING DIAGRAM**

- **ORANGE**
- **CAPACITOR**
- **BLUE**
- **BLACK**
- **YELLOW**
- **RED**

**GRUNDFOS® CONTROL BOX* WIRING DIAGRAM**

- **ORANGE**
- **CAPACITOR**
- **BLUE**
- **BLACK**
- **YELLOW**
- **RED**

For installation instructions see the Fresh Water Pumping Catalog at www.Littelfuse.com/PumpProtection

* For boxes manufactured in mid 2014 or later. See 232-INSIDER on next page for boxes manufactured prior to mid 2014.
Single-Phase Pump Monitor

Description
The Model 232-Insider single-phase PumpSaver® fits inside 1/3, 1/2, 3/4, and 1hp, 230V Grundfos control boxes manufactured prior to mid 2014. The PumpSaver® Model 232-Insider is a pump monitor designed to protect single-phase pumps from dry-well, dead-head, jammed impeller, overvoltage and undervoltage conditions. Typical applications include residential water wells, commercial water wells, irrigation wells, and golf course systems.

A calibration adjustment allows the 232-Insider to be calibrated to your specific pumping application, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations, overcurrent, and undercurrent. When an abnormality, such as loss of suction is detected, the 232-Insider deactivates its output relay and directly disconnects the pump motor. The 232-Insider then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the 232-Insider reactivates its output relay and turns the pump back on. By leaving the restart delay knob in the reset position, the 232-Insider will operate in manual reset mode.

The Insider communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults. This is valuable for troubleshooting the pump while it is running.

Note: The use of flow restrictors or unusually high head pressures at the time of calibration may interfere with the detection of dead-head conditions. Contact Littelfuse for information on a product to fit these applications.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of voltage and current protects pumps from dry-well, dead-head, jammed impeller, and voltage faults</td>
</tr>
<tr>
<td>Adjustable restart delay</td>
<td>Allows user to select well recovery time delay after a dry-well condition occurs, or to select manual reset</td>
</tr>
<tr>
<td>Built in IR communications link</td>
<td>Used with the Informer, allows user to see stored faults, run time, and also troubleshoot the pump while it’s running</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides status and diagnostics for troubleshooting</td>
</tr>
</tbody>
</table>

Accessories

Informer
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system.

For installation instructions see the Install Bulletin.
### Specifications

#### Functional Adjustments/Settings
- Overcurrent: 125% of calibration point
- Underload (dry-well): Approx. 80% of calibration point
- Underload (dry-well) with high sensitivity jumper removed: Approx. 87% of calibration point
- Overvoltage: 265VAC
- Undervoltage: 190VAC
- Trip Delay Times:
  - Overcurrent: 5 seconds
  - Dry-well: 4 seconds
- Restart Delay Times:
  - Over/undervoltage: 2 seconds
  - All other faults: Manual, 2-225 minutes

#### Input Characteristics
- Supply Voltage: 230VAC
- Load Range: ¼ – 1 hp
- Frequency: 50*/60Hz

#### Output Characteristics
- Output Contact Rating-SPST: 1hp@240VAC (17 amps max.)

#### General Characteristics
- Operating Temperature: -40° to 60° C (-40° to 140° F)
- Maximum Input Power: 5 W
- Safety Marks: UL, CSA
- UL: UL508
- CSA: C22.2 No. 14
- Weight: 10 oz.
- Mounting Methods: Grundfos® Control Box manufactured prior to mid 2014

---

*Note: 50 Hz will increase all delay timers by 20%*
Motor and Pump Protection

Description
The Littelfuse Models 111P (115 volt, \(\frac{1}{3}\) to 1hp); 233P-1.5 (230 volt, \(\frac{1}{3}\) to 1.5hp); and 233P (230 volt, \(\frac{1}{3}\) to 3hp) protect pumps from dry-well, dead-head, jammed impeller, overvoltage/undervoltage conditions and now rapid-cycle protection whether the pressure switch is mounted before or after our unit.

A calibration adjustment allows the unit to be calibrated to your specific pumping applications, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations, overcurrent, and undercurrent. When an abnormality, such as loss of suction is detected, the unit deactivates its output relay and directly disconnects the pump motor. The unit then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the unit reactivates its output relay and turns the pump back on.

The infrared LED communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults.

Special considerations for pump cables larger than #10 AWG:
In some cases where larger motors are installed with deep set pumps, pump cables are used that exceed the relay’s terminal size. In these conditions, a short splice of #10 AWG or #12 AWG may be a solution at the control box. Note: All local, state and national electric codes should be followed when applying this solution.

NOTE: The 111P/233P/233P-1.5 models have a sensitivity adjustment for the dry-well trip point. After calibration is done, you can adjust the sensitivity for the dry-well/dead-head trip point from 70-90% of the full load. This makes the unit even more adaptable to varying pumping applications. If you have a very low producing well, you increase the sensitivity closer to the 90% mark, or if you have a very heavy producing well, you would decrease the sensitivity around the 70% mark.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of voltage, power factor, current for reliable pump protection</td>
</tr>
<tr>
<td>Onboard calibration process</td>
<td>Calibrates unit to your specific individual pumping application and reduces nuisance tripping</td>
</tr>
<tr>
<td>Onboard sensitivity adjustment</td>
<td>User adjustable sensitivity knob makes the unit more adaptable to varying pumping applications</td>
</tr>
</tbody>
</table>

Accessories

Informer
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system.

For dimensional drawing see: Appendix page 511, Figure 15.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>111P</td>
<td>115VAC</td>
<td>Load Range: (\frac{1}{3}) - 1hp</td>
</tr>
<tr>
<td>111P-ENCL</td>
<td>115VAC</td>
<td>111P with NEMA3R enclosure</td>
</tr>
<tr>
<td>233P</td>
<td>230VAC</td>
<td>Load Range: (\frac{1}{3}) - 3hp</td>
</tr>
<tr>
<td>233P-ENCL</td>
<td>230VAC</td>
<td>233P with NEMA3R enclosure</td>
</tr>
<tr>
<td>233P-1.5</td>
<td>230VAC</td>
<td>Load Range: (\frac{1}{3}) - 1.5hp</td>
</tr>
<tr>
<td>233P-1.5-ENCL</td>
<td>230VAC</td>
<td>233P-1.5 with NEMA3R enclosure</td>
</tr>
</tbody>
</table>
### Specifications

#### Functional Specifications

<table>
<thead>
<tr>
<th>Category</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustments/Settings</td>
<td>125% of calibration point</td>
</tr>
<tr>
<td>Overcurrent</td>
<td>Adjustable (70 to 90% of calibrated run power)</td>
</tr>
<tr>
<td>Underload (dry-well)</td>
<td>132.5VAC</td>
</tr>
<tr>
<td>Overvoltage</td>
<td>265VAC</td>
</tr>
<tr>
<td>Undervoltage</td>
<td>95VAC</td>
</tr>
<tr>
<td>233P, 233P-1.5</td>
<td>190VAC</td>
</tr>
<tr>
<td>Number of restarts allowed</td>
<td>4</td>
</tr>
<tr>
<td>in a 60-sec. period</td>
<td></td>
</tr>
<tr>
<td>(rapid-cycling)</td>
<td></td>
</tr>
<tr>
<td>Trip Delay Times</td>
<td></td>
</tr>
<tr>
<td>Overcurrent</td>
<td>5 seconds</td>
</tr>
<tr>
<td>Dry-well</td>
<td>4 seconds</td>
</tr>
<tr>
<td>Restart Delay Times</td>
<td></td>
</tr>
<tr>
<td>Over/undervoltage</td>
<td>2 seconds</td>
</tr>
<tr>
<td>All other faults</td>
<td>Manual, 2-225 Minutes</td>
</tr>
</tbody>
</table>

#### Input Characteristics

<table>
<thead>
<tr>
<th>Supply Voltage</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>111P</td>
<td>115VAC</td>
</tr>
<tr>
<td>233P, 233P-1.5</td>
<td>230VAC</td>
</tr>
<tr>
<td>Load Range:</td>
<td></td>
</tr>
<tr>
<td>111P</td>
<td>¹⁄₃ - 1 hp</td>
</tr>
<tr>
<td>233P, 233P-1.5</td>
<td>¹⁄₃ - 1.5 hp</td>
</tr>
<tr>
<td>233P</td>
<td>¹⁄₄ - 3 hp</td>
</tr>
<tr>
<td>Frequency</td>
<td>50*/60Hz</td>
</tr>
</tbody>
</table>

#### Output Characteristics

<table>
<thead>
<tr>
<th>Output Contact Rating-SPST</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>111P</td>
<td>1hp@120VAC (16 amps max.)</td>
</tr>
<tr>
<td>233P-1.5</td>
<td>1.5hp@240VAC (10 amps max.)</td>
</tr>
<tr>
<td>233P</td>
<td>3hp@240VAC (17 amps max.)</td>
</tr>
</tbody>
</table>

#### General Characteristics

<table>
<thead>
<tr>
<th>Operating Temperature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Input Power</td>
<td>5 W</td>
</tr>
<tr>
<td>Wire Gauge</td>
<td>Solid or Stranded 10 - 22AWG</td>
</tr>
<tr>
<td>Terminal Torque</td>
<td>13 in.-lbs.</td>
</tr>
<tr>
<td>Safety Marks</td>
<td>cUL Listed</td>
</tr>
<tr>
<td>cUL Listed</td>
<td>UL508, C22.2 No. 14</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 73.66 mm (2.9&quot;), W 133.35 mm (5.25&quot;), D 73.99 mm (2.913&quot;)</td>
</tr>
<tr>
<td>Weight</td>
<td>14 oz.</td>
</tr>
<tr>
<td>Mounting Methods</td>
<td>#8 screws</td>
</tr>
</tbody>
</table>

*Note: 50Hz will increase all delay timers by 20%
Description

The PumpSaver® Model 234-P is designed to be mounted inside a Grundfos® control box to protect 1/3 – 3hp, 2- or 3-wire, 230V pumps. The Model 234-P protects single-phase pumps from dry-well, dead-head, rapid-cycle, jammed-impeller, and over/undervoltage conditions. Typical applications include residential waterwells, commercial waterwells, irrigation wells, and golf course and other sprinkler systems.

A calibration adjustment allows the 234-P to be calibrated to your specific pumping applications, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations, overcurrent, and undercurrent. When an abnormality, such as loss of suction is detected, the 234-P deactivates its output relay and directly disconnects the pump motor. The 234-P then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the 234-P reactivates its output relay and turns the pump back on. By leaving the restart delay knob in the reset position, the 234-P will operate in manual reset mode.

The 234-P communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults. An IR Kit-12 (12” fiber optic kit) allows the Informer to access these parameters even when the 234-P is enclosed in a control box. This is valuable for troubleshooting the pump while it is running.

NOTE: The PumpSaver® models have a sensitivity adjustment for the dry-well trip point. After calibration is done, you can adjust the sensitivity for the dry-well/dead-head trip point from 70-90% of the full load. This makes the unit even more adaptable to varying pumping applications. If you have a very low producing well, you increase the sensitivity closer to the 90% mark, or if you have a very heavy producing well, you would decrease the sensitivity around the 70% mark.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of voltage and current protects pumps from dry-well, dead-head, jammed-impeller, rapid cycling, and voltage faults</td>
</tr>
<tr>
<td>Onboard sensitivity adjustment</td>
<td>Allows user to adjust the current sensitivity for the dry-well / dead-head trip point from 70% - 90% of the full load.</td>
</tr>
<tr>
<td>Adjustable restart delay</td>
<td>Allows user to select well recovery time delay after a dry-well condition occurs, or to select manual reset</td>
</tr>
<tr>
<td>Built in IR communications link</td>
<td>Used with the Informer, allows user to see stored faults, run time, and also troubleshoot the pump while it’s running</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides status and diagnostics for troubleshooting</td>
</tr>
</tbody>
</table>

For installation instructions see the Install Bulletin.
Accessories

**Informer**
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system. Includes the Informer IR Kit-12

**Informer IR Kit-12**
12” infrared adapter cable attaches to the face of the unit to provide remote diagnostics without opening the panel. Included with the Informer

Specifications

**Functional Specifications**

**Adjustments/Settings**
- Overcurrent: 125% of calibration point
- Underload (dry-well): Adjustable (70 - 90% of calibrated run power)
- Overvoltage: 265VAC
- Undervoltage: 190VAC
- Number of restarts allowed in a 60-second period (rapid-cycling): 4
- Trip Delay Times
  - Overcurrent: 5 seconds
  - Dry-well: 4 seconds
- Restart Delay Times
  - Over/undervoltage: 2 seconds
  - All other faults (dry-well recovery timer): Manual, 2-225 Minutes

**Input Characteristics**
- Supply Voltage: 230VAC
- Load Range: $\frac{1}{3}$ – 3 hp
- Frequency: 50*/60Hz

**Output Characteristics**
- Output Contact Rating (SPST): 3 hp @ 240VAC (17 amps max.)

**General Characteristics**
- Operating Temperature: -40º to 60º C (-40º to 140º F)
- Maximum Input Power: 5W
- Dimensions: Fitted to Grundfos® Control Box
- Weight: 14 oz.
- Mounting Methods: Grundfos® Control Box

**Standards Passed**
- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 2, 4kV contact, 6kV air

*Note: 50 Hz will increase all delay timers by 20%
**Description**

The Littelfuse 235P is designed to protect 5-15hp, 230V, single-phase pumps from dry-well, dead-head, jammed impeller and overvoltage and undervoltage conditions.

A calibration adjustment allows the 235P to be calibrated to your specific pumping applications, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations causing overcurrent and undercurrent. When an abnormality, such as loss of suction is detected, the 235P deactivates its output relay and directly disconnects the pump motor. The unit then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the unit reactivates its output relay and turns the pump back on.

The 235P communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults.

An external current transformer is required for operation (sold separately).

**Special considerations for pump cables larger than #10 AWG:**

In some cases where larger motors are installed with deep set pumps, pump cables are used that exceed the relay's terminal size. In these conditions, a short splice of #10 AWG or #12 AWG may be a solution at the control box. **Note:** All local, state and national electric codes should be followed when applying this solution.

**Features & Benefits**

**Model 235P**

- **Proprietary microcontroller-based circuitry:** Constant monitoring of voltage and current protects pumps from dry-well, dead-head, jammed impeller, rapid cycling, and voltage faults.
- **Onboard sensitivity adjustment:** Allows user to adjust the current sensitivity for the dry-well/dead-head trip point from 70%-90% of the full load. This makes the unit even more adaptable to varying pumping applications. If you have a very low producing well, you increase the sensitivity closer to the 90% mark, or if you have a very heavy producing well, you would decrease the sensitivity around the 70% mark.
- **Adjustable restart delay:** Allows user to select well recovery time delay after a dry-well condition occurs, or to select manual reset.
- **Built-in IR communications link:** Used with the Informer, allows user to see stored faults, run time, and also troubleshoot the pump while it's running.
- **LED indication:** Provides status and diagnostics for troubleshooting.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>235P</td>
<td>230VAC</td>
<td>5 - 15hp</td>
</tr>
<tr>
<td>235P-ENCL</td>
<td>230VAC</td>
<td>233P with NEMA3R enclosure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART*</th>
<th>SIZE</th>
<th>CURRENT (A)</th>
<th>CT CURRENT RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT-0050-D10</td>
<td>5 - 7.5hp</td>
<td>27.5 - 42.1</td>
<td>50:5</td>
</tr>
<tr>
<td>CT-0075-D10</td>
<td>10hp</td>
<td>51</td>
<td>75:5</td>
</tr>
<tr>
<td>CT-0100-D10</td>
<td>15hp</td>
<td>75</td>
<td>100:5</td>
</tr>
</tbody>
</table>

* Current transformer sold separately
## Accessories

**Informer**
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system. Includes the Informer IR Kit-12

## Specifications

### Functional Specifications

<table>
<thead>
<tr>
<th>Adjustment/Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overcurrent</td>
<td>125% of calibration point</td>
</tr>
<tr>
<td>Underload (dry-well)</td>
<td>Adjustable (70 to 90% of calibrated run power)</td>
</tr>
<tr>
<td>Undervoltage</td>
<td>190VAC</td>
</tr>
<tr>
<td>Number of restarts allowed in a 60-sec. period</td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>Trip Delay Time</td>
<td><strong>5</strong> seconds</td>
</tr>
<tr>
<td>Overcurrent</td>
<td><strong>5</strong> seconds</td>
</tr>
<tr>
<td>Dry-well</td>
<td><strong>4</strong> seconds</td>
</tr>
<tr>
<td>Restart Delay Time</td>
<td><strong>2</strong> seconds</td>
</tr>
<tr>
<td>Over/undervoltage</td>
<td>Manual, 2-225 Minutes</td>
</tr>
</tbody>
</table>

### Input Characteristics

- **Supply Voltage**: 230VAC
- **Load Range**: 5 - 15 hp
- **Frequency**: 50*/60Hz

### Output Characteristics

- **Output Contact Rating-SPST**: A300, 720A @240VAC (10 amps max.)
- **Operating Temperature**: -40º to 60º C (-40º to 140º F)
- **Maximum Input Power**: 5 W
- **Wire Gauge**: Solid or Stranded 10 - 22 AWG
- **Terminal Torque**: 13 in.-lbs.
- **cUL Listed**: UL508, C22.2 No. 14
- **Dimensions**: H 73.66 mm (2.9"), W 133.35 mm (5.25"), D 73.99 mm (2.913")
- **Weight**: 14 oz.
- **Mounting Methods**: #8 screws

*Note: 50Hz will increase all delay timers by 20%*
**Description**

The MP8000 is an advanced motor protection electronic overload relay that is fully programmable via Bluetooth® using the Littelfuse app on an Android® or iPhone® mobile device. It is easy to use and arc-flash safety is increased because the app allows settings to be modified and real-time operational information viewed. Viewing operational information and faults on the app does not require the user to open the control panel.

The MP8000 protects any motor drawing 0.5-1,000 full load Amps (external CTs are required above 100 amperes). It is designed for single or 3-phase systems with operating voltages of 90-690 VAC (use of external potential transformers can extend upper voltage range above 690 VAC). Common applications include conveyor systems, HVAC equipment, saws and grinders, fan motors, and almost any pumping application.

Protection is unsurpassed by combining overload, voltage, phase loss and reversal, voltage and current unbalance, power monitoring, and underload in one package. For standalone applications, the Bluetooth interface can be used when paired with a smartphone or tablet. The units also feature an Ethernet communications port that can be used to form an Ethernet Modbus TCP/IP network or Ethernet/IP. Units can be remotely monitored and controlled from a PC, or SCADA system, and data logging through a PC with the optional Solutions software or other software program using the MP8000 memory map. This capability allows for a simple cost-effective way to further enhance arc-flash safety.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluetooth interface</td>
<td>Visual indication for programming, viewing real-time voltage or current, and last fault information (date and time stamped)</td>
</tr>
<tr>
<td>Programmable voltage and current settings</td>
<td>Allows usage on wide range of systems</td>
</tr>
<tr>
<td>3 selectable restart options</td>
<td>Choose from automatic, semi-automatic, or manual to best meet individual application needs</td>
</tr>
<tr>
<td>4 programmable delay timers</td>
<td>Program separate delay times for power up, rapid cycle protection, motor cool down, and underload restarting</td>
</tr>
<tr>
<td>Flexible reset</td>
<td>Reset can be done through pushbutton on panel, remotely via the network</td>
</tr>
<tr>
<td>Network communications capability</td>
<td>Compatible with Ethernet Modbus TCP/IP and Ethernet/IP</td>
</tr>
</tbody>
</table>

**Accessories**

**ZSCT Series Current Transformer**

Used with Littelfuse relays to detect low levels of earth-leakage current.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>MOTOR FULL AMP RANGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP8000</td>
<td>90-690VAC (use of external potential transformers can extend upper voltage range above 690VAC)</td>
<td>0.5-1,000A+ (external CTs required above 100A)</td>
<td>Provides remote wired communication via Ethernet Modbus TCP/IP</td>
</tr>
</tbody>
</table>
Advanced Features
- Overload/Overpower (49)
- Underload/Underpower (37P)
- Overcurrent (51)/Jam
- Undercurrent (37)
- Current Unbalance/Phase Loss (46)
- Phase Reversal (47)
- Overvoltage (59)
- Undervoltage (27)
- Voltage Unbalance (47)
- Rapid Cycling/Jog
- Contactor Failure
- Zero-Sequence Ground Fault (50Ns)
- PTC Motor Overtemperature (49)

Littelfuse Mobile App

Specifications

Functional Characteristics
- Frequency: 50/60Hz
- TC- Overcurrent Trip Class: Trip class 02-60 or linear

Output Characteristics
- Output Contact Rating:
  - Control relay: SPST - Form A
  - Auxiliary relay: SPDT - Form C

Pilot Duty Rating: B300

General Purpose
- General Characteristics
  - Ambient Temperature Range:
    - Operating: -40° to 70°C (-40° to 158°F)
    - Storage: -40° to 85°C (-40° to 185°F)

Accuracy
- Voltage: ±1% of reading ±0.5 V
- Current: ±2% (2 to 100 amperes direct)
- Timing: +/-0.5% of setting +/- 1 second
- GF Current: ±5%

Repeatability
- Voltage: ±0.5%
- Current: ±1% (2 to 100 amps direct)

Power Consumption: <5 W

Pollution Degree: 3 (conformal coating standard)

Class of Protection: IP20

Relative Humidity: 10-95%, non-condensing per IEC 68-2-3

Terminal Torque (depluggable terminal blocks): 5.5 in.-lbs.

Terminal Torque (Earth Ground): 7.9 in.-lbs.

Standards Passed
- Electrostatic Discharge (ESD)
  - IEC 61000-4-2, Level 3, 8kV contact, 8kV air
- Radio Frequency Immunity (RFI), Conducted
  - IEC 61000-4-6, Level 3 10V/m
- Radio Frequency Immunity (RFI), Radiated
  - IEC 61000-4-3, Level 3 10V/m
- Fast Transient Burst
  - IEC 61000-4-4, Level 3, 3.5kV input power
  - IEC 61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground

- Surge
  - Part 15.107 for emissions,
  - Part 15.247 for intentional radiators

- Short Circuit Withstand Rating
  - 100kA symmetrical at 690VAC

- Hi-Potential Test
  - Meets UL508 (2 x rated V +1000V for 1 minute)

Safety Marks
- cULus
  - UL60947, UL1053, C22.2 (File #E68520)
- CE
  - IEC 60947 Edition 5.2, IEC 60947-8

Maximum Conductor Size (with insulation)
- 0.63”
- H 74.42 mm (2.93”); W 103.63 mm (4.08”)
- D 121.67 mm (4.79”)

Weight
- 0.85 lbs (13.6 oz, 385.6 g)

Mounting Method
- Surface mount (4 - #8 screws)
- or DIN-rail mount
777 SERIES

3-Phase Current & Voltage Monitor

Description
The 777 is a fully programmable electronic overload relay designed to protect any motor drawing 2-800 full load amps (external CTs are required above 90 amps). The 777 (family of products) is for 3-phase 200-480VAC applications, with several specialized units for other voltage ranges and unique applications. Common applications include conveyor systems, HVAC equipment, saws and grinders, fan motors, and almost any pumping application. Some unique applications include use with a Subtrol® equipped Franklin submersible motor to detect high motor temperatures and applications where a fast linear trip is required.

All of the overload relays provide unsurpassed protection by combining overload, voltage, phase loss and reversal, voltage and current unbalance, power monitoring, and underload based on current in one package. For standalone applications, the units incorporate a 3-digit LED display that is used for programming, providing real-time operational information and displaying diagnostic codes to aid in troubleshooting a fault condition. The units also feature a communications port that can be used with communication modules listed in the 777 accessories section to form a Modbus, DeviceNet™, Profibus, or Ethernet network. Up to 99 units can be remotely monitored and controlled from a PC, PLC, or SCADA system, and data logging through a PC with the optional Solutions software. This capability allows for a simple, cost-effective way to meet new requirements for arc-flash safety.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in display</td>
<td>Visual indication for programming, viewing real-time voltage or current, and last fault code</td>
</tr>
<tr>
<td>Programmable voltage and current settings</td>
<td>Allows usage on wide range of systems</td>
</tr>
<tr>
<td>3 selectable restart options</td>
<td>Choose from automatic, semi-automatic, or manual to best meet individual application needs</td>
</tr>
<tr>
<td>3 programmable restart delay timers</td>
<td>Program separate restart delay time for rapid cycle protection, motor cool down, and dry-well recovery</td>
</tr>
<tr>
<td>Remote display compatibility</td>
<td>Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations</td>
</tr>
<tr>
<td>Flexible reset</td>
<td>Reset can be done through pushbutton on relay or remotely with optional 777-MRSW or OL-RESET remote reset kit</td>
</tr>
<tr>
<td>Network communications capability</td>
<td>Compatible with Modbus, DeviceNet™, Profibus, or Ethernet using optional communications module</td>
</tr>
</tbody>
</table>

Ordering Information
See next page.

For dimensional drawing see: Appendix page 507, Figure 1.
## Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>MOTOR FULL AMP RANGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>777-P2</td>
<td>200-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts</td>
</tr>
<tr>
<td>777-LR-P2</td>
<td>200-480VAC</td>
<td>1-800A (external CTs required above 90A)</td>
<td>Protects low range motors when wired directly or with 10-800 FLA with use of external CTs</td>
</tr>
<tr>
<td>777-HVR-P2</td>
<td>340-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 470VA @ 600VAC output SPDT relay contacts. Required when a control power transformer (CPT) is not used with a 480V system</td>
</tr>
<tr>
<td>777-HVR-LR-P2</td>
<td>340-480VAC</td>
<td>1-800A (external CTs required above 90A)</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 470VA @ 600VAC output SPDT relay contacts. Required when a control power transformer (CPT) is not used with a 480V system</td>
</tr>
<tr>
<td>777-575-P2</td>
<td>500-600VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common</td>
</tr>
<tr>
<td>777-575-LR-P2</td>
<td>500-600VAC</td>
<td>1-800A (external CTs required above 90A)</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common</td>
</tr>
<tr>
<td>777-MV-P2</td>
<td>100-240VAC</td>
<td>10-800A with external CTs</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Designed for Medium Voltage applications where both PTs and CTs are used. Has built in multipliers for 25.5, 50.5, 100.5 CTs. The voltage unbalance, single-phase and reverse phase protection can be disabled for applications where only the PTs are used</td>
</tr>
<tr>
<td>777-HRG-P2</td>
<td>200-480VAC</td>
<td>2-90A only</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Designed for high resistance grounding systems that incorporate an external zero-sequence CT that correspond with the built in multipliers to detect ground faults</td>
</tr>
<tr>
<td>777-LR-HRG-P2</td>
<td>200-480VAC</td>
<td>10-800A (external CTs required above 90A)</td>
<td>Overload relays designed for high resistance grounding systems that incorporate an external zero-sequence CTs that correspond with the built in multipliers to detect ground faults</td>
</tr>
<tr>
<td>777-575-HRG-P2</td>
<td>500-600VAC</td>
<td>2-90A only</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common. Designed for high resistance grounding systems that incorporate an external zero-sequence CT that correspond with the built in multipliers to detect ground faults</td>
</tr>
<tr>
<td>777-575-LR-HRG-P2</td>
<td>500-600VAC</td>
<td>10-800A with external CTs</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common. Designed for high resistance grounding systems that incorporate an external zero-sequence CT that correspond with the built in multipliers to detect ground faults</td>
</tr>
<tr>
<td>777-FT</td>
<td>200-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides linear overcurrent trip and 480VA @ 240VAC output SPDT relay contacts. Also known as shock relay, it is designed for fast linear trip applications. Overcurrent trip delay can be set ranging from less than 500ms - 70 seconds. Low trip delay is ideal in chain drive and drive linkage applications to prevent breaking in overload or jam situations. Other applications include sewage clarifiers, mixers, augers, and conveyors. Longer trip delay is ideal for motor test panels in rewind shops. Also includes adjustable motor acceleration time and overcurrent trip delay time when the faster linear trip mode is used</td>
</tr>
<tr>
<td>777-TS</td>
<td>200-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts. For use with Subtrol® equipped Franklin submersible motors to detect high motor temperatures</td>
</tr>
<tr>
<td>777-LR-TS</td>
<td>200-480VAC</td>
<td>1-9A only</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts. For use with Subtrol® equipped Franklin submersible motors to detect high motor temperatures</td>
</tr>
<tr>
<td>777-575-TS</td>
<td>500-600VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts. For use with Subtrol® equipped Franklin submersible motors with nominal 500-600VAC range to detect high motor temperatures</td>
</tr>
<tr>
<td>777A-02</td>
<td>200-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Has restart delay 1 setpoints of 2-500 minutes and undercurrent trip delay setpoints of 2-60 minutes.</td>
</tr>
<tr>
<td>777A-03</td>
<td>200-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. For use with static and rotary single to 3-phase converters. High and low voltage trip feature only applies to the utility supplied power. Works well with unloaded phase converters because the relay ignores severely unbalanced voltages</td>
</tr>
</tbody>
</table>

* Network programmable only
Accessories

RS485MS-2W Communication Module
Required to enable the Modbus communications function on Model 77X-type products.

CIO-MB/CIO-120-MB Communication Module
Modbus-RTU interfaces capable of providing discrete control and monitoring of an overload relay over a Modbus network.

CIO-DN-P/CIO-120-DN-P Communication Module
DeviceNet™ interfaces capable of providing discrete control and monitoring of motor starters, drives and other devices over a DeviceNet™ network.

CIO-777-PR Communication Module
Profinet interface capable of providing discrete control and monitoring of motor starters, drives and other devices over a Profinet network.

RS485-RS232–Converter with cable & plug
RS485-USB–Converter with cable & plug
RS232-USB–Converter
Specifications match industry standard.

RM1000 Remote Monitor
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

RM2000 Remote Monitor
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.

777-MRSW Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

OL-RESET Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

Specifications

Functional Characteristics
- Frequency: 50/60Hz
- TC- Overcurrent Trip Class (777 Plus Series units): 02-60, J02-J60, L00-L60 or Off
- TC- Overcurrent Trip Class (77C, 777 non-Plus Series units): 5, 10, 15, 20, 30
  (J prefix enables jam protection feature)

Output Characteristics
- Output Contact Rating (SPDT - Form C): 480VA @ 240VAC, B300
- General purpose: 10A @ 240VAC
- Pilot duty rating for HVR models: 470VA @ 600VAC, B600

Accuracy
- Voltage: ±1%
- Current: ±3% (<100 amps direct)
- GF Current: ±15%
- Timing (777 Plus Series units): ±0.5 second
- Timing (77C, 777 non-Plus Series units): 5% ±1 second

Repeatability
- Voltage: ±0.5% of nominal voltage
- Current: ±1% (<100 amps direct)
- Maximum Input Power: 10 W
- Pollution Degree: 3
- Class of Protection: IP20
- Relative Humidity: 10-95%, non-condensing per IEC 68-2-3

Terminal Torque
7 in.-lbs.

Standards Passed
- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- Radio Frequency Immunity (RFI), Conducted: IEC 61000-4-6, Level 3 10V/m
- Radio Frequency Immunity (RFI), Radiated: IEC 61000-4-3, Level 3 10V/m
- Fast Transient Burst: IEC 61000-4-4, Level 3, 3.5kV input power
- Short Circuit: 100kA
- Surge: IEC 61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
- ANSI/IEEE C62.41 Surge and Ring Wave Compliance to a level of 8kV line-to-line

Hi-potential Test
Meets UL508 (2 x rated V +1000V for 1 minute)

Vibration
IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis

Shock
IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse
777 SERIES

Safety Marks
UL
UL508, UL1053 (File #E68520)
CE
IEC 60947-1, IEC 60947-5-1
CSA
C22.2 No. 14

Maximum Conductor Size
(with insulation) through
777/77C
0.65"

Dimensions
H 77.47 mm (3.05”); W 97.79 mm (3.85”);
D 128.27 mm (5.05”)

Weight
1.56 lbs. (24.96 oz., 707.6 g)

Mounting Method
Surface mount (4 - #8 screws) or DIN rail mount
Description

The 777/77C Series is a fully programmable electronic overload relay designed to protect any motor drawing 2-800 full load amps (external CTs are required above 90 amps). Common applications include conveyor systems, HVAC equipment, saws and grinders, fan motors, and almost any pumping application.

All of the overload relays provide unsurpassed protection by combining overload, underload, and voltage in one package. For standalone applications, the units incorporate a 3-digit LED display that is used for programming, providing real-time operational information and displaying diagnostic codes to aid in troubleshooting a fault condition. The units also feature a communications port that can be used with communication modules listed in the 777 accessories section to form a Modbus, DeviceNet™, Profibus, or Ethernet network. Up to 99 units can be remotely monitored and controlled from a PC, PLC, or SCADA system, and data logging through a PC with the optional Solutions software. This capability allows for a simple, cost-effective way to meet new requirements for arc-flash safety.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in display</td>
<td>Visual indication for programming, viewing real-time voltage or current, and last fault code</td>
</tr>
<tr>
<td>Programmable voltage and current settings</td>
<td>Allows usage on wide range of systems</td>
</tr>
<tr>
<td>3 selectable restart options</td>
<td>Choose from automatic, semi-automatic, or manual to best meet individual application needs</td>
</tr>
<tr>
<td>3 programmable restart delay timers</td>
<td>Program separate restart delay time for rapid cycle protection, motor cool down, and dry-well recovery</td>
</tr>
<tr>
<td>Remote display compatibility</td>
<td>Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations</td>
</tr>
<tr>
<td>Flexible reset</td>
<td>Reset can be done through pushbutton on relay or remotely with optional 777-MRSW or OL-RESET remote reset kit</td>
</tr>
<tr>
<td>Network communications capability</td>
<td>Compatible with Modbus, DeviceNet™, Profibus, or Ethernet using optional communications module</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>MOTOR FULL AMP RANGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>77C</td>
<td>100-240VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts</td>
</tr>
<tr>
<td>77C-LR</td>
<td>100-240VAC</td>
<td>1-9A only</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts</td>
</tr>
<tr>
<td>777- HVR-SP</td>
<td>340-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides 470VA @ 600VAC output SPDT relay contacts. For systems with no control power transformer</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix page 507, Figure 1.
### Accessories

**RS485MS-2W Communication Module**
Required to enable the Modbus communications function on Model 77X-type products.

**Communication Adapters**
- RS485-RS232 – Converter with cable & plug
- RS485-USB – Converter with cable & plug
- RS232-USB – Converter

Specifications match industry standard.

**RM1000 Remote Monitor**
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

**RM2000 Remote Monitor**
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

**Solutions Software: Solutions-M**
Software features include data logging, real-time data monitoring and fault and event monitoring.

**777-MRSW Manual Remote Reset Kit**
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

**OL-RESET Manual Remote Reset Kit**
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

### Specifications

**Frequency**
50/60Hz

**Functional Characteristics**

| TC- Overcurrent Trip Class (77C, 777 non-Plus Series units) | 5, 10, 15, 20, 30 (J prefix enables jam protection feature) |

**Output Characteristics**

<table>
<thead>
<tr>
<th>Output Contact Rating (SPDT - Form C)</th>
<th>480VA @ 240VAC, B300</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>10A @ 240VAC</td>
</tr>
<tr>
<td>Pilot duty rating for HVR models</td>
<td>470VA @ 600VAC, B600</td>
</tr>
</tbody>
</table>

**General Characteristics**

<table>
<thead>
<tr>
<th>Ambient Temperature Range</th>
<th>Operating -20° to 70°C (-4° to 158°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage -40° to 80°C (-40° to 176°F)</td>
<td></td>
</tr>
</tbody>
</table>

**Accuracy**

| Voltage | ±1% |
| Current | ±3% (<100 amps direct) |
| GF Current | ±15% |

**Timing (77C, 777 non-Plus Series units)**

| Timing | 5% ±1 second |

**Repeatability**

| Voltage | ±0.5% of nominal voltage |
| Current | ±1% (<100 amps direct) |

**Maximum Input Power**

| Power | 10 W |

**Pilot duty rating for HVR models**

| Voltage | 470VA @ 600VAC, B600 |
| Current | 10A @ 240VAC |

**Standards Passed**

<table>
<thead>
<tr>
<th>Electrostatic Discharge (ESD)</th>
<th>IEC 61000-4-2, Level 3, 6kV contact, 8kV air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Frequency Immunity (RFI), Conducted</td>
<td>IEC 61000-4-6, Level 3 10V/m</td>
</tr>
<tr>
<td>Radio Frequency Immunity (RFI), Radiated</td>
<td>IEC 61000-4-3, Level 3 10V/m</td>
</tr>
<tr>
<td>Fast Transient Burst</td>
<td>IEC 61000-4-4, Level 3, 3.5kV input power</td>
</tr>
<tr>
<td>Short Circuit</td>
<td>100kA</td>
</tr>
</tbody>
</table>

**Surge**

| Surge | IEC 61000-4-5, Level 3, 2kV line-to-line, Level 4, 4kV line-to-ground |

| ANSI/IEEE | C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line |

| Hi-potential Test | Meets UL508 (2 x rated V +1000V for 1 minute) |

| Vibration | IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axes |
| Shock | IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse |

**Safety Marks**

| UL | UL508, UL1053 (File #E68520) |
| CE | IEC 60947-1, IEC 60947-5-1 |
| CSA | C22.2 |

| Maximum Conductor Size (with insulation) through 777/77C | 0.65” |
| Dimensions | H 77.47 mm (3.05”), W 97.79 mm (3.85”), D 128.27 mm (5.05”) |
| Weight | 1.56 lbs. (24.96 oz., 707.6 g) |
| Mounting Method | Surface mount (4 - #8 screws) or DIN rail mount |
Description

The 777-KW/HP-P2 Series has the overload, voltage, phase loss and reversal, voltage and current unbalance, current and power monitoring*, and underload trip based on power in one package. The underpower trip feature is desirable anytime the current vs. load characteristic is non-linear or has little change. In general terms, smaller motors and slow-speed motors have little change in current over the normal load range. Larger motors that are running light loads will also show small current changes over the operating load range. For standalone applications, the units incorporate a 3-digit LED display that is used for programming, providing real-time operational information and displaying diagnostic codes to aid in troubleshooting a fault condition.

The units also feature a communications port that can be used with communication modules listed in the 777 accessories section to form a Modbus, DeviceNet™, Profinet, or Ethernet network. Up to 99 units can be remotely monitored and controlled from a PC, PLC, or SCADA system, and data logging through a PC with the optional Solutions software.

* Low current trip and high power trip are network programmable only

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low and High Power Protection</td>
<td>Increases reliability for non-linear motors where the load characteristic has little change</td>
</tr>
<tr>
<td>Built-in Display</td>
<td>Visual indication for programming, viewing real-time voltage, current, kilowatts, or horsepower, and last fault code</td>
</tr>
<tr>
<td>Programmable voltage and current settings</td>
<td>Allows usage on wide range of systems</td>
</tr>
<tr>
<td>3 selectable restart options</td>
<td>Choose from automatic, semi-automatic, or manual to best meet individual application needs</td>
</tr>
<tr>
<td>3 programmable restart delay timers</td>
<td>Program separate restart delay time for rapid cycle protection, motor cool down, and dry-well recovery</td>
</tr>
<tr>
<td>Remote display compatibility</td>
<td>Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations</td>
</tr>
<tr>
<td>Flexible reset</td>
<td>Reset can be done through pushbutton on relay or remotely with optional 777-MRSW or OL-RESET remote reset kit</td>
</tr>
<tr>
<td>Network communications capability</td>
<td>Compatible with Modbus, DeviceNet™, Profinet, or Ethernet using optional communications module</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix page 507, Figure 1.
**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>MOTOR FULL AMP RANGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>777-KW/HP-P2</td>
<td>200-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts</td>
</tr>
<tr>
<td>777-LR-KW/HP-P2</td>
<td>200-480VAC</td>
<td>1-800A (external CTs required above 9A)</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts</td>
</tr>
<tr>
<td>777-HVR-KW/HP-P2</td>
<td>340-480VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides 470VA @ 600VAC output SPDT relay contacts. Required when a CPT (control power transformer) is not used on a 480V system. Commonly used in pumping applications to save the cost and extra wiring associated with a CPT</td>
</tr>
<tr>
<td>777-575-KW/HP-P2</td>
<td>500-600VAC</td>
<td>2-800A (external CTs required above 90A)</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common</td>
</tr>
<tr>
<td>777-MLR-KW/HP-P2</td>
<td>200-480VAC</td>
<td>0.5-21A and 40-740A with external CTs</td>
<td>Provides 480VA @ 240VAC output SPDT relay contacts. It is wired directly without the need to loop conductors for 5-21 amps (under 5 amps requires looping of conductors), and can be used with external CTs for 40-740 amps</td>
</tr>
</tbody>
</table>

**Accessories**

- **RS485MS-2W Communication Module**  
  Required to enable the Modbus communications function on Model 77X-type products.

- **CIO-MB/CIO-120-MB Communication Module**  
  Modbus-RTU interfaces capable of providing discrete control and monitoring of an overload relay over a Modbus network.

- **CIO-DN-P/CIO-120-DN-P Communication Module**  
  DeviceNet™ interfaces capable of providing discrete control and monitoring of motor starters, drives and other devices over a DeviceNet™ network.

- **CIO-777-PR Communication Module**  
  Profibus interface capable of providing discrete control and monitoring of motor starters, drives and other devices over a Profibus network.

- **CIO-EN (non-POE) Communication Module**  
  Modbus-TCP and Modbus-RTU interface capable of providing discrete control and monitoring of an overload relay over a Modbus network.

- **Communication Adapters**  
  - RS485-RS232—Converter with cable & plug
  - RS485-USB—Converter with cable & plug
  - RS232-USB—Converter
  Specifications match industry standard.

- **RM1000 Remote Monitor**  
  The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

- **RM2000 Remote Monitor**  
  The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

- **Solutions Software: Solutions-M**  
  Software features include data logging, real-time data monitoring and fault and event monitoring.

- **777-MRSW Manual Remote Reset Kit**  
  Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

- **OL-RESET Manual Remote Reset Kit**  
  Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.
## 777-KW/HP-P2 SERIES

### Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>50/60Hz</td>
</tr>
<tr>
<td><strong>Functional Characteristics</strong></td>
<td>TC-Overcurrent Trip Class 02-60, J02-J60, L00-L60 or OFF</td>
</tr>
<tr>
<td><strong>Output Characteristics</strong></td>
<td>Output Contact Rating (SPDT - Form C) 480VA @ 240VAC, B300 General purpose 10A @ 240VAC Pilot duty rating for HVR model 470VA @ 600VAC, B600</td>
</tr>
<tr>
<td><strong>General Characteristics</strong></td>
<td><strong>Ambient Temperature Range</strong></td>
</tr>
<tr>
<td>Operating Accuracy Voltage</td>
<td>±1%</td>
</tr>
<tr>
<td>Operating Accuracy Current</td>
<td>±3% (&lt;100 amps direct)</td>
</tr>
<tr>
<td>Operating Accuracy Power</td>
<td>±4% (&lt;100 amps direct)</td>
</tr>
<tr>
<td>Operating Accuracy GF Current</td>
<td>±15%</td>
</tr>
<tr>
<td>Operating Accuracy Timing</td>
<td>±0.5 second</td>
</tr>
<tr>
<td>Operating Repeatability Voltage</td>
<td>±0.5% of nominal voltage</td>
</tr>
<tr>
<td>Operating Repeatability Current</td>
<td>±1% (&lt;100 amps direct)</td>
</tr>
<tr>
<td>Operating Repeatability Power</td>
<td>±2%</td>
</tr>
<tr>
<td>Operating Maximum Input Power</td>
<td>10 W</td>
</tr>
<tr>
<td>Operating Pollution Degree</td>
<td>3</td>
</tr>
<tr>
<td>Operating Class of Protection</td>
<td>IP20</td>
</tr>
<tr>
<td>Operating Relative Humidity</td>
<td>10-95%, non-condensing per IEC 68-2-3</td>
</tr>
<tr>
<td>Operating Terminal Torque</td>
<td>7 in.-lbs.</td>
</tr>
<tr>
<td>Standards Passed Electrostatic Discharge (ESD)</td>
<td>IEC 61000-4-2, Level 3, 6kV contact, BkV air</td>
</tr>
<tr>
<td>Standards Passed Radio Frequency Immunity (RFI), Conducted</td>
<td>IEC 61000-4-6, Level 3 10V/m</td>
</tr>
<tr>
<td>Standards Passed Radio Frequency Immunity (RFI), Radiated</td>
<td>IEC 61000-4-3, Level 3 10V/m</td>
</tr>
<tr>
<td>Standards Passed Fast Transient Burst</td>
<td>IEC 61000-4-4, Level 3, 3.5 kV input power</td>
</tr>
<tr>
<td>Standards Passed Short Circuit Rating</td>
<td>100kA</td>
</tr>
</tbody>
</table>

### Surge

| **IEC** | 61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground |
| **ANSI/IEEE** | C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line |
| **Hi-potential Test** | Meets UL508 (2 x rated V +1000V for 1 minute) |
| **Vibration** | IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis |
| **Shock** | IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse |

### Safety Marks

| **UL** | UL508, UL1053 (File #E68520) |
| **CE** | IEC 60947-1, IEC 60947-5-1 |
| **CSA** | C22.2 No. 14 |

### Maximum Conductor Size

| with insulation through 777 | 0.65" |

### Dimensions

| H | 77.47 mm (3.05") |
| W | 97.79 mm (3.85") |
| D | 128.27 mm (5.05") |

### Weight

| 1.56 lbs. (24.96 oz., 707.6 g) |

### Mounting Method

| Surface mount (4 - #8 screws) or DIN rail mount |
Description
The 777-AccuPower is a fully-programmable 3-phase motor and pump protection relay. It allows motor hp rating, full load amps, efficiency and power factor to be entered and will accurately calculate motor output power. This is most useful with mag-drive pumps or process applications where the process power is desired over the utility power. Voltage, current and power measurements can be displayed as well as fault information and setpoints. The built-in display simplifies troubleshooting and allows the user to easily and precisely configure setpoints. The 777-AccuPower can be used with the optional COM 4-20 output module to give an analog signal proportional to output shaft power, the RS485MS-2W (for limited Modbus capabilities, and for use with the RM1000/RM2000) remote displays listed in the 777 accessories section.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor output power measurement</td>
<td>Allows use of process power over utility power</td>
</tr>
<tr>
<td>3 programmable restart delay timers</td>
<td>Program separate restart delay time for rapid cycle protection, motor cool down, and dry-well recovery</td>
</tr>
<tr>
<td>Built-in Display</td>
<td>Visual indication for programming, viewing real-time voltage or current, and last fault code</td>
</tr>
<tr>
<td>Remote display compatibility</td>
<td>Increases safety through remote display of run-hour meter, last four fault codes, without the need to open the cabinet. Aids with arc flash safety regulations</td>
</tr>
<tr>
<td>Network communications capability</td>
<td>Limited Modbus capabilities using RS485MS-2W communication module</td>
</tr>
</tbody>
</table>

Accessories

- **RS485MS-2W Communication Module**
  Required to enable the Modbus communications function on Model 77X-type products.

- **COM 4-20 Output Communication Module**
  This module allows communication to a PLC with an analog input and no Modbus input.

- **RM1000 Remote Monitor**
  The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

- **RM2000 Remote Monitor**
  The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

For dimensional drawing see: Appendix page 507, Figure 1.
Specifications

Input Characteristics
- Line Voltage: 200-480VAC
- Frequency: 50/60Hz
- Motor Full Load Amp Range: 2-800A (external CTs required over 90A)

Functional Characteristics
- TC- Overcurrent Trip Class: 5, 10, 15, 20, 30 (J prefix enables jam protection feature)

Output Characteristics
- Output Contact Rating (SPDT - Form C):
  - Pilot duty: 480VA @ 240VAC
  - General Purpose: 10A @ 240VAC

General Characteristics
- Ambient Temperature Range:
  - Operating: -40° to 70°C (-40° to 158°F)
  - Storage: -40° to 80°C (-40° to 176°F)

Accuracy
- Measured Horsepower/Kilowatt:
  - Typical: ±3%
  - Current: ±3% (<100 amps direct)
  - GF Current: ±15%
  - Timing: 5% ±1 second
- Repeatability:
  - Voltage: ±0.5% of nominal voltage
  - Current: ±1% (<100 amps direct)

Weight
- 1.3 lbs. (20.8 oz., 589.67 g)

Mounting Method
- Surface mount (4 - #8 screws) or DIN rail mount

Standards Passed
- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- Radio Frequency Immunity (RFI), Conducted: IEC 61000-4-6, Level 3 10V/m
- Radio Frequency Immunity (RFI), Radiated: IEC 61000-4-3, Level 3 10V/m
- Fast Transient Burst: IEC 61000-4-4, Level 3, 3.5 kV input power 100kA
- Surge: IEC 61000-4-5 Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
- ANSI/IEEE C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
- Hi-Potential Test: Meets UL508 (2 x rated V + 1000V for 1 min.)
- Vibration: IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hrs, 3 axis
- Shock: IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse
- Safety Marks:
  - UL: UL508, UL1053
  - CE: IEC 60947-1, IEC 60947-5-1
  - CSA: C22.2
- Max. Conductor Size through 777: 0.65" with insulation
- Dimensions:
  - H: 77.47 mm (3.05’’), W: 97.79 mm (3.85’’), D: 128.27 mm (5.05’’)
- Mounting Method: Surface mount (4 - #8 screws) or DIN rail mount

*On a well balanced system within recommended current range.
**Description**

The 77C-KW/HP and 77C-LR-KW/HP are fully programmable pump protection relays which will monitor the voltage and current for high or low voltage, overload and underload conditions based on power, in one package. The underpower trip feature is desirable anytime the current vs. load characteristic is non-linear or has little change. In general terms, smaller motors and slow-speed motors have little change in current over the normal load range. Larger motors that are running light loads will also show small current changes over the operating load range. Common uses include pumping applications where motors run slower than around 3400 rpm and usually have small current vs. load changes; such as slow speed mixer or agitator motors up to 50 hp, and magdrive or can pumps.

The Littelfuse PumpSaver relay provides the high sensitivity of a power monitor to protect pump motors from dry run and dead-head conditions.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underload protection</td>
<td>Increases reliability for non-linear motors where the load characteristic has little change</td>
</tr>
<tr>
<td>Built-in display</td>
<td>Visual indication for programming, viewing real-time voltage, current, kilowatts or horsepower, and last fault code</td>
</tr>
<tr>
<td>15 programmable criteria settings</td>
<td>Allows user flexibility to fine-tune the relay for maximum protection in any application.</td>
</tr>
<tr>
<td>Last fault memory</td>
<td>Provides instant troubleshooting diagnostics</td>
</tr>
<tr>
<td>Remote display compatibility</td>
<td>Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations.</td>
</tr>
<tr>
<td>Flexible reset</td>
<td>Reset options: automatic, manual using pushbutton on relay, or remotely with optional 777-MRSW or OL-RESET remote reset kit.</td>
</tr>
<tr>
<td>Network communications capability</td>
<td>Compatible with Modbus using optional communications module (RS485MS-2W)</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>MOTOR FULL AMP RANGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>77C-KW/HP</td>
<td>100-240VAC</td>
<td>2-90A (external CTs required above 90A)</td>
<td>Provides 480VA @ 240VAC output SPDT (Form C) relay contacts</td>
</tr>
<tr>
<td>77C-LR-KW/HP</td>
<td>100-240VAC</td>
<td>1-9A (external CTs required above 9A)</td>
<td>Provides 480VA @ 240VAC output SPDT (Form C) relay contacts</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix page 507, Figure 1.
Accessories

**RS485MS-2W Communication Module**
Required to enable the Modbus communications function on Model 77X-type products.

**Communication Adapters**
- **RS485-RS232**–Converter with cable & plug
- **RS485-USB**–Converter with cable & plug
- **RS232-USB**–Converter

Specifications match industry standard.

**RM1000 Remote Monitor**
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

**RM2000 Remote Monitor**
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

**Solutions Software: Solutions-M**
Software features include data logging, real-time data monitoring and fault and event monitoring.

**777-MRSW Manual Remote Reset Kit**
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

**OL-RESET Manual Remote Reset Kit**
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

Specifications

**Input Characteristics**

- **Suppl Voltage**: 100-240 VAC, 1Ø
- **Frequency**: 50-60 Hz
- **Motor Full Load Amp Range**
  - **77C-KW/HP**: 2-25 Amps (Loops Required)
  - **26-90 Amps (Direct)**
  - **91-800 Amps (External CT’s)**
  - **77C-LR-KW/HP**: 1.0 Amps - 2.0 Amps (additional Loop)

**Short Circuit Withstand Rating**
- 100kA per UL and CSA
- 5W (Maximum)

**Expected Life**
- Mechanical: 1 x 10^6 operations
- Electrical: 1 x 10^5 operations at rated load

**Accuracy at 25° C (77° F)**
- Voltage: ±1%
- Current: ±3% (Direct, No External CTs)
- Timing: 5% ± 1 second
- Repeatability: ± 0.5% of nominal voltage
- Current: ± 1% (Direct, No External CTs)

**Safety Marks**
- UL: UL508, UL1053
- CE: IEC 60947-1, IEC 60947-5-1
- CSA: C22.2 No. 14

**Standards Passed**
- Electrostatic Discharge (ESD)
  - IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- Radio Frequency Immunity (RFI), Conducted
  - IEC 61000-4-6, Level 3 10V/m
- Radio Frequency Immunity (RFI), Radiated
  - IEC 61000-4-3, Level 3 10V/m
- Fast Transient Burst
  - IEC 61000-4-4, Level 3, 3.5kV input power
- Surge
  - IEC 61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
  - ANSI/IEEE C62.41 Surge and Ring Wave compliance to a level of 6kV line-to-line
- Hi-potential Test
  - Meets UL508 (2 x rated V +1000V for 1 min.)
  - IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis
  - IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse

**Mechanical**
- Dimensions: H 77.47 mm (3.05”); W 97.79 mm (3.85”); D 128.27 mm (5.05”)
- Maximum conductor size through holes: 0.65” (with insulation)
- Terminal Torque: 7 in.-lbs.
- Enclosure Material: polycarbonate
- Weight: 1.2 lbs
- Mounting Methods: 35mm DIN rail or surface mount

77C-KW/HP SERIES

Motor & Pump Protection – Single-Phase Pump Protection
### Environmental

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>-20° - 70° C (-4° - 158°F)</th>
<th>-40° - 80° C (-40° - 176°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Operating</td>
<td>-20° - 70° C (-4° - 158°F)</td>
<td>-40° - 80° C (-40° - 176°F)</td>
</tr>
<tr>
<td>Ambiance Storage</td>
<td>10-95%, non-condensing per IEC 68-2-3</td>
<td></td>
</tr>
<tr>
<td>Class of Protection</td>
<td>IP20, NEMA 1</td>
<td>IP20, NEMA 1</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>10-95%, non-condensing per IEC 68-2-3</td>
<td></td>
</tr>
</tbody>
</table>

### Programmable

<table>
<thead>
<tr>
<th>Operating Points</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV- Low Voltage Threshold</td>
<td>85V - HV Setting</td>
</tr>
<tr>
<td>HV- High Voltage Threshold</td>
<td>LV Setting - 264V</td>
</tr>
<tr>
<td>MULT- # of Conductors or CT Ratio (XXX:5)</td>
<td>1-10 Conductors or 100-800 Ratio</td>
</tr>
<tr>
<td>77C:</td>
<td>1 or 2</td>
</tr>
<tr>
<td>77C-LR:</td>
<td>1 or 2</td>
</tr>
<tr>
<td>OC- Overcurrent Threshold</td>
<td>(20-100A) ÷ MULT or 80-120% of CT Primary</td>
</tr>
<tr>
<td>TC- Overcurrent Trip Class</td>
<td>5, J5, 10, J10, 15, J15, 20, J20, 30, J30, or Lin (linear)</td>
</tr>
<tr>
<td>RD1- Rapid Cycle Timer</td>
<td>0, 2 - 500 Seconds</td>
</tr>
<tr>
<td>RD2- Restart Delay After All Faults Except Undercurrent</td>
<td>2 - 500 Minutes/Seconds</td>
</tr>
<tr>
<td>RD3- Restart Delay After Undercurrent</td>
<td>2 - 500 Minutes/Seconds</td>
</tr>
<tr>
<td>#RU- Number of Restarts</td>
<td>0, 1, 2, 3, 4, A (Automatic)</td>
</tr>
<tr>
<td>ADDR- RS485 Address</td>
<td>A01- A99</td>
</tr>
<tr>
<td>#RO- Number of Restarts</td>
<td>0, 1, 2, 3, 4, A (Automatic)</td>
</tr>
<tr>
<td>LP/PWS (PWS = LP Range)</td>
<td>1 = 0.01 - 0.99 KW, 5 = 0.01 - 1.30 HP</td>
</tr>
<tr>
<td></td>
<td>2 = 1.00 - 9.95 KW, 6 = 1.34 - 13.3 HP</td>
</tr>
<tr>
<td></td>
<td>3 = 10.0 - 99.5 KW, 8 = 13.4 - 133 HP</td>
</tr>
<tr>
<td></td>
<td>4 = 100 - 650 KW, 9 = 134 - 871 HP</td>
</tr>
</tbody>
</table>

* If J Prefix is displayed in trip class setting, jam protection is enabled. If programmed to Lin position, overcurrent trip delays are fixed linear-type delays set in OPT1 position.

** RD2 & RD3 can be changed from minutes to seconds under program position OPT2.
**Description**

The SIO-RTD is a microprocessor-based data-acquisition system for measuring temperatures accurately with resistance temperature detectors (RTDs) and for monitoring 4-20 mA analog-output devices in industrial environments. RTD inputs are noise-filtered and automatically calibrated for lead-length compensation, ambient temperature, and other factors providing accurate readings through the specified temperature range for several types of RTD devices.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 inputs</td>
<td>Single module can collect multiple data points</td>
</tr>
<tr>
<td>CSA Class 1 Zone 2 Hazardous-location Certified</td>
<td>Can be mounted in hazardous areas</td>
</tr>
<tr>
<td>Individually-selectable input type</td>
<td>Flexible; can be used with Pt100, Ni100, Ni120, Cu10 RTD or 4-20 mA inputs</td>
</tr>
<tr>
<td>Conformal coating</td>
<td>Protects circuit boards against corrosion and moisture</td>
</tr>
<tr>
<td>Remote monitoring</td>
<td>Up to 1.2 km away from network master</td>
</tr>
<tr>
<td>Notch filter</td>
<td>Rejcts noise from motor monitoring applications</td>
</tr>
</tbody>
</table>

**Specifications**

- **Input Voltage**: 18 to 32 Vdc, 2W
- **RTD Types**: Pt100 (default), Ni100, Ni120, Cu10
- **RTD Range**: -40 to 200˚C with open and short detection
- **Analog Range**: 4-20 mA
- **Accuracy**: (Pt100, Ni100, Ni120) 1˚C, (Cu10) 3˚C, (4-20 mA) 0.1 mA
- **Lead Compensation**: Up to 20 Ω
- **Communications**: Modbus RTU®
- **Conformally Coated**: Standard feature
- **Approvals**: cCSAus
- **Dimensions**: H 87 mm (3.43”); W 112.5 mm (4.43”); D 56 mm (2.2”)
- **Warranty**: 5 years
- **Mounting**: DIN, Surface

For dimensional drawing see: Appendix page 515, Figure 49.
PUMP CONTROLS & LIQUID LEVEL CONTROLS

Protect and disable a pump if a hazardous condition arises. PumpSaver® offers a wide variety of controls for both single phase and three phase applications. Intrinsically safe relays are specifically designed to interface between hazardous and non-hazardous areas.

ACBC-120 Series Alarm Controller/Battery Charging Unit .... 146
PC-102 Series Dual Channel Switch ....................... 148
PC-105 5-Channel Pump Controller ..................... 149
PC-XXX-LLC-CZ Series Liquid Level Control Relays .... 150
PC-XXX-LLC-GM Series Liquid Level Control Relays .... 150
201-100-SLD Single-Channel Seal-Leak Detector .... 152
460-15-100-LLS Single-Channel Liquid Level Sensor .... 153
460-15-100-SLD Single-Channel Seal-Leak Detector .... 155
LLC1 Series Open Board Liquid Level Control .... 157
LLC2 Series Open Board Liquid Level Control .... 159
LLC4 Series Octal Plug-In Liquid Level Control .... 161
LLC5 Series Liquid Level Control .... 163
LLC6 Series Low Level Cutoff Liquid Level Control .... 165
LLC8 Series Low Level Cutoff Liquid Level Control .... 167

Alternating Relays

ALT Series 8-pin Plug-in Alternating Relays .......... 169
ALT-XXX-1-SW / ALT-XXX-3-SW Series Alternating Relays .......... 171
ARP Series Alternating Relays .......... 173
50R-400-ALT Alternating Relay .......... 175

Intrinsically Safe Relays

ISS-100 Intrinsically Safe Switch .......... 176
ISS-101 Intrinsically Safe Switch .......... 177
ISS-102 Series Two-Channel Intrinsically Safe Switch .... 179
ISS-105 Series Five-Channel Intrinsically Safe Switch .... 181

For More Information…
and to download our Fresh Water Pumping Catalog, visit Littelfuse.com/PumpProtection
Alarm Controller and Battery Charger for pump control panels

Description
The ACBC-120 Series is a dual purpose alarm controller/battery charging unit. When there is a loss of 120VAC power, the ACBC-120’s primary function as an alarm controller activates. When this power loss occurs, input power is switched to a 12VDC, lead-acid, rechargeable backup battery and a 12VDC alarm consisting of a strobe light and/or a horn is activated. The horn follows a 2 second on/2 second off pattern with a “horn silence” option to turn the sound off. An LED indicator on the unit also signals that the device has entered the alarm mode.

When 120VAC input is present the alarm circuit can be tested and the unit’s secondary function as a 12VDC backup battery charger is activated. In fast charge mode, the unit has the capability to source up to 100mA of charging current. However, the device normally charges at a current of 14mA in maintenance mode. The alarm circuit can be tested by pressing the “test” button located on the front of the unit or by activating an external switch via the “alarm contact” pin.

The device has the ability to signal low battery voltage if the voltage drops below 10.5VDC. The device can also detect if no battery is present or if the battery is connected backwards. In either of these cases, the ACBC-120 will signal a battery error and will not attempt to charge.

Must use Model SD12-PC socket for UL Rating!
*Note: Manufacturer’s recommended screw terminal torque for the SD Series Sockets is 12 in.-lbs.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls 12VDC alarm circuit</td>
<td>Activates strobe and/or horn when power loss occurs</td>
</tr>
<tr>
<td>Selectable fast charge mode</td>
<td>Unit sources higher charging current up to 100mA (normal mode is 14mA)</td>
</tr>
<tr>
<td>Trip delay timer</td>
<td>Prevents nuisance tripping</td>
</tr>
<tr>
<td>Battery fault detection and reverse polarity protection</td>
<td>Signals if battery voltage drops below 10.5VDC and can detect if no battery is present or if the battery is connected backwards</td>
</tr>
<tr>
<td>LED indication</td>
<td>Visual indication of unit status or trip</td>
</tr>
<tr>
<td>Test button</td>
<td>Preventative maintenance check of the alarm circuit by pressing the test button on the unit or externally through alarm contact connection</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACBC-120</td>
<td>120VAC</td>
<td>Does not include SD12-PC socket for mounting</td>
</tr>
<tr>
<td>ACBC-120-SD</td>
<td>120VAC</td>
<td>Includes SD12-PC socket for mounting</td>
</tr>
</tbody>
</table>

Accessories

SD12-PC 12-pin Rectangle Socket
Rectangle Socket for the ACBC-120. 12-pin surface mountable.
# Specifications

## Input Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>120V +/-10%</td>
</tr>
<tr>
<td>AC Input Voltage</td>
<td>120V +/-10%</td>
</tr>
<tr>
<td>Frequency</td>
<td>50/60Hz</td>
</tr>
<tr>
<td>AC Input Current</td>
<td>0.018A (max.) 0.003 (typical)</td>
</tr>
<tr>
<td>AC Input Power</td>
<td>2.4W (max.) fast charge current</td>
</tr>
<tr>
<td></td>
<td>0.4W (typical) maint. charge current</td>
</tr>
</tbody>
</table>

## Functional Characteristics

### Battery Charging

- **Acceptable Battery Type**: 12V lead-acid rechargeable
- **Fast Charge Current**: 100mA +/-10%
- **Maintenance Charge Current**: 14mA +/-50%
- **Low Battery Alert Level**: 10.5V

### Output Characteristics

- **Strobe Light Alarm Output**: 12VDC@1A (max.)
- **Horn Alarm Output**: 12VDC@1A (max.)

## General Characteristics

- **Temperature Range**: -40° to 60°C (-40° to 140°F)

## Standards Passed

- **Electrostatic Discharge (ESD)**: IEC 61000-4-2, Level 3, 8kV contact, 8kV air
- **Radio Frequency, Radiated**: IEC 61000-4-3, 150MHz, 10V/m
- **Fast Transient Burst**: IEC 61000-4-4, Level 4, 4kV input lines; 4kV signal lines

## Safety Marks

- **UL (SD12-PC socket required)**
- **UL508 (File #E68520)**

## Dimensions

- **H**: 44.45 mm (1.75”)
- **W**: 60.325 mm (2.375”)
- **D**: 104.775 mm (4.125”) (with socket)

## Weight

- **0.7 lb. (11.2 oz., 317.51 g)**

## Mounting Method

- Surface mount with #8 or #10 screws (plug into SD12-PC socket)

## Socket Available

- Model SD12-PC (UL Rating 600V)
- The 600V socket can be surface mounted
PC-102 SERIES

Protection Relays
Pump Controls and Liquid Level Controls

Dual Seal-Leak Detector or Seal-Leak & Over-Temperature Detector

**Description**

The PC-102 is a dual-channel switch that provides dual protection against seal failures and over-temperature in submersible pumping applications. Both units have two form-C isolated output relays and two LEDs, which illuminate when each associated output relay is energized. The sensitivity adjustment (4.7k-100kΩ) allows you to define the input impedance at which the output relays will change state. The sensitivity for the over-temperature detector can be set to 4k Ohms with use of the DIP switches.

This unit may not be compatible with Flygt pumps.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger-safe terminals</td>
<td>Meets IEC 61000 safety requirements</td>
</tr>
<tr>
<td>Compact design for DIN rail or surface mount</td>
<td>Allows flexibility in panel installation</td>
</tr>
<tr>
<td>LED Status Indicator</td>
<td>Visual indication of relay engagement</td>
</tr>
<tr>
<td>Two input channels</td>
<td>Flexibility for pump-up/pump-down or two-channel switch applications</td>
</tr>
</tbody>
</table>

**Specifications**

**Input Characteristics**

- Frequency: 50/60Hz

**Functional Characteristics**

- Probe Sense Voltage: 5Vdc pulsed
- Sensitivity: 4.7k-100kΩ
- Sensitivity (for temp): Selectable 4kΩ with DIP switches
- Input Logic: Direct or inverted
- Debounce Time Delay: 0.5 or 2 seconds

**Output Characteristics**

- Relay Output Rating: 180VA @ 120VAC, C150
- Pilot Duty: 5A @ 240VAC
- General Purpose: 5A @ 240VAC
- General Characteristics: Temperature Range -20° to 55°C (-4° to 131°F), Maximum Input Power 2W, Depluggable Connector Phoenix Contact-Series MSTB plugs, Output Relay Status Indicators: LEDs
- Terminal Torque: 4.5 in.-lbs
- Wire range: 12-20 AWG

**Standards Passed**

- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- Radio Frequency Immunity (RFI): IEC 61000-4-3, Level 3, 10V/m
- Fast Transients: IEC 61000-4-4, Level 3, 4kV input power 2kV inputs/outputs
- Safety Marks: UL
- Weight: 0.9 lb. (14.4 oz., 408.23 g)
- Mounting Method: 35mm DIN rail or Surface Mount (#6 or #8 screws)

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC-102CICI-DL</td>
<td>120VAC nominal</td>
<td>Dual seal-leak detector uses inputs to sense seal failures and energize the output relay. Input logic direct or inverted is DIP switch selectable</td>
</tr>
<tr>
<td>PC-102CICI-LT</td>
<td>120VAC nominal</td>
<td>Seal-leak and over-temperature detector uses one input to sense seal failures and the temperature input to detect motor overheating. Configurable to suit various probes. Seal input logic direct or inverted, plus over-temperature trip reset automatic or manual, is DIP switch selectable</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 510, Figure 10.
**Description**

The PC-105 is a 5-channel pump controller designed to handle multiple pump applications. Alternatively, it can operate as a 5-channel switch.

The PC-105’s control functions support all of the popular industry-standard multi-pump, pump-up and pump-down configurations. It can indicate low, high and out-of-sequence alarms and use alternating and non-alternating pump control. The non-alternating pump can be used as a jockey pump or emergency pump.

Using the built-in DIP switches, individual pumps can be disabled when taken out of service for repair or maintenance.

**Features**

- Compact design
- Low, high and out-of-sequence alarms
- Variable time delay/lag pump delay from 2-255 seconds
- Duplex SPS (separate pump stop) pump control
- Duplex, triplex or quadplex pump control
- Pump-up or pump-down functions
- External silence, reset and alternation configuration
- Five-channel relay configuration
- DIN rail or surface mountable

**Specifications**

**Input Characteristics**
- Supply Voltage: 120VAC
- Frequency: 50*/60Hz

**Functional Characteristics**
- Probe Sense Voltage: 5vdc continuous

**Output Characteristics**
- Relay Output Rating: Pilot Duty 480VA @ 240VAC, B300
- General Purpose 7A @ 240VAC

**General Characteristics**
- Temperature Range: -20° to 55°C (-4° to 131°F)
- Maximum Input Power: 4 W
- Wire range: 12 to 20 AWG
- Terminal Torque: 4.5 in.-lbs. (max.)
- Pump In-rush delay: 2 seconds

**Standards Passed**
- Electrostatic Discharge (ESD) IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
- Radio Frequency Immunity (RFI) IEC 61000-4-3, Level 3, 10V/m
- Fast Transients IEC 61000-4-4, Level 3, 4kV input power
- 2kV inputs/outputs

**Safety Marks**
- UL 508 (File #E68520)

**Dimensions**
- H 94.06 mm (3.703’’);
- W 127.64 mm (5.025’’);
- D 59.69 mm (2.35’’)

**Weight**
- 1.2 lbs. (19.2 oz., 544.31 g)

**Mounting Method**
- 35 mm DIN rail or Surface Mount
- (#6 or #8 screws)

*Note: 50Hz will increase all delay timers by 20%.*
**Description**

The PC-xxx-LLC-CZ and PC-xxx-LLC-GM Series are liquid level control relays used to control conductive liquid pumping operations in a pump-up or pump-down application. The units come in two different voltage ranges (see specs below).

The units have an adjustable sensitivity knob (4.7k to 100k ohms) that is set according to the resistance level at which you want the probes (sold separately) to sense the conductive liquid. The units have a built-in debounce time delay that prevents the relay from energizing if the probe resistance momentarily goes above or below the sensitivity setpoint (due to liquid splashing in the tank).

The units operate their internal relay based on inputs from a high and low probe and a common reference (when a conductive tank is used) or common probe (when a non-conductive tank is used).

**PC-xxx-LLC-CZ**
- Compatible with Crouzet’s PNR & PNRU series liquid level control

**PC-xxx-LLC-GM**
- Compatible with Gems’ Series 16M general purpose control

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debounce time delay</td>
<td>Prevents rapid cycling of the pump due to turbulence in the tank</td>
</tr>
<tr>
<td>(2 seconds)</td>
<td></td>
</tr>
<tr>
<td>Adjustable sensitivity</td>
<td>Allows user to fine tune the sensing resistance to prevent false tripping due to foam or debris</td>
</tr>
<tr>
<td>(4.7 to 100Kohms)</td>
<td></td>
</tr>
<tr>
<td>Dual probe design</td>
<td>Allows user the ability to set the level differential required</td>
</tr>
<tr>
<td>(plus a common)</td>
<td></td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC-100-LLC-CZ</td>
<td>95-120VAC</td>
<td>Compatible with Crouzet’s PNR &amp; PNRU Series liquid level control</td>
</tr>
<tr>
<td>PC-200-LLC-CZ</td>
<td>190-240VAC</td>
<td>Compatible with Crouzet’s PNR &amp; PNRU Series liquid level control</td>
</tr>
<tr>
<td>PC-100-LLC-GM</td>
<td>95-120VAC</td>
<td>Compatible with Gems’ Series 16M liquid level control</td>
</tr>
<tr>
<td>PC-200-LLC-GM</td>
<td>190-240VAC</td>
<td>Compatible with Gems’ Series 16M liquid level control</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 509, Figure 8.
Protection Relays
Pump Controls and Liquid Level Controls

PC-XXX-LLC-CZ / PC-XXX-LLC-GM SERIES

Accessories

**OT08PC 8-pin Octal Socket**
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

Specifications

<table>
<thead>
<tr>
<th>Input Characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage PC-100-LLC-CZ</td>
<td>95-120VAC</td>
</tr>
<tr>
<td>PC-100-LLC-GM</td>
<td>95-120VAC</td>
</tr>
<tr>
<td>PC-200-LLC-CZ</td>
<td>190-240VAC</td>
</tr>
<tr>
<td>PC-200-LLC-GM</td>
<td>190-240VAC</td>
</tr>
<tr>
<td>Frequency</td>
<td>50/60Hz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functional Characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe Sense Voltage</td>
<td>5VDC pulsed</td>
</tr>
<tr>
<td>Debounce Time Delay</td>
<td>2 seconds</td>
</tr>
<tr>
<td>Probe Sensitivity</td>
<td>4.7k to 100k Adjustable</td>
</tr>
</tbody>
</table>

Output Characteristics

<table>
<thead>
<tr>
<th>Output Contact Rating</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot Duty</td>
<td>480VA @ 240VAC</td>
</tr>
<tr>
<td>General Purpose</td>
<td>10A @240VAC</td>
</tr>
</tbody>
</table>

**General Characteristics**

Temperature Range: -40° to 70°C (-40° to 158°F)

Maximum Input Power: 5 W

Standards Passed

- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
- Radio Frequency Immunity (RFI): 150MHz, 10V/m
- Fast Transients: IEC 61000-4-4, Level 3, 2kV input power and controls

Safety Marks

- UL (OT08PC octal socket required) UL508 (File #E68520)
- CE IEC60947-6-2

Dimensions (when installed in socket base): H 44.45 mm (1.75”); W 60.33 mm (2.375”); D 104.78 mm (4.125”)

Weight: 0.65 lb, (10.4 oz., 294.84 g)

Mounting Method: DIN rail or surface mount (plug into OT08PC socket)

Socket Available: Model OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.
Single-Channel Seal-Leak Detector

**Description**

The model 201-100-SLD is an 8-pin plug-in style seal-leak detector to sense seal failures on submersible pumps. A microcontroller-based relay that monitors the shaft seal of a submersible pump motor. A resistive probe is installed in the seal cavity. If water leaks into the pump, the resistance measured by the probe decreases. When the resistance drops below the sensitivity setpoint, the unit will trip and the relay contacts will change state. The unit will automatically reset when a fault is cleared.

**Features & Benefits**

- LED status indicator
- Compact plug-in design
- DIN rail or surface mountable via octal base

**Accessories**

**OT08PC 8-pin Octal Socket**

Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

**Specifications**

- **Control Voltage**: 110/120VAC nominal
- **Frequency**: 50/60Hz
- **Sensitivity**: 4.7k-100kΩ
- **Probe Sense Voltage**: 5vdc pulsed
- **Output contact Rating**: SPDT
- **Pilot Duty**: 480VA @ 240VAC
- **General Purpose**: 10A @ 240VAC
- **Operating Temperature**: -40° to 70°C (-40° to 158°F)
- **Storage**: -40° to 80°C (-40° to 176°F)
- **Maximum Input Power**: 5 W
- **Relative Humidity**: 10-95%, non-condensing per IEC 68-2-3
- **Electrostatic Discharge (ESD)**: IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- **Radio Frequency Immunity, Radiated**: 150MHz, 10V/m
- **Fast Transient Burst**: IEC 61000-4-4, Level 3, 3.5kV input power and controls
  - IEC 61000-4-5, Level 3, 4kV line-to-line; level 4, 4kV line-to-ground
  - ANSI/IEEE C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
  - Hi-Potential Test: Meets UL508 (2 x rated V + 1000V for 1 min.)
  - UL*: UL508 (File #E688520)
  - CE: IEC 60947-6-2
- **Enclosure**: Polycarbonate
- **Dimensions**: H 44.45 mm (1.75”); W 60.325 mm (2.375”); D (with socket) 104.78 mm (4.125”)
- **Weight**: 0.7 lb (11.2 oz, 317.51 g)
- **Mounting Method**: DIN rail or surface mount (plug into OT08PC socket)
- **Socket Available**: Model OT08PC (UL Rating 600V)
- **Approvals**: UL, CE

*Must use Model OT08PC socket for UL Rating!

The 600V socket can be surface mounted or installed on DIN Rail.

For dimensional drawing see: Appendix, page 509, Figure 8.
Protection Relays
Pump Controls and Liquid Level Controls

460-15-100-LLS
Single-Channel Liquid Level Sensor

Description
The 460-15-100-LLS is a liquid level sensor to detect the presence of conductive liquids. A probe is mounted at the desired tank level and connected to the PumpSaver®. When the probe is submersed, the relay’s output contacts will change state as soon as the debounce time expires. The adjustable debounce timer is intended to prevent nuisance actuating due to waves or splashing in the tank.

Relay logic can be inverted so the relay’s output contacts change state when the probe is no longer submersed. This makes the unit versatile for use in pump-up and pump-down applications.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique Probe Protection</td>
<td>Probes are protected from scale build up through pulsed DC signal between the probes</td>
</tr>
<tr>
<td>Invertible relay logic</td>
<td>Allows flexibility to be used in pump-up and pump-down applications</td>
</tr>
<tr>
<td>Adjustable debounce timer</td>
<td>Prevents nuisance actuating caused by waves or splashing in the tank</td>
</tr>
<tr>
<td>LED status indicators</td>
<td>Provides visual indication of the relay status</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Input Characteristics</th>
<th>110/120VAC nominal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Voltage</td>
<td>50/60Hz (Note: 50Hz will increase all delay timers by 20%)</td>
</tr>
<tr>
<td>Frequency</td>
<td>100kΩ</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functional Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe Sense Voltage</td>
</tr>
<tr>
<td>Debounce Time Delay</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output contact Rating</td>
</tr>
<tr>
<td>(Two Form A - SPST)</td>
</tr>
<tr>
<td>Pilot Duty</td>
</tr>
<tr>
<td>General Purpose</td>
</tr>
<tr>
<td>General Characteristics</td>
</tr>
<tr>
<td>Ambient Temperature Range</td>
</tr>
<tr>
<td>Operating</td>
</tr>
<tr>
<td>Storage</td>
</tr>
<tr>
<td>Maximum Input Power</td>
</tr>
<tr>
<td>Class of Protection</td>
</tr>
<tr>
<td>Relative Humidity</td>
</tr>
<tr>
<td>Terminal Torque</td>
</tr>
<tr>
<td>Wire</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standards Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic Discharge (ESD)</td>
</tr>
<tr>
<td>IEC 61000-4-2, Level 3, 6kV contact, 8kV air</td>
</tr>
<tr>
<td>Radio Frequency</td>
</tr>
<tr>
<td>Immunity, Radiated</td>
</tr>
<tr>
<td>Fast Transient Burst</td>
</tr>
<tr>
<td>150MHz, 10 V/m</td>
</tr>
<tr>
<td>IEC 61000-4-4, Level 3, 3.5kV input power and controls</td>
</tr>
</tbody>
</table>
Surge
IEC
IEC 61000-4-5, Level 3, 4kV line-to-line;
Level 4, 4kV line-to-ground

ANSI/IEEE
C62.41 Surge and Ring Wave Compliance to
a level of 6kV line-to-line

Hi-Potential Test
Meets UL508 (2 x rated V + 1000 V for 1 min.)

Safety Marks
UL
UL508 (File #E68520)
CE
IEC 60947

Enclosure
Polycarbonate

Dimensions
H 88.9 mm (3.5”); W 52.93 mm (2.08”);
D 59.69mm (2.35”)

Weight
1 lb. (16 oz., 453.59 g)

Mounting Method
35mm DIN rail or Surface Mount
(#6 or #8 screws)
Description
The 460-15-100-SLD is a seal-leak detector to sense seal failures on submersible pumps. A microcontroller-based relay monitors the shaft seal of a submersible pump motor. A resistive probe is installed in the seal cavity. If water leaks into the pump, the resistance measured by the probe decreases. When the resistance drops below the sensitivity setpoint, the unit will trip and the relay contacts will change state. Output relay logic can be reversed by removing an external jumper. The unit will automatically reset when a fault is cleared.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique probe protection logic</td>
<td>Probes are protected from scale build up through pulsed DC signal between the probes</td>
</tr>
<tr>
<td>Invertible relay logic</td>
<td>Allows flexibility to be used in pump-up and pump-down applications</td>
</tr>
<tr>
<td>LED status indicators</td>
<td>Provides visual indication of the relay status</td>
</tr>
<tr>
<td>2 relay contacts</td>
<td>Control independent loads on different circuits</td>
</tr>
</tbody>
</table>

Specifications

**Input Characteristics**
- Control Voltage: 110/120VAC nominal
- Frequency: 50/60Hz (Note: 50Hz will increase all delay timers by 20%)  

**Functional Characteristics**
- Sensitivity: 4.7k-100kΩ
- Probe Sense Voltage: 5vdc pulsed

**Output Characteristics**
- Output contact Rating: (Two Form A - SPST)
- Pilot Duty: 360VA @ 240VAC
- General Purpose: 8A @ 240VAC

**General Characteristics**
- Ambient Temperature Range:
  - Operating: -40° to 70°C (-40° to 158°F)
  - Storage: -40° to 80°C (-40° to 176°F)
- Maximum Input Power: 2 W
- Class of Protection: IP20, NEMA 1 (finger safe)
- Relative Humidity: 10-95%, non-condensing per IEC 68-2-3
- Terminal Torque: 4.5 in.-lbs.
- Wire: AWG 12-20 AWG

**Standards Passed**
- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- Radio Frequency Immunity, Radiated: 150MHz, 10 V/m
- Fast Transient Burst: IEC 61000-4-4, Level 3, 3.5kV input power and controls

For dimensional drawing see: Appendix, page 510, Figure 10.
### Surge
- **IEC**
  - IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
- **ANSI/IEEE**
  - C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
- **Hi-Potential Test**
  - Meets UL508 (2 x rated V + 1000 V for 1 min.)

### Safety Marks
- **UL**
  - UL508 (File #E68520)
- **CE**
  - IEC 60947

### Enclosure
- Polycarbonate

### Dimensions
- **H**: 88.9 mm (3.5”);
- **W**: 52.93 mm (2.08”);
- **D**: 59.69 mm (2.35”)

### Weight
- 1 lb. (16 oz., 453.59 g)

### Mounting Method
- 35mm DIN rail or Surface Mount (#6 or #8 screws)
Protection Relays
Pump Controls and Liquid Level Controls

LLC1 SERIES
Open Board Liquid Level Controls

Description
The LLC1 Series is a single probe conductive liquid level control designed for OEM equipment and commercial appliances. This unit may be ordered with fixed fill or fixed drain operation. A time delay (1-60s) prevents rapid cycling of the output relay. On adjustable units, the sensitivity adjustment allows accurate level sensing while ignoring foaming agents and floating debris. Isolated AC voltage is provided at the probe to prevent electrolysis. A trickle current of less than 1mA determines the presence or absence of liquid between the probe and common. The LLC1 Series printed circuit board is conformal coated to resist moisture and corrosion.

Operation
Drain (Pump-Down Mode): When the liquid level rises and touches the probe, a fixed time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energizes and remains energized until the liquid level falls below the probe. The output relay then de-energizes and remains de-energized until the liquid again touches the probe.

Fill (Pump-Up Mode): When the liquid level falls below the probe, a fixed time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energizes and remains energized until the liquid level rises and touches the probe. The output relay then de-energizes and remains de-energized until the liquid level again falls below the probe.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated AC voltage on probe</td>
<td>Prevents scale buildup on the probe</td>
</tr>
<tr>
<td>Open PCB design</td>
<td>Cost effective design for OEM equipment and commercial appliances</td>
</tr>
<tr>
<td>Conformally coated PCB</td>
<td>Protects against moisture and corrosion</td>
</tr>
<tr>
<td>Sensitivity adjustment</td>
<td>Provides accurate level sensing while ignoring foam or floating debris</td>
</tr>
</tbody>
</table>

Wiring Diagram

For dimensional drawing see: Appendix, page 514, Figure 40.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>OPERATION</th>
<th>TIME DELAY</th>
<th>SENSE RESISTANCE</th>
<th>MOUNTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLC14A1AX</td>
<td>120VAC</td>
<td>Drain</td>
<td>1s</td>
<td>Adjustable</td>
<td>0.5 in nylon standoffs (3)</td>
</tr>
<tr>
<td>LLC14A5AX</td>
<td>120VAC</td>
<td>Drain</td>
<td>5s</td>
<td>Adjustable</td>
<td>0.5 in nylon standoffs (3)</td>
</tr>
<tr>
<td>LLC14B15AX</td>
<td>120VAC</td>
<td>Fill</td>
<td>15s</td>
<td>Adjustable</td>
<td>0.5 in nylon standoffs (3)</td>
</tr>
<tr>
<td>LLC14B1AX</td>
<td>120VAC</td>
<td>Fill</td>
<td>1s</td>
<td>Adjustable</td>
<td>0.5 in nylon standoffs (3)</td>
</tr>
<tr>
<td>LLC14B60AX</td>
<td>120VAC</td>
<td>Fill</td>
<td>60s</td>
<td>Adjustable</td>
<td>0.5 in nylon standoffs (3)</td>
</tr>
<tr>
<td>LLC16A25AX</td>
<td>230VAC</td>
<td>Drain</td>
<td>25s</td>
<td>Adjustable</td>
<td>0.5 in nylon standoffs (3)</td>
</tr>
<tr>
<td>LLC16A3AX</td>
<td>230VAC</td>
<td>Drain</td>
<td>3s</td>
<td>Adjustable</td>
<td>0.5 in nylon standoffs (3)</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Accessories

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**PHST-38QTN Electrode**
Designed for a maximum steam pressure of 240 PSI; 400°F. UL353 Recognized.

**LLP-24 Threaded Probe (24”)**
Threaded stainless steel probe measuring 24” (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

Specifications

Control Type
ON/OFF (single level) resistance sensor with built-in time delay to prevent rapid cycling

Sense Voltage
Low voltage AC between probe & common. Isolated from input & output.

Sense Resistance
Fixed or adjustable to 250KΩ

Sense Resistance Tolerance
Adjustable - guaranteed range
Factory fixed ±10%

Time Delay
Range
Fixed 1 - 60s in 1s increments

Input Voltage
24, 120, or 230VAC

Tolerance
24VAC -15% - 20%
120 & 230VAC -20% - 10%

AC Line Frequency
50/60 Hz

Output Type
Electromechanical relay

Form
Non-isolated, SPST & Isolated, SPDT contacts

Rating
10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC

Life Protection
Mechanical - 1 x 10⁷; Electrical - 1 x 10⁶

Surge
IEEE C62.41-1991 Level A

Isolation Voltage
≥ 1500V RMS between input, output & probe

Termination
Surface mount to probe common with two #6 (M3.5 x 0.6) screws or 0.50 in. (12.7 mm) nylon standoffs with three #6 (M3.5 x 0.6) screws (use Terminal 5 for probe common)

Dimensions (Open Board)
H 88.9 mm (3.5”); W 69.9 mm (2.75”); D 50.8 mm (2.0”)

Environmental Operating/Storage Temperature
-20° to 55°C/-40° to 80°C

Coating
Printed circuit board is conformal coated to resist moisture and corrosion

Weight
8.7 oz (247 g)
**Description**

The LLC2 Series is a dual-probe conductive liquid level control designed for OEM equipment and commercial appliance applications. Models are available for fill or drain operation. Transformer isolated 12VAC is provided at the probes to prevent electrolysis. A trickle current of less than 1mA determines the presence or absence of liquid between the probes and common. On adjustable units, the sensitivity adjustment allows accurate level sensing while ignoring foaming agents and floating debris. The LLC2 Series printed circuit board is conformal coated to resist moisture and corrosion.

**Operation**

**Drain (Pump-Down Mode):** When the liquid level rises and touches the high probe, the output relay energizes and remains energized until the liquid level falls below the low probe. The output relay then de-energizes and remains de-energized until the liquid again touches the high probe.

**Fill (Pump-Up Mode):** When the liquid level falls below the low probe, the output relay energizes and remains energized until the liquid level rises and touches the high probe. The output relay then de-energizes and remains de-energized until the liquid level again falls below the low probe.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated 12VAC probes</td>
<td>Prevents scale buildup on the probes</td>
</tr>
<tr>
<td>Open PCB design</td>
<td>Cost effective design for OEM equipment and commercial appliances</td>
</tr>
<tr>
<td>Conformally coated PCB</td>
<td>Protects against moisture and corrosion</td>
</tr>
<tr>
<td>Sensitivity adjustment</td>
<td>Provides accurate level sensing while ignoring foam or floating debris</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **PHST-38QTN Electrode**
  Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

- **LLP-24 Threaded Probe (24”)**
  Threaded stainless steel probe measuring 24” (61 cm) long. For use with PHST-38QTN liquid level control electrodes.
Specifications

Control Type
- Resistance sensing for high & low level detection of conductive liquids
- 12VAC at probe terminals

Sense Voltage
- Fixed or adjustable to 100KΩ

Sense Resistance
- Adjustable: guaranteed range
- Fixed: ±10%

Sense Resistance Tolerance
- Adjustable: guaranteed range
- Fixed: ±10%

Input Voltage
- 24, 120, or 230VAC

Tolerance
- 24VAC: -15% - 20%
- 120 & 230VAC: -20% - 10%

AC Line Frequency
- 50/60 Hz

Output Type
- Electromechanical relay

Form
- Isolated, SPDT

Rating
- 10A resistive @ 120/240VAC & 28VDC;
- 1/3 hp @ 120/240VAC
- Mechanical: 1 x 10⁷; Electrical: 1 x 10⁵

Protection Isolation Voltage
- ≥ 1500V RMS between input, output, & probe

Mechanical Mounting
- Surface mount with two or four #6 (M3.5 x 0.6) screws

Termination
- 0.25 in. (6.35 mm) duplex male quick connect terminals. Terminal blocks for up to #14 AWG

Dimensions (Open Board)
- H: 101.6 mm (4.0”);
- W: 76.2 mm (3.0”);
- D: 50.8 mm (2.0”)

Environmental Operating/Storage Temperature
- -20° to 55°C / -40° to 80°C

Coating
- Printed circuit board is conformal coated to resist moisture and corrosion

Weight
- ≅ 9 oz (255 g)

Mounting Dimensions

<table>
<thead>
<tr>
<th>DIAGRAM KEY</th>
<th>MODEL NUMBERS ENDING IN:</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>C</td>
</tr>
<tr>
<td>W 0.440”</td>
<td>0.250”</td>
</tr>
<tr>
<td>(11.176 mm)</td>
<td>(6.350 mm)</td>
</tr>
<tr>
<td>X 3.620”</td>
<td>3.500”</td>
</tr>
<tr>
<td>(91.948 mm)</td>
<td>(88.900 mm)</td>
</tr>
<tr>
<td>Y 2.120”</td>
<td>2.500”</td>
</tr>
<tr>
<td>(53.848 mm)</td>
<td>(63.500 mm)</td>
</tr>
<tr>
<td>Z 0.190”</td>
<td>0.250”</td>
</tr>
<tr>
<td>(4.826 mm)</td>
<td>(6.350 mm)</td>
</tr>
</tbody>
</table>
Description
The LLC4 combines resistance sensing circuitry with solid-state timing to provide single probe level maintenance. On adjustable units, the sensitivity adjustment allows accurate level sensing while ignoring foaming agents and floating debris. Isolated 12VAC is provided at the probe to prevent electrolysis. A trickle current of less than 1mA determines the presence or absence of conductive liquid between the probe and common. The LLC4 Series can be used with many types of low voltage (resistance changing) transducers to perform other control functions like temperature limit control, photo limit control, condensation sensing, and ice sensing.

Operation
Drain (Pump-Down Mode): When the liquid level rises and touches the probe, the time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energizes and remains energized until the liquid level falls below the probe level. The output relay then de-energizes and remains de-energized until the liquid rises and touches the probe.

Fill (Pump-Up Mode): When the liquid level falls below the probe, the time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energizes and remains energized until the liquid level rises and touches the probe. The output relay then de-energizes and remains de-energized until the liquid level again falls below the probe level.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated 12VAC probes</td>
<td>Prevents scale buildup on probe</td>
</tr>
<tr>
<td>Industry standard 8-pin octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
<tr>
<td>Sensitivity adjustment</td>
<td>Provides accurate level sensing while ignoring foam or floating debris</td>
</tr>
</tbody>
</table>

Wiring Diagram

For dimensional drawing see: Appendix, page 513, Figure 33.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>OPERATION</th>
<th>TIME DELAY</th>
<th>SENSE RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLC42A10A</td>
<td>24VAC</td>
<td>Drain</td>
<td>10s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC42A1A</td>
<td>24VAC</td>
<td>Drain</td>
<td>1s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC42B15A</td>
<td>24VAC</td>
<td>Fill</td>
<td>15s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44A10A</td>
<td>120VAC</td>
<td>Drain</td>
<td>10s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44A15A</td>
<td>120VAC</td>
<td>Drain</td>
<td>15s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44A1A</td>
<td>120VAC</td>
<td>Drain</td>
<td>1s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44A2A</td>
<td>120VAC</td>
<td>Drain</td>
<td>2s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44A4A</td>
<td>120VAC</td>
<td>Drain</td>
<td>4s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44A5A</td>
<td>120VAC</td>
<td>Drain</td>
<td>5s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>OPERATION</th>
<th>TIME DELAY</th>
<th>SENSE RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLC44B1A</td>
<td>24VAC</td>
<td>Fill</td>
<td></td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44A60A</td>
<td>120VAC</td>
<td>Drain</td>
<td>60s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44B20A</td>
<td>120VAC</td>
<td>Fill</td>
<td>20s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44B2A</td>
<td>120VAC</td>
<td>Fill</td>
<td>2s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44B30A</td>
<td>120VAC</td>
<td>Fill</td>
<td>30s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44B4A</td>
<td>120VAC</td>
<td>Fill</td>
<td>4s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44B5A</td>
<td>120VAC</td>
<td>Fill</td>
<td>5s</td>
<td>Adjustable 1 - 250kΩ</td>
</tr>
<tr>
<td>LLC44B5F100</td>
<td>120VAC</td>
<td>Fill</td>
<td>5s</td>
<td>Fixed 100kΩ</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848
### Accessories

**BZ1 Front Panel Mount Kit**
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

**NDS-8 Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

**PSC8 Hold-down Clips**

**PHST-38QTN Electrode**
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

**LLP-24 Threaded Probe (24”)**
Threaded stainless steel probe measuring 24” (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

### Specifications

<table>
<thead>
<tr>
<th>Control Type</th>
<th>ON/OFF (single level) resistance sensor with built-in time delay to prevent rapid cycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing Voltage</td>
<td>12VAC</td>
</tr>
<tr>
<td>Sensing Resistance</td>
<td>Fixed or adjustable to 250KΩ</td>
</tr>
<tr>
<td>Sensing Resistance Tolerance</td>
<td>Adjustable: 1K ±500Ω at low end; 250K ±25% at high end</td>
</tr>
<tr>
<td>Factory fixed: ±10% or 500Ω, whichever is greater</td>
<td></td>
</tr>
</tbody>
</table>

| Input Voltage | 24, 120, or 230VAC |
| Tolerance | 24VAC: -15%, +20% |
| 120 & 230VAC: -20%, +10% |

| AC Line Frequency | 50/60 Hz |

| Output Type | Electromechanical relay |
| Form | Isolated, SPDT |
| Rating | 4A resistive @ 240VAC; 1/10 hp @ 240VAC |

| Protection Surge | IEEE C62.41-1991 Level A |
| Isolation Voltage | ≥ 1500V RMS between input, output & probe |

| Mechanical Mounting | Plug-in socket |
| Termination | Octal 8-pin plug-in |
| Dimensions | H 73.9 mm (2.91”); W 60.7 mm (2.39”); D 45.2 mm (1.78”) |

| Environmental Operating/Storage Temperature | -20° to 60°C/-40° to 80°C |
| Weight | 6 oz (170 g) |
**Description**

The LLC5 provides dual probe conductive liquid level control in a convenient octal plug-in package. Models are available for fixed fill or drain operation. Isolated, pulsed DC voltage on the probes prevents electrolytic plating. Less than 1 mA of current is used to sense the presence of conductive liquid between the probes and common. On adjustable units, the sensitivity adjustment eliminates false tripping caused by floating debris and foaming agents.

**Operation**

**Drain (Pump-Down Mode):** When the liquid level rises and touches the high level probe, the output relay and LED energize and remain energized until the liquid level falls below the low level probe. The output relay and LED de-energize and remain de-energized until the liquid rises and touches the high level probe.

**Fill (Pump-Up Mode):** When the liquid level falls below the low level probe, the output relay and LED energize and remain energized until the liquid level rises and touches the high level probe.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique Probe Protection logic</td>
<td>Probes are protected from scale build up through pulsed DC signal between the probes.</td>
</tr>
<tr>
<td>LED status indicator</td>
<td>Visual indication of relay engagement in pump-up or pump-down activity</td>
</tr>
<tr>
<td>Isolated 5A SPDT contacts</td>
<td>Allows control of loads for AC voltage</td>
</tr>
</tbody>
</table>

**Accessories**

- **BZ1 Front Panel Mount Kit**
  Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

- **NDS-8 Octal 8-pin Socket**
  8-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

- **PSC8 Hold-down Clips**

  **Note:** use of the PSC8 clips partly covers the LED window of the LLC5 unit. Use of alternative socket base P1011-6 with its corresponding hold down clips PSCR86 do not cover up the LED window, but the socket base is not DIN rail mountable.

---

For dimensional drawing see: Appendix, page 514, Figure 43.

If you don’t find the part you need, call us for a custom product 800-843-8848
**Accessories**

**PHST-38QTN Electrode**  
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

**LLP-24 Threaded Probe (24”)**  
Threaded stainless steel probe measuring 24” (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

**Specifications**

<table>
<thead>
<tr>
<th>Control</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Resistance sensing for high &amp; low level detection of conductive liquids</td>
</tr>
<tr>
<td></td>
<td>Pulsed DC at probe terminals</td>
</tr>
<tr>
<td>Sensing Voltage</td>
<td>Factory fixed or adjustable to 100KΩ</td>
</tr>
<tr>
<td>Sensing Resistance</td>
<td>Adjustable: 1K ±500Ω at low end; 100KΩ ±25%, 0% at high end</td>
</tr>
<tr>
<td>Tolerance</td>
<td>Factory fixed: +10% or 5000 whichever is greater</td>
</tr>
<tr>
<td>Response Time</td>
<td>Debounce time delay &lt;1s</td>
</tr>
<tr>
<td>Input</td>
<td>AC Line Frequency 50/60 Hz</td>
</tr>
<tr>
<td>Tolerance</td>
<td>-15%, +20%</td>
</tr>
<tr>
<td>24VAC</td>
<td>-20%, +10%</td>
</tr>
<tr>
<td>120 &amp; 230VAC</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Output</td>
<td>Electromechanical relay</td>
</tr>
<tr>
<td>Type</td>
<td>Isolated, SPDT</td>
</tr>
<tr>
<td>Form</td>
<td>5A resistive @ 240VAC, 1/10 hp @ 240VAC</td>
</tr>
<tr>
<td>Rating</td>
<td>≥ 1500V RMS between input, output, &amp; probe</td>
</tr>
<tr>
<td>Protection</td>
<td>Plug-in socket</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Octal 8-pin plug-in</td>
</tr>
<tr>
<td>Mounting</td>
<td>Operating/Storage Temperature -20° to 60°C / -40° to 80°C</td>
</tr>
<tr>
<td>Dimensions</td>
<td>6 oz (170 g) approx.</td>
</tr>
<tr>
<td>Termination</td>
<td>Weight</td>
</tr>
</tbody>
</table>
### LLC6 Series

**Description**

The LLC6 Series is a plug-in, single-probe conductive liquid level control designed for low liquid level cutoff protection. It offers a factory fixed time delay of 1 - 60s and is available in input voltages of 24, 120, or 230VAC. LED indicator illuminates whenever the LLC6's 10A, SPDT output relay is energized. Available with automatic/manual reset or a special manual reset with power outage feature, which auto resets the unit when power is restored and the water level is acceptable. 24VAC and 120VAC units are recognized as limit switches under UL353 (230VAC units are UL508) and CSA certified under Standard 14.

**Operation**

**Automatic Reset (Reset terminals not connected):** When liquid rises to the low level cutoff probe, the output relay and the LED indicator energize. When the liquid falls below low level cutoff probe, the output relay and the LED indicator de-energize after a fixed time delay.

**Manual Reset (Reset switch connected):** When the liquid level falls below the low level probe, the output relay and LED de-energize after a fixed time delay. When the liquid level rises to the low level probe, the output relay and LED indicator remain de-energized until the manual reset switch is opened; then they energize immediately.

**Power Outage Manual Reset (Reset switch connected):** A power outage causes the output relay and LED indicator to de-energize. Upon restoration of power, if the liquid level is above the low level probe, the output relay and LED indicator will re-energize. If the liquid level is below the low level probe, the output relay and LED indicator remain de-energized until the Normally Closed (NC) reset switch is opened.

### Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated 12VAC on probe</td>
<td>Prevents electrolysis</td>
</tr>
<tr>
<td>Industry standard 11-pin octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
<tr>
<td>LED indication</td>
<td>Visual indication output relay is energized</td>
</tr>
<tr>
<td>Power outage protection (see ordering table for models)</td>
<td>Automatically resets the unit when power is restored and the water level is acceptable</td>
</tr>
</tbody>
</table>

### Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>TIME DELAY (FIXED)</th>
<th>SENSE RESISTANCE</th>
<th>RESET</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLC6210F10M</td>
<td>24VAC</td>
<td>10s</td>
<td>10kΩ</td>
<td>Manual/Automatic</td>
</tr>
<tr>
<td>LLC6410F10M</td>
<td>120VAC</td>
<td>10s</td>
<td>10kΩ</td>
<td>Manual/Automatic</td>
</tr>
<tr>
<td>LLC643F26M</td>
<td>120VAC</td>
<td>3s</td>
<td>26kΩ</td>
<td>Manual/Automatic</td>
</tr>
<tr>
<td>LLC6610F5P</td>
<td>230VAC</td>
<td>10s</td>
<td>5kΩ</td>
<td>Power Outage Manual Reset</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848.

---

**Wiring Diagram**

Metal Tank or use additional Probe

PC = Probe
P = Probe
V = Voltage
R = Optional NC Reset Switch

Connect common to conductive tank. Additional probe is necessary for non-conductive or insulated tanks.

For dimensional drawing see: Appendix, page 513, Figure 33.
Accessories

**BZ1 Front Panel Mount Kit**
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

**NDS-11 11-pin Socket**
11-pin 35mm DIN rail or surface mount. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

**PSC11 Hold-down Clips**

**PHST-38QTN Electrode**
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

**LLP-24 Threaded Probe (24”)**
Threaded stainless steel probe measuring 24” (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

Specifications

**Control**
**Type**
ON/OFF (single level) resistance sensor with built-in time delay to prevent rapid cycling

**Sense Voltage**
12VAC nominal at probe terminals

**Sense Resistance**
Fixed 5K - 250KΩ

**Sense Resistance Tolerance**
Fixed ±10%

**Time Delay**
**Range**
1 - 60s in 1s increments

**Tolerance**
±20%

**Repeat Accuracy**
±10%

**Time Delay vs Temp. & Voltage**
±10%

**Power Outage Reset Delay**
≤ 1s

**Input**
**Voltage**
24, 120, or 230VAC

**Tolerance**
24VAC +20% to -15%
120 or 230VAC +10% to -20%

**AC Line Frequency**
50/60 Hz

**Output**
**Type**
Electromechanical relay

**Form**
Non-isolated, SPDT

**Rating**
10A resistive @ 240VAC; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC

**Protection**
**Surge**
IEEE C62.41-1991 Level A
≥ 2500V RMS between input & output terminals

**Environmental**
**Operating/Storage Temperature**
-40° to 60°C / -40° to 80°C

**Humidity**
95% relative, non-condensing

**Weight**
≈ 7.3 oz (207 g)
**Description**

The LLC8 Series is a low cost, single-probe conductive liquid level control designed for low liquid level cutoff protection. It offers a factory fixed time delay of 1 - 60s and is available for input voltages of 24, 120, or 230VAC. LED indicator illuminates whenever the LLC8’s isolated, 10A, SPDT output relay is energized. Sense resistance is fixed from 5K - 250KΩ. Available with manual/automatic reset or a special manual reset with a power outage feature that auto resets the unit when power is restored and the water level is acceptable. 24 and 120VAC units are UL recognized as limit switches under UL353 (230VAC units are UL 508) and CSA certified under Standard 14.

**Operation**

**Automatic Reset (Reset switch not connected):** When liquid rises to low level cutoff probe, output relay and LED indicator energize. When liquid falls below the low level cutoff probe, the output relay and LED indicator de-energize after a fixed time delay.

**Manual Reset (Reset switch connected):** When the liquid level falls below low level probe, the output relay and LED de-energize after a fixed time delay. When the liquid level rises to low level probe, the output relay and LED indicator remain de-energized until the NC manual reset switch is opened; then they energize immediately.

**Power Outage Manual Reset (Reset switch connected):** A power outage causes the output relay and LED indicator to de-energize. Upon restoration of power, if the liquid is touching the low level probe, the output relay and LED indicator will re-energize. If the liquid level is below the low level probe, the output relay and LED indicator remain de-energized until the NC reset switch is opened.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated 12VAC probes</td>
<td>Prevents scale buildup on probe</td>
</tr>
<tr>
<td>Open PCB design</td>
<td>Cost effective design for OEM low liquid level cutoff protection</td>
</tr>
<tr>
<td>Conformally coated PCB</td>
<td>Protects against moisture and corrosion</td>
</tr>
<tr>
<td>LED indication</td>
<td>Visual indication output relay is energized</td>
</tr>
<tr>
<td>Power outage protection (see ordering table for models)</td>
<td>Automatically resets the unit when power is restored and the water level is acceptable</td>
</tr>
<tr>
<td>24VAC &amp; 120VAC models meet UL353</td>
<td>Required for use as a low level limit switch</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 514, Figure 42.
## Accessories

- **P1015-13** (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **PHST-38QTN Electrode**
  Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

- **LLP-24 Threaded Probe (24”)**
  Threaded stainless steel probe measuring 24” (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

## Specifications

**Control**
- **Type**: Resistance sensing for conductive liquids with time delay
- **Sense Voltage**: 12VAC nominal at probe terminals
- **Sense Resistance**: Fixed 5K - 250KΩ
- **Sense Resistance Tolerance**: ±10%
- **Time Delay Tolerance**: ±20%
- **Repeat Accuracy**: ±10%
- **Time Delay vs Temp. & Voltage**: ±10%
- **Power Outage Reset Delay**: ≤1s

**Input**
- **Voltage**: 24, 120, or 230VAC
  - **Tolerance**: 24VAC -15% - 20%
  - **120 or 230VAC**: -20% - 10%
- **AC Line Frequency**: 50/60 Hz

**Output**
- **Type**: Electromechanical relay
- **Form**: Isolated SPDT
- **Rating**: 10A resistive @ 120/240VAC; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC

**Protection**
- **Surge**: IEEE C62.41-1991 Level A
- **Isolation Voltage**: ≥ 2500V RMS input to output terminals

**Mechanical**
- **Mounting**: 0.5 in. (12.7 mm) x .187 (4.76 mm) dia. nylon standoffs (3)
- **Termination Dimensions**: H 63.5 mm (2.5”), W 55.6 mm (2.19”), D 47.8 mm (1.88”)
- **Electrical**: 0.25 in. (6.35 mm) male quick connect terminals
- **Reset Switch & Probe(s)**: 0.187 x 0.03 in. (4.75 x 0.76 mm) male quick connect terminals

**Environmental**
- **Operating/Storage Temperature**: -40° to 60°C / -40° to 80°C
- **Coating**: Printed circuit board is conformal coated to resist moisture & corrosion
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 5 oz (141.7 g)
ALT SERIES

8-pin Plug-in Alternating Relay

Description
The ALT alternating relays are used to alternate between two loads. The ALT is commonly used in duplex pumping applications to balance the runtime of both pumps.

The ALT-S is used in single high-level float applications. When the float switch opens, the alternating relay changes state, forcing the other pump to run the next time the float closes.

All ALT relays have a built-in debounce feature that prevents the relay from changing state if the switch or float contact bounces momentarily.

The ALT-X has an internal cross-connected relay and is used in dual high-level float applications. These floats are commonly referred to as lead and lag floats.

The pumps alternate as in the ALT-S version but the cross-connected relay configuration allows both pumps to run simultaneously when both the lead and lag floats are closed.

These relays are also available with a built-in switch (SW option) that is used to manually force one of the pumps to run every time the float switch is closed. This is helpful when a pump has been removed for repair or for test purposes. In the case of the ALT-X-SW, the switch essentially forces one pump to be the lead pump, while still allowing the second to run when both floats are closed.

Must use the OT08PC socket for UL Rating!

*Note: Manufacturer’s recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debounce time delay</td>
<td>Prevents nuisance actuating causes by waves or spashing in the tank</td>
</tr>
<tr>
<td>Built-in manual/auto switch</td>
<td>Force lead pump operation when a pump is removed for repair or testing (on select models)</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALT024-S</td>
<td>20-26VAC</td>
<td>For single high-level float applications</td>
</tr>
<tr>
<td>ALT024-S-SW</td>
<td>20-26VAC</td>
<td>For single high-level float applications with built in manual switch</td>
</tr>
<tr>
<td>ALT115-S</td>
<td>95-125VAC</td>
<td>For single high-level float applications</td>
</tr>
<tr>
<td>ALT115-S-SW</td>
<td>95-125VAC</td>
<td>For single high-level float applications with built in manual switch</td>
</tr>
<tr>
<td>ALT115-X</td>
<td>95-125VAC</td>
<td>For dual high-level (lead and lag) float applications</td>
</tr>
<tr>
<td>ALT115-X-SW</td>
<td>95-125VAC</td>
<td>For dual high-level (lead and lag) float applications with built in manual switch</td>
</tr>
<tr>
<td>ALT230-S</td>
<td>195-250VAC</td>
<td>For single high-level float applications</td>
</tr>
<tr>
<td>ALT230-S-SW</td>
<td>195-250VAC</td>
<td>For single high-level float applications with built in manual switch</td>
</tr>
<tr>
<td>ALT230-X</td>
<td>195-250VAC</td>
<td>For dual high-level (lead and lag) float applications</td>
</tr>
<tr>
<td>ALT230-X-SW</td>
<td>195-250VAC</td>
<td>For dual high-level (lead and lag) float applications with built in manual switch</td>
</tr>
</tbody>
</table>

Accessories

**OT08PC Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

1ALT024-S and ALT024-S-SW are not UL Listed
### Specifications

**Input Characteristics**
- **Supply Current**: 40mA

**Functional Characteristics**
- **Debounce Time Delay**: 0.5 second
- **Control Input Impedance (min)**:
  - 24: 10kΩ
  - 115: 56kΩ
  - 230: 100kΩ

**Output Characteristics**
- **Output Contact Rating**: 480VA @ 240VAC

### General Characteristics

**Temperature Range**: -40° to 50°C (-40° to 122°F)
**Maximum Input Power**: 5 W

**Safety Marks**
- UL (OT08PC octal socket required)
- CSA
- UL508 (File #E68520)
- C22.2 No. 14 (File #46510)

**Dimensions (with socket)**
- H: 44.45 mm (1.75”)
- W: 60.33 mm (2.375”)
- D: 104.78 mm (4.125”)

**Weight**: 0.38 lb. (6.08 oz., 172.67 g)

**Mounting Method**
- DIN rail or surface mount (plug into OT08PC socket)
- OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.

---

**Disclaimer Notice** – Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at www.littelfuse.com/product-disclaimer.
ALT-XXX-1-SW / ALT-XXX-3-SW SERIES

Alternating Relay

Description
The ALT-xxx-1-SW/ALT-xxx-3-SW Series are used to alternate between two loads and are commonly used in duplex pump-up and pump-down applications to balance the runtime of both pumps.

The ALT relays have a built-in debounce time delay that prevents the relay from changing state if the float momentarily bounces, and they have a built-in switch to manually force a specific load (pump) to operate each time the input float closes. This is helpful when performing periodic maintenance or pump repair.

Must use the OT08PC socket for the 8-pin models, and the OT11PC socket for the 11-pin models, for UL Rating!

*Note: Manufacturer’s recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debounce time delay</td>
<td>Prevents rapid cycling caused by waves or splashing in the tank</td>
</tr>
<tr>
<td>LED indicators</td>
<td>Visual indication of load operation in duplex application</td>
</tr>
<tr>
<td>Built-in manual switch to force load operation</td>
<td>Helpful to control load operation when performing periodic maintenance or pump repair</td>
</tr>
<tr>
<td>ALT-xxx-3-SW offers duplexing</td>
<td>Allows lag pump to energize if lead pump can’t handle current demand</td>
</tr>
</tbody>
</table>

Accessories

OT08PC  8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

OT11PC  11-pin Magnal Socket
11-pin surface & DIN rail mountable. Rated for 10A @ 300VAC.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOTAGE</th>
<th>MOUNTING</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALT-100-1-SW</td>
<td>95-120VAC</td>
<td>11-pin magnal</td>
<td>Single float input, two isolated Form C relays (DPDT), 2 LEDs for load indication</td>
</tr>
<tr>
<td>ALT-100-3-SW</td>
<td>95-120VAC</td>
<td>8-pin octal</td>
<td>Three float inputs (lead, lag, stop floats), actuating latching relays on lead/lag floats, 2 LEDs for load indication</td>
</tr>
<tr>
<td>ALT-200-3-SW</td>
<td>190-240VAC</td>
<td>8-pin octal</td>
<td>Three float inputs (lead, lag, stop floats), actuating latching relays on lead/lag floats, 2 LEDs for load indication</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 509, Figure 8.
### Specifications

#### Input Characteristics
- **Supply Voltage**
  - ALT-100-1-SW, ALT-100-3-SW: 95-120VAC
  - ALT-200-3-SW: 190-240VAC
- **Frequency**
  - 50/60Hz

#### Functional Characteristics
- **Debounce Time Delay**
  - ALT-100-1-SW: 1 second
  - ALT-100-3-SW, ALT-200-3-SW: 5 seconds

#### Output Characteristics
- **Output Relay (DPDT)**
  - Pilot Duty: 480VA @ 240VAC
  - General Purpose: 10A @ 240VAC

#### General Characteristics
- **Temperature Range**
  - -40° to 70°C (-40° to 158°F)
- **Maximum Input Power**
  - 5 W

### Standards Passed

- **Electrostatic Discharge (ESD)**
  - IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- **Radio Frequency, Radiated**
  - 150MHz, 10V/m
- **Fast Transient Burst**
  - IEC 61000-4-4, Level 3, 3.5kV input power and controls
- **Safety Marks**
  - UL (OT08PC or OT11PC octal socket required)
  - UL508 (File #E68520)
- **CE**
  - IEC 60947-6-2
- **Dimensions**
  - H 44.45 mm (1.75”); W 60.33 mm (2.375”); D 104.78 mm (4.125”) (with socket)
- **Weight**
  - 0.65 lb. (10.4 oz., 294.84 g)
- **Mounting Method**
  - DIN rail or surface mount (plug into OT08PC or OT11PC socket)
- **Sockets Available**
  - Model OT08PC: UL Rating 600V
  - Model OT11PC: UL Rating 300V

The sockets can be surface mounted or installed on DIN Rail.
Description
The ARP Series is used in systems where equal run time for two motors is desirable. The selector switch allows selection of alternation or for continuous operation of either load. LED’s indicate the status of the output relay. This versatile series may be front panel mounted (BZ1 accessory required) or 35 mm DIN rail mounted with an accessory socket.

Operation
Alternating: When the rotary switch is in the “alternate” position, alternating operation of Load A and Load B occurs upon the opening of the control switch S1. To terminate alternating operation and cause only the selected load to operate, rotate the switch to position “A” to lock Load A or position “B” to lock Load B. The LEDs indicate the status of the internal relay and which load is selected to operate.

Note: Input voltage must be applied at all times for proper alternation. The use of a solid-state control switch for S1 may not initiate alternation correctly. S1 voltage must be from the same supply as the unit’s input voltage (see connection diagrams). Loss of input voltage resets the unit; Load A becomes the lead load for the next operation.

Duplexing (Cross-Wired): Duplexing models operate the same as alternating relays and when both the Control (S1) and Lag Load (S2) Switches are closed, Load A and Load B energize simultaneously.

The DPDT 8-pin, cross-wired option, allows extra system load capacity through simultaneous operation of both motors when needed. Relay contacts are not isolated.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternating or electrically locked operation</td>
<td>Flexibility to run unit alternating between the two loads as normal or lock the relay to one specific load.</td>
</tr>
<tr>
<td>Low profile selector switch</td>
<td>Prevents accidental actuation</td>
</tr>
<tr>
<td>LED status indication</td>
<td>Visual indication of which load is engaged</td>
</tr>
<tr>
<td>Industry standard base connection</td>
<td>Flexibility to use in many applications</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>OUTPUT FORM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR120A-3095</td>
<td>120VAC</td>
<td>SPDT</td>
<td>8-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.</td>
</tr>
<tr>
<td>ARP23S</td>
<td>24VAC</td>
<td>DPDT</td>
<td>8-pin cross-wired for duplexing applications. Rotary switch allows user to lock internal relay to one specific load.</td>
</tr>
<tr>
<td>ARP41</td>
<td>120VAC</td>
<td>SPDT</td>
<td>8-pin for alternating applications.</td>
</tr>
<tr>
<td>ARP41S</td>
<td>120VAC</td>
<td>SPDT</td>
<td>8-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.</td>
</tr>
<tr>
<td>ARP42S</td>
<td>120VAC</td>
<td>DPDT</td>
<td>11-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.</td>
</tr>
<tr>
<td>ARP43</td>
<td>120VAC</td>
<td>DPDT</td>
<td>8-pin cross-wired for duplexing applications.</td>
</tr>
<tr>
<td>ARP43S</td>
<td>120VAC</td>
<td>DPDT</td>
<td>8-pin cross-wired for duplexing applications. Rotary switch allows user to lock internal relay to one specific load.</td>
</tr>
<tr>
<td>ARP61S</td>
<td>230VAC</td>
<td>SPDT</td>
<td>8-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.</td>
</tr>
<tr>
<td>ARP62S</td>
<td>230VAC</td>
<td>DPDT</td>
<td>11-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.</td>
</tr>
<tr>
<td>ARP63S</td>
<td>230VAC</td>
<td>DPDT</td>
<td>8-pin cross-wired for duplexing applications. Rotary switch allows user to lock internal relay to one specific load.</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
## Accessories

**BZ1 Front Panel Mount Kit**
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

**NDS-8 Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

**NDS-11 11-pin Socket**
1-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

**PSC8 or PSC11 Hold-down Clips**
Securely mounts plug-in controls in any position. Provides protection against vibration. Use PSC8 with NDS-8 Octal Socket or PSC11 with NDS-11 Socket. Sold in pairs.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

## Specifications

### Input
- **Tolerance**
  - 24VAC: -15% to 20%
  - 120 & 230VAC: -20% to 10%

### AC Line Frequency
- 50/60Hz

### Output
- **Type**
  - Electromechanical relay
- **Form**
  - SPDT, DPDT, or cross-wired DPDT
- **Rating**
  - 10A resistive @ 120/240VAC & 28 VDC;
  - 1/3 hp @ 120/240VAC
  - 250VAC
- **Maximum Voltage**
  - 250VAC
- **Life**
  - Mechanical - 1 x 10⁷; Electrical - 1 x 10⁶

**Protection**
- **Isolation Voltage**
  - ≥ 1500V RMS input to output

**Mechanical**
- **Mounting**
  - Plug-in socket
- **Dimensions**
  - H 60.7 mm (2.39”); W 45.2 mm (1.78”);
  - D 81.3 mm (3.2”)
- **Termination**
  - Octal 8-pin or magnal 11-pin

**Environmental**
- **Operating/Storage Temperature**
  - -20° to 60°C / -30° to 85°C
- **Weight**
  - 5.6 oz (159 g) approx.

**NOTE:** Unit does not have debounce time delay.
Description
The 50R-400-ALT alternating relays are used to alternate between two loads, most commonly in duplex pumping and compressor applications to balance the runtime of both loads.

When used in single float applications, the alternating relay changes state after the float switch opens*, forcing the other pump to run the next time the float closes. When used in dual float applications, the alternating relay will allow both pumps to run simultaneously when the lead and lag floats are both closed. An adjustment knob provides the option to force one pump to run every time the float switch is closed. This is helpful when one pump has been removed for repair or for test purposes. A built-in debounce feature prevents the alternating relay from changing state if the float contact bounces momentarily.

*The alternating relay will not switch states while current is flowing. Switching will only occur after current has been sensed, followed by loss of current for the duration of the debounce time delay.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debounce time delay</td>
<td>Prevents rapid cycling caused by waves or splashing in the tank</td>
</tr>
<tr>
<td>LED indicators</td>
<td>Visual indication of load operation in duplex application</td>
</tr>
<tr>
<td>Built-in manual switch to force load operation</td>
<td>Helpful to control load operation when performing periodic maintenance or pump repair</td>
</tr>
<tr>
<td>Operates from 380 - 480VAC</td>
<td>No transformer required to provide 120 - 240V for control circuit</td>
</tr>
</tbody>
</table>

Specifications

Input Characteristics
- Supply Voltage: 380-480VAC
- Supply Current: 40mA

Functional Characteristics
- Control Input Impedance (min): 1MΩ

Output Characteristics
- Output Contact Rating:
  - Pilot Duty: 470VA @ 600VAC
  - General Purpose: 10A
- Debounce Time Delay: 1 second

General Characteristics
- Maximum Input Power: 5 W
- Terminal Torque: 7 in.-lbs.
- Wire Size: 12-18 AWG
- Safety Marks: UL508 (File #E68520)
- CE: IEC 60947
- Dimensions: H 74.4 mm (2.93”); W 133.9 mm (5.27”); D 74.9 mm (2.95”)
- Weight: 0.98 lb. (15.68 oz., 444.52 g)
- Mounting Method: #8 screws

For dimensional drawing see: Appendix, page 509, Figure 6.
Description
The ISS-100 switches are UL 913 listed as an associated apparatus for interfacing between hazardous and non-hazardous areas. These units must be installed in a non-hazardous area.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger-safe terminals</td>
<td>Meets IEC 61000 safety requirements</td>
</tr>
<tr>
<td>Compact design for DIN rail or surface mount</td>
<td>Allows flexibility in panel installation</td>
</tr>
<tr>
<td>LED Status Indicator</td>
<td>Visual indication of relay engagement</td>
</tr>
<tr>
<td>Isolated output relay</td>
<td>Allows connection to PLC or control voltage</td>
</tr>
</tbody>
</table>

Specifications

Input Characteristics
- Supply Voltage: 90-120VAC

Functional Characteristics
- Probe Sense Voltage: 5Vdc continuous

Output Characteristics
- Output Contact Rating: 180VA @120VAC, C300
- General Purpose: 8A @120VAC
- Relay Contact Life (Electrical): 100,000 cycles min. @ rated load
- Relay Contact Life (Mechanical): 10,000,000 cycles

General Characteristics
- Temperature Range: -20°C to 55°C (-4°F to 131°F)
- Maximum Input Power: 1.5 W
- Wire range: 12 to 20 AWG
- Terminal Torque: 3.5 to 4.5 in.-lbs. (max. 4.5 in.-lbs.)
- Provides Intrinsically-Safe Circuits in the following locations:
  - Division 1 and 2
  - Class I, Groups A,B,C,D;
  - Class II, Groups E,F,G;
  - and Class III

Entity Parameters
- \( V_o = 16.8V \)
- \( P_o = V_o \times I_s_c \)
- \( I_s_c = 1.2mA \)
- \( L_s = 100\text{mH} \)
- \( C_s = 0.39\mu\text{F} \)

Standards Passed
- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- Radio Frequency Immunity (RFI): IEC 61000-4-3, Level 3, 10W/m
- Fast Transients: IEC 61000-4-4, Level 3, 4kV input power
- Safety Mark: UL
- Dimensions: H 88.9 mm (3.5”); W 52.93 mm (2.08”);
              D 59.69 mm (2.35”)
- Weight: 0.5 lb. (8 oz., 226.8 g)
- Mounting Method: 35mm DIN rail or Surface Mount (#6 or #8 screws)

Wiring Diagram

1. Maximum distance between unit and switch contact is 10,000 feet.
2. All non-intrinsically safe wiring shall be separated from intrinsically safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically Safe Systems. Check your state and local codes for additional requirements.
3. All switch contacts shall be non-energy storing, containing no inductance or capacitance.

For dimensional drawing see: Appendix, page 510, Figure 10.
Description
The ISS-101 switches are UL 913 listed as an associated apparatus for interfacing between hazardous and non-hazardous areas. These units must be installed in a non-hazardous area.

Must use Model OT08PC socket for UL Rating!
Note: Manufacturer’s recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact design for DIN rail or surface mount via octal base</td>
<td>Allows flexibility in panel installation</td>
</tr>
<tr>
<td>LED status indicator</td>
<td>Visual indication of relay engagement</td>
</tr>
<tr>
<td>Isolated output relay</td>
<td>Allows connection to PLC or control voltage</td>
</tr>
<tr>
<td>Standard 8-pin socket</td>
<td>Pop-in replacement for other manufacturers’ parts</td>
</tr>
</tbody>
</table>

Specifications

**Input Characteristics**
- **Supply Voltage:** 90-120VAC
- **Functional Characteristics**
  - **Probe Sense Voltage:** 5 VDC continuous
- **Output Characteristics**
  - **Output Contact Rating:**
    - **Pilot Duty:** 180VA @120VAC, C300
    - **General Purpose:** 8A @120VAC
- **Relay Contact Life**
  - **Electrical:** 100,000 cycles min. @ rated load
  - **Mechanical:** 10,000,000 cycles

**General Characteristics**
- **Temperature Range:** -20° to 55°C (-4° to 131°F)
- **Maximum Input Power:** 1.5 W
- **Wire range:** 12 to 20 AWG
- **Terminal Torque:** 3.5 to 4.5 in.-lbs. (max. 4.5 in.-lbs.)

**Provides Intrinsically-Safe Circuits in the following locations:**
- Division 1 and 2
  - Class I, Groups A,B,C,D;
  - Class II, Groups E,F,G;
  - Class III
- **Entity Parameters**
  - \( V_{oc} = 16.8V \)
  - \( I_{sc} = 1.2mA \)
  - \( L_2 = 100mH \)
  - \( C_a = 0.39uF \)

For dimensional drawing see: Appendix, page 509, Figure 8.
Standards Passed

**Electrostatic Discharge (ESD)**
IEC 61000-4-2, Level 3, 6kV contact, 8kV air

**Radio Frequency**
IEC 61000-4-3, Level 3, 10V/m

**Immunity (RFI)**
IEC 61000-4-4, Level 3, 4kV input power

**Fast Transients**
IEC 61000-4-4, Level 3, 4kV input power

**Safety Mark**
UL

**Dimensions**
- H: 44.45 mm (1.75”)
- W: 60.33 mm (2.375”)
- D: 104.78 mm (4.125”)

**Weight**
0.5 lb. (8 oz., 226.8 g)

**Mounting Method**
DIN rail or surface mount
(plug into OT08PC socket)
ISS-102 SERIES

Two-Channel Intrinsically Safe Switch

Description

The ISS-102 is a two-channel, intrinsically-safe switch designed for multiple uses including a pump-up/pump-down (latching) controller or two-channel switch. LEDs indicate the state of the intrinsically-safe inputs and output relays and user-selectable options are available including a variable resistance threshold for float inputs. The ISS-102 enclosure is surface or DIN rail mountable.

- **LC** Each input channel is active when the corresponding switch is closed. When the lag input (CH2) is activated, the output closes. Applying latching logic, the output contact remains closed until the lead (CH1) and the lag (CH2) inputs are deactivated. Sensitivity is fixed at 100kOhms with a debounce time delay of 2 seconds.

- **DCS** This dual-channel switch has two Form A output relays. Two LEDs illuminate the output state of their respective Form A relay. Resistance probes or switches can be used on its inputs. Sensitivity is fixed at 100kOhms with a debounce time delay of 0.5 seconds.

- **MC** By selecting the proper functionality through the DIP switches, you can define a pump-up or pump-down, single or dual channel non-latching switch. The sensitivity adjustment (4.7k-100kOhms) allows you to define the input impedance at which the output relays (one Form A & one Form C) will change state, with a debounce time delay of 0.5 or 2 seconds.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger-safe terminals</td>
<td>Meets IEC 61000 safety requirements</td>
</tr>
<tr>
<td>Compact design for DIN rail or surface mount</td>
<td>Allows flexibility in panel installation</td>
</tr>
<tr>
<td>LED status indicator</td>
<td>Visual indication of relay engagement</td>
</tr>
<tr>
<td>Two input channels</td>
<td>Flexibility for pump up/pump down latching controller or two-channel switch applications</td>
</tr>
</tbody>
</table>

Wiring Diagrams

See Notes 1 & 2

For more wiring diagrams and notes, see next page.

For dimensional drawing see: Appendix, page 510, Figure 10.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISS-102A-LC</td>
<td>120VAC</td>
<td>Latching Controller</td>
</tr>
<tr>
<td>ISS-102AA-DCS</td>
<td>120VAC</td>
<td>Dual Channel Switch</td>
</tr>
<tr>
<td>ISS-102ACI-MC</td>
<td>120VAC</td>
<td>Multi-function Controller</td>
</tr>
<tr>
<td>ISS-102C-M-LC</td>
<td>120VAC</td>
<td>MSHA* evaluated</td>
</tr>
<tr>
<td>ISS-102CCI-M-MC</td>
<td>120VAC</td>
<td>MSHA* evaluated</td>
</tr>
</tbody>
</table>

* Mine Safety and Health Administration
Wiring Diagrams (continued)

![Wiring Diagram](image)

**Specifications**

**Functional Characteristics**
- Debounce Time: 0.5 or 2 seconds
- Probe Sense Voltage: 5Vdc pulsed

**Output Characteristics**
- Output Contact Rating:
  - Pilot Duty: 180VA @120VAC, C150
  - General Purpose: 5A @120VAC
- Relay Contact Life (Electrical): 100,000 cycles min. @ rated load
- Relay Contact Life (Mechanical): 10,000,000 cycles

**Output Relay Type**
- ISS-102A-LC: One Form A
- ISS-102AA-DCS: Two Form A
- ISS-102ACI-MC: One Form A & One isolated Form C
- ISS-102C-M-LC: One Form C
- ISS-102CCI-M-MC: Two Form C (one isolated)

**General Characteristics**
- Temperature Range: -20° to 55°C (-4° to 131°F)
- Maximum Input Power: 2 W
- Wire Range: 12 to 20 AWG
- Terminal Torque: 3.5 to 4.5 in.-lbs. (max. 4.5 in.-lbs.)

**Provides Intrinsically-Safe Circuits in the following locations:**
- Division 1 and 2
- Class I, Groups A,B,C,D;
- Class II, Groups E,F,G;
- Class III

**Entity Parameters**
- \( V_{oc} = 16.8 \text{V} \)
- \( I_{sc} = 1.2 \text{mA} \)
- \( L_a = 100 \text{mH} \)
- \( C_a = 0.39 \text{uF} \)

**Standards Passed**
- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
- Radio Frequency Immunity (RFI): IEC 61000-4-3, Level 3, 10V/m
- Fast Transients: IEC 61000-4-4, Level 3, 4kV input power
- UL: UL913 Sixth Edition (File #E233355) (except Models ISS-102C-M-LC & ISS-102CCI-M-MC which have been evaluated by MSHA)

**Dimensions**
- H: 88.9 mm (3.5”);
- Width: 52.93 mm (2.08”);
- D: 59.69 mm (2.35”)
- Weight: 0.7 lb. (11.2 oz., 317.51 g)
- Mounting Method: 35mm DIN rail or Surface Mount (#6 or #8 screws)

**Notes:**
1. Maximum distance between unit and switch contact is 10,000 feet.
2. All non-intrinsically-safe wiring shall be separated from intrinsically-safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically-Safe Systems. Check your state and local codes for additional requirements.
3. All switch contacts shall be non-energy storing, containing no inductance or capacitance.
**ISS-105 SERIES**

Five-Channel Intrinsically Safe Switch

**Description**

The ISS-105 is a “smart” five-channel intrinsically safe relay and pump controller. The ISS-105 can be configured for pump-up or pump-down applications or as a five-channel relay covering a wide variety of applications.

The ISS-105 has a long list of features that are needed for multiple pump applications and can indicate low, high and out-of-sequence alarms. If an out-of-sequence alarm occurs, the skipped pump(s) will be started as intended.

The Model ISS-105 can be set-up to do non-alternating control, alternating control and alternating control with one non-alternating pump. The non-alternating pump is intended for use with an emergency or jockey pump. The ISS-105 can start an emergency pump once every 50 cycles to keep it working freely. Using the built-in DIP switches, individual pumps can be disabled when taken out of service for repair or maintenance.

**Features & Benefits**

- 5 intrinsically-safe input channels meeting UL913 Sixth Edition
- 4 normally open output relays and 1 SPDT output relay
- Field selectable pump control options
- Monitors float sequencing and sends signal to alarm if out-of-sequence condition occurs
- High and/or low alarm options depending on the number of pumps and settings
- Output contacts for audible alarm
- Meets IEC EMC standards for Electrical Fast Transients (EFT), Electrostatic Discharge (ESD) and Radio Frequency Immunity (RFI)
- DIN rail or surface mountable allows flexibility in panel installation
- User-selectable alternator/non-alternator option
- Non-alternating pump option for emergency or jockey applications
- Pump disable switches make it easy to disable individual pumps when they are out for service or repair
- Adjustable lag pump delay for all pumping modes
- Adjustable delay-on-make/break timer in five-channel relay mode
- Finger-safe terminals meet IEC 61000 safety requirements

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISS-105</td>
<td>120VAC</td>
<td>Intrinsically-Safe &amp; Pump Controller</td>
</tr>
<tr>
<td>ISS-105-ISO</td>
<td>120VAC</td>
<td>Intrinsically-Safe Only</td>
</tr>
<tr>
<td>ISS-105-ISO-3</td>
<td>120VAC</td>
<td>3-Channel Intrinsically-Safe Only</td>
</tr>
<tr>
<td>ISS-105-ISO-4</td>
<td>120VAC</td>
<td>4-Channel Intrinsically-Safe Only</td>
</tr>
<tr>
<td>ISS-105-ISO-F</td>
<td>120VAC</td>
<td>ISO with Fast Trip Relays</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 511, Figure 12.
## Specifications

### Input Characteristics
- **Supply Voltage**: 120VAC
- **Frequency**: 50*/60Hz

### Functional Characteristics
- **Probe Sense Voltage**: 5Vdc continuous

### Output Characteristics
- **Relay Output Rating**
  - Pilot Duty: 480VA @ 240VAC, B300
  - General Purpose: 7A @ 240VAC

### General Characteristics
- **Relay Contact Life (Electrical)**: 100,000 cycles min. @ rated load
- **Relay Contact Life (Mechanical)**: 10,000,000 cycles
- **Temperature Range**: -40° to 55°C (-40° to 131°F)
- **Maximum Input Power**: 5 W
- **Wire range**: 12 to 20 AWG
- **Recommended Terminal Torque**: 3.5 to 4.5 in.-lbs. (max. 4.5 in.-lbs.)

### Provides Intrinsically-Safe Circuits in the following locations:
- Division 1 and 2
- Class I, Groups A,B,C,D;
- Class II, Groups E,F,G;
- and Class III

### Entity Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{oc}$</td>
<td>16.8V</td>
</tr>
<tr>
<td>$I_{oc}$</td>
<td>1.2mA</td>
</tr>
<tr>
<td>$L_a$</td>
<td>100mH</td>
</tr>
<tr>
<td>$C_a$</td>
<td>0.39uF</td>
</tr>
</tbody>
</table>

### Standards Passed
- **Electrostatic Discharge (ESD)**: IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
- **Radio Frequency Immunity (RFI)**: IEC 61000-4-3, Level 3, 10V/m
- **Fast Transients**: IEC 61000-4-4, Level 3, 4kV input power; 2kV inputs/outputs
- **Safety Marks**: UL UL913 Sixth Edition (File #E233355)

### Dimensions
- **H**: 94.06 mm (3.703”)
- **W**: 127.64 mm (5.025”)
- **D**: 59.69 mm (2.350”)

### Weight
- 1.2 lbs. (19.2 oz., 544.31 g)

### Mounting Method
- 35 mm DIN rail or Surface Mount (#6 or #8 screws)

*Note: 50Hz will increase all delay timers by 20%.
AC SYSTEM MONITORS/LOAD SENSORS

Current monitors provide protection against both supply line and load side faults when the motor is running. They protect against single-phasing and current unbalance problems that can be caused by voltage supply problems, bad contactors, loose wiring, bad wires, or damaged motors. They also provide very reliable overload and underload protection.

Littelfuse voltage monitors are microcontroller based and factory calibrated for highly accurate and precise voltage measurements providing high sensitivity while minimizing nuisance tripping. This precise operation can detect a single-phase condition or voltage unbalance even with regenerated voltages present.

**Current Monitoring Relays and Transducers**
- CP5 Series  Single-Phase Current Monitor........184
- LSR-0 Load Sensor, Low Cost Relay .................185
- LSR-XXX Series  Load Sensors ..................186
- LSRU Series  Load Sensors.............................187
- LSRX / LSRX-C Series  Load Sensors, Low Cost Relays ...189
- ECS Series  Current Sensors ......................191
- ECSW Series  Current Sensors ....................194
- TCS Series  Current Sensors .......................197
- TCSA Series  Current Transducers ............199
- DCSA Series  Current Transducers ..............201
- LCS10T12 / LPM Series  Current Indicators .......203

**Voltage Monitoring Relays**
- 50R Series ..................................................204
- 201-XXX-SP Series ..................................206
- 201-XXX-SP-DPDT Series ..........................208
- 202-200-SP Series ..................................210
- 460-XXX-SP Series ..................................212
- 102A Series .............................................214
- 201A Series .............................................216
- 201A-AU Series .......................................218
- 201-XXX-DPDT Series ...............................220
- 202 Series ..............................................222
- 250A Series ..............................................224
- 350 Series ..............................................226
- 355 Series ..............................................228
- 455 Series ..............................................230
- 460 Series ..............................................232
- 601 Series ..............................................234
- 601-CS-D-P1 ...........................................236
- WVM Series ............................................238
- DLMU Series ...........................................240
- HLMU Series ...........................................243
- PLMU11 ....................................................245
- PLM Series ..............................................247
- TVV Series ..............................................249
- TVM Series ..............................................251
- PLR Series ..............................................253
- PLS Series ..............................................255
- HLVA6i23 ..................................................257
- KVM Series ..............................................259

For More Information… on common faults and how to fix them, visit Littelfuse.com/MotorProtection
**Description**

The CP5 Series are undercurrent monitors designed to monitor one leg of a 3-phase system. It is commonly used as a tower monitor on center pivot irrigation systems to detect stalled or jammed towers to prevent over watering.

The CP5 Series has both an adjustable trip level and an adjustable trip delay timer. When the current is sensed, the CP5 Series activates its output relay, thus starting the motor/pump. When the current in the monitored power line falls below the user-selectable trip point, the unit goes through a trip delay timer and then deactivates the output relay if the monitored current does not recover first.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable trip level (0-5A)</td>
<td>Provides ability to precisely set the current trip point for any application</td>
</tr>
<tr>
<td>Adjustable trip delay (0-10m)</td>
<td>Prevents nuisance tripping due to power line fluctuations</td>
</tr>
<tr>
<td>600V rated relay contacts available on CP5-460 model</td>
<td>Eliminates the need for a control transformer to step voltage down to 120 - 240V for a control circuit</td>
</tr>
</tbody>
</table>

**Specifications**

**Input Characteristics**

- **Nominal Input Voltage**
  - CP5115: 115VAC
  - CP5460: 460VAC
- **Frequency**
  - 50*/60Hz

**Functional Characteristics**

- **Operating Points**
  - Trip Level: 0-5 Amps
  - Trip Delay: 0-10 minutes
  - Restart: 1 second

**Output Characteristics**

- **Output Contact Rating (SPDT)**
  - CP5115: 480VA @ 240VAC
  - CP5460: 470VA @ 600VAC

**General Characteristics**

- **Terminal**
  - Torque: 7 in.-lbs.
  - Wire Size: 12-18AWG
- **UL Safety Marks**
  - UL508 (File #E68520)
- **Dimensions**
  - H: 74.4 mm (2.93”); W: 133.9 mm (5.27”); D: 74.9 mm (2.95”)
- **Weight**
  - 1 lb. (16 oz., 453.59 g)
- **Mounting Method**
  - #8 screws

*Note: 50Hz will increase all delay timers by 20%*

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP5115</td>
<td>115VAC</td>
</tr>
<tr>
<td>CP5460</td>
<td>460VAC</td>
</tr>
</tbody>
</table>
Description
The LSR-0 is a self-powered load sensor intended for use as a proof relay. It is used to verify that current is flowing as intended. It has a guaranteed 15A pull-in current and 2.5A drop-out current. Proof relays are typically used to interlock fans, compressors, motors, heating elements and other devices. The LSR-0 is self-powered, that is, it draws its power from the wire being monitored so it does not require separate control power wiring.

Features
- Self-powered
- Low cost proof relay
- Can monitor up to 135A loads

Specifications
Max Current Ratings
- 135A continuous

Functional Characteristics
- Turn-on Threshold: Fixed, 15A (max.)*
- Turn-off Threshold: 2.5A (min.)
- Power: Induced from conductor
- Isolation: 600VAC rms

Output Characteristics
- Relay Output Rating: 480VA @ 240VAC

General Purpose
- 10A

General Characteristics
- Temperature Range: -20° to 70°C (-4° to 158°F)
- Wire Size: #12-24AWG
- Hole Size: 0.725” diameter
- Terminal Torque: 7 in.-lbs.
- Safety Marks: CSA, CSA-NRTL/C (File #46510)

Dimensions
- H 42.42 mm (1.67”); W 58.42 mm (2.3”); D 90.43 mm (3.56”)

Weight
- 0.35 lb. (5.6 oz., 158.76 g)

Mounting Method
- Four #6 screws 3/4” in length

*Conductors may be looped for smaller motor applications.

Caution: This product should not be relied upon solely for safety of life or safety applications.

For dimensional drawing see: Appendix, page 511, Figure 14.
The LSR-xxx Series load sensors use current levels to determine feed rates, tool wear, loss of prime on pumps, mixer viscosity and all types of overload and underload conditions. They may also be used to stage pump motors, chillers and other machinery. These devices combine a current transformer (CT) with Form C (SPDT) relay contacts to switch alarm circuits, contactors or any resistive or inductive load. One simple screwdriver adjustment will calibrate the sensor for all single-phase or 3-phase applications up to 100hp.

**Features**
- Can monitor current of motors up to 100Hp
- Fine adjustment with 20-turn pot
- Status LEDs

**Specifications**

**Functional Characteristics**
- Isolation: 600VAC rms
- Current Adjustment Range (Typical): 2-100A
- Current Adjustment Range (Min-Max): 0.5-135A
- Trip Setpoint: Adjustable to ±1% range

**Input Characteristics**
- Control Power:
  - LSR-24: 24VAC
  - LSR-115: 115VAC
  - LSR-230: 230VAC
- Max Current Ratings: 135A max. continuous

**Output Characteristics**
- Output Contact Rating (SPDT): 480VA @ 240VAC
- General Purpose: 10A

**General Characteristics**
- Temperature Range: -20° to 70°C (-4° to 158°F)
- Wire Size: #12-24AWG
- Hole Size: 0.725” diameter
- Terminal Torque: 7 in.-lbs.
- Safety Marks:
  - CSA, CSA-NRTL/C (File #46510)
  - CE
- IEC 60947

**Dimensions**
- H: 42.42 mm (1.67”); W: 58.42 mm (2.3”);
- D: 90.43 mm (3.56”)
- Weight: 0.4 lb. (6.4 oz., 181.44 g)
- Mounting Method: Four #6 screws 3/4” in length

Caution: This product should not be relied upon solely for safety of life or safety applications.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSR-24</td>
<td>24VAC</td>
</tr>
<tr>
<td>LSR-115</td>
<td>115VAC</td>
</tr>
<tr>
<td>LSR-230</td>
<td>230VAC</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 511, Figure 14.
Description
The LSRU Series is a microcontroller-based family of load sensors. The LSRU family of products employ three basic types of control logic: motor control logic, alarm logic and feed control logic.

Motor Control Logic
Several combinations of functions are available in the LSRU, including overcurrent and undercurrent or either overcurrent or undercurrent with variable trip, restart or extended restart delay settings. These various versions of the LSRU trip on the respective fault and then automatically reset after the restart delay expires, in preparation for the next motor start. LSRUs do not trip on undercurrent when the load turns off, this is recognized as a normal condition.

Alarm Logic
The LSRU-AL simply indicates whether the current is between the setpoints or outside of the setpoints. This product is best used with a PLC or other controller where status indication is desired.

Feed Control
The LSRU-FC is a load monitor intended to control feeder mechanisms in a variety of applications. It stops the feeder when the grinder, chipper, saw, auger, etc. nears overload. When the load is reduced to a preset level, the feeder is restarted.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED indicator</td>
<td>Visual indication of relay status</td>
</tr>
<tr>
<td>Built in current sensor</td>
<td>Eliminates the need for a stand alone current transformer and also provides isolation between the monitored and control circuits</td>
</tr>
<tr>
<td>Adjustable current sensing range</td>
<td>Provides ability to precisely set the current trip point for any application</td>
</tr>
</tbody>
</table>

Ordering Information
See next page.
### Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOTAGE</th>
<th>CURRENT RANGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSRU-024-AL-2</td>
<td>24VAC</td>
<td>5-25A</td>
<td>Alarm logic</td>
</tr>
<tr>
<td>LSRU-024-AL-3</td>
<td>24VAC</td>
<td>25-100A</td>
<td>Alarm logic</td>
</tr>
<tr>
<td>LSRU-115-AL-1.5</td>
<td>115VAC</td>
<td>0-10A</td>
<td>Alarm logic</td>
</tr>
<tr>
<td>LSRU-115-AL-2</td>
<td>115VAC</td>
<td>5-25A</td>
<td>Alarm logic</td>
</tr>
<tr>
<td>LSRU-115-AL-3</td>
<td>115VAC</td>
<td>25-100A</td>
<td>Alarm logic</td>
</tr>
<tr>
<td>LSRU-115-FC-1.5</td>
<td>115VAC</td>
<td>0-10A</td>
<td>Feed control logic</td>
</tr>
<tr>
<td>LSRU-115-OT-1.5</td>
<td>115VAC</td>
<td>0-10A</td>
<td>Motor control logic with overcurrent trip, adj trip delay (0.5-60s)</td>
</tr>
<tr>
<td>LSRU-115-OT-2</td>
<td>115VAC</td>
<td>5-25A</td>
<td>Motor control logic with overcurrent trip, adj trip delay (0.5-60s)</td>
</tr>
<tr>
<td>LSRU-115-OT-3</td>
<td>115VAC</td>
<td>25-100A</td>
<td>Motor control logic with overcurrent trip, adj trip delay (0.5-60s)</td>
</tr>
<tr>
<td>LSRU-115-OR-1.5</td>
<td>115VAC</td>
<td>0-10A</td>
<td>Motor control logic with overcurrent trip, adj restart delay (0.5-300s, manual)</td>
</tr>
<tr>
<td>LSRU-115-OR-2</td>
<td>115VAC</td>
<td>5-25A</td>
<td>Motor control logic with overcurrent trip, adj restart delay (0.5-300s, manual)</td>
</tr>
<tr>
<td>LSRU-115-UE-2</td>
<td>115VAC</td>
<td>5-25A</td>
<td>Motor control logic with undercurrent trip, adj ext restart delay (2-300m, manual)</td>
</tr>
<tr>
<td>LSRU-115-UT-2</td>
<td>115VAC</td>
<td>5-25A</td>
<td>Motor control logic with undercurrent trip, adj trip delay (0.5-60s)</td>
</tr>
<tr>
<td>LSRU-115-UT-3</td>
<td>115VAC</td>
<td>25-100A</td>
<td>Motor control logic with undercurrent trip, adj trip delay (0.5-60s)</td>
</tr>
<tr>
<td>LSRU-115-UR-2</td>
<td>115VAC</td>
<td>5-25A</td>
<td>Motor control logic with undercurrent trip, adj restart delay (0.5-300s, manual)</td>
</tr>
<tr>
<td>LSRU-115-OU-1.5</td>
<td>115VAC</td>
<td>0-10A</td>
<td>Motor control logic with overcurrent and undercurrent trip</td>
</tr>
<tr>
<td>LSRU-115-OU-2</td>
<td>115VAC</td>
<td>5-25A</td>
<td>Motor control logic with overcurrent and undercurrent trip</td>
</tr>
<tr>
<td>LSRU-115-OU-3</td>
<td>115VAC</td>
<td>25-100A</td>
<td>Motor control logic with overcurrent and undercurrent trip</td>
</tr>
</tbody>
</table>

**PART # KEY**

- **O** = Overcurrent Trip
- **U** = Undercurrent Trip
- **T** = Adj. Trip Delay (0.5-60 seconds)
- **R** = Adj. Restart Delay (0.5-300 seconds, Manual)
- **E** = Adj. Extended Restart Delay (2-300 minutes, Manual)

### Specifications

#### Functional Characteristics

- **Isolation**: 600VAC rms
- **Power**: 2 Watts
- **Motor Acceleration Time**: 2 seconds
- **When not selected as an option:**
  - **Fixed Trip Delay**: 0.5 second
  - **Fixed Restart Delay**: as soon as current is within limits
  - **Input Characteristics**:
    - **Control Power**: 24VAC or 115VAC
    - **Output Characteristics**:
      - **Output Contact Rating (SPDT)**: 480VA @ 240VAC
      - **Pilot Duty**: 10A @ 240VAC

#### General Characteristics

- **Temperature Range**: -40° to 70°C (-40° to 158°F)
- **Wire Size**: #12-24AWG
- **Hole Size**: 0.725” diameter
- **Terminal Torque**: 7 in.-lbs.
- **Safety Marks**: CSA, CSA-NRTL/C (File #46510)
- **Dimensions**:
  - **H**: 42.42 mm (1.67”)
  - **W**: 58.42 mm (2.3”)
  - **D**: 90.43 mm (3.56”)
- **Weight**: 0.5 lb. (8 oz., 226.8 g)
- **Mounting Method**: Four #6 screws 3/4” in length

**Caution:** This product should not be relied upon solely for safety of life or safety applications.
Protection Relays
Current Monitoring Relays and Transducers

LSRX / LSRX-C SERIES
Self-Powered Load Sensor, Low-Cost Proof Relay

Description
The LSRX/LSRX-C Series are AC current sensors designed to energize the output contact whenever 4.5 Amps or greater is present. The LSRX/LSRX-C Series is used commonly as an AC current proof relay to indicate if a motor is operating. It can also be used to interlock fans, compressors and motors; to indicate equipment status such as feed rates, tool wear, loss of prime on pumps, mixer viscosity and all types of current sensing conditions or to stage pump motors, chillers, or other machinery.

This device combines a current transformer (CT), transducer and high current output relay together to switch alarm circuits, contactors and most resistive or inductive loads. The LSRX/LSRX-C Series can perform the function of an auxiliary contact, yet has the advantages of universal application and isolation.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-powered</td>
<td>Eliminates need for separate control voltage. Draws power from wire being monitored</td>
</tr>
<tr>
<td>Quick-connect terminals</td>
<td>Saves time at installation</td>
</tr>
<tr>
<td>LED indication</td>
<td>Visual indication of relay status</td>
</tr>
<tr>
<td>Built in current sensor will monitor up to 200A loads</td>
<td>Eliminates the need for a stand alone current transformer and also provides isolation between the monitored and control circuits</td>
</tr>
</tbody>
</table>

Accessories

Informer IR Kit-36 (36” infrared adapter cable)
Attaches to the face of the unit to provide remote diagnostics without opening the panel.

Specifications

<table>
<thead>
<tr>
<th>Input Characteristics</th>
<th>Operating Current</th>
<th>Minimum Pull-in Current</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5-200A Continuous</td>
<td>4.5A (typical), 7.0A (max)*</td>
<td>Induced from AC conductor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output Characteristics</th>
<th>Relay Output Rating (SPST - Form A)</th>
<th>Pilot Duty</th>
<th>General Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>480VA @ 240VAC, B300</td>
<td>5A @ 240VAC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical Life</th>
<th>Mechanical Life</th>
<th>Maximum Conductor</th>
<th>Diameter</th>
<th>Output Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x10^5</td>
<td>1x10^7</td>
<td>0.7 in.</td>
<td>0.25” quick-connect fast-ons</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Torque Rating</th>
<th>LSRX</th>
<th>LSRX-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 in.-lbs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSRX</td>
<td>Fast-on terminal</td>
</tr>
<tr>
<td>LSRX-C</td>
<td>Depluggable screw terminals</td>
</tr>
<tr>
<td>LSRX-OEM</td>
<td>Fast-on terminals, 10 pack</td>
</tr>
</tbody>
</table>
**General Characteristics**

Temperature Range:
- **Operating**: -20° to 70°C (-4° to 158°F)
- **Storage**: -40° to 80°C (-40° to 176°F)

**Hole Size**: 0.72” diameter

**Wire Size**: 12-26 AWG

**Output Relay Status Indicator**: LED

**Relative Humidity**: 10-95%, non-condensing per IEC 68-2-3

**Standards Passed**

**Electrostatic Discharge (ESD)**: IEC 61000-4-2, Level 2, 4kV contact, 4kV air

**Fast Transient Burst**: IEC 61000-4-4, Level 3, 2kV power, 1kV input/output

**Surge**
- IEC 61000-4-5, Level 3, 2kV line-to-line;
- 2kV line-to-ground

**Safety Marks**

**UL**: UL508 Recognized (File #E68520)

**CE**: IEC 60947

**Dimensions**
- **H**: 68.58 mm (2.7”);
- **W**: 28.7 mm (1.13”);
- **D**: 63.5 mm (2.5”)

**Weight**: 0.3 lb. (4.8 oz., 136.08 g)

**Mounting Method**: Surface Mount

*Conductors may be looped for smaller motor applications.*
**ECS SERIES**

**Current Sensors**

**Description**

The ECS Series of single-phase AC current sensors is a universal, overcurrent or undercurrent sensing control. Its built-in toroidal sensor eliminates the inconvenience of installing a stand-alone current transformer. Includes onboard adjustments for current sensing mode, trip point, and trip delay. Detects over or undercurrent events like locked rotor, loss of load, an open heater or lamp load, or proves an operation is taking place or has ended.

**Operation**

Input voltage must be supplied at all times for proper operation. When a fault is sensed throughout the trip delay, the output relay is energized. When the current returns to the normal run condition or zero, the output and the delay are reset. If a fault is sensed and then corrected before the trip delay is completed, the relay will not energize and the trip delay is reset to zero.

**Adjustment**

Select the desired function, over or under current sensing. Set the trip point and trip delay to approximate settings. Apply power to the ECS and the monitored load. Turn adjustment and watch the LED. LED will light; turn slightly in opposite direction until LED is off. Adjustment can be done while connected to the control circuitry if the trip delay is set at maximum. To increase sensitivity, multiple turns may be made through the ECS’s toroidal sensor. The appropriate trip point range is determined by multiplying the amperage load by the number of turns/passes through the toroidal sensor. When using an external CT, select a 2VA, 0-5A output CT rated for the current to be monitored. Select ECS adjustment range 0. Pass one secondary wire lead through the ECS toroid and connect the secondary leads together.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in toroidal current sensing</td>
<td>Eliminates need to install stand-alone current transformer and provides isolation from monitored circuit</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Adjustable mode, trip point and trip delay</td>
<td>Provides flexibility for use in many applications</td>
</tr>
<tr>
<td>10A, SPDT isolated relay output</td>
<td>Allows control of AC voltage loads</td>
</tr>
</tbody>
</table>

**Wiring Diagram**

- V = Voltage
- I> = Overcurrent
- I< = Undercurrent
- W = Insulated Wire Carrying Monitored Current

Relay contacts are isolated. Arrow on the toroid points toward the load.

For dimensional drawing see: Appendix, page 513, Figure 34.

**Ordering Information**

See next page.

**Accessories**

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect

These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
## Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SENSING</th>
<th>INPUT VOLTAGE</th>
<th>TRIP POINT ADJUSTABLE</th>
<th>TRIP DELAY</th>
<th>SENSING DELAY ON STARTUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECS20BC</td>
<td>Selectable, over or undercurrent</td>
<td>24VAC</td>
<td>0.5 - 5A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS21BC</td>
<td>Selectable, over or undercurrent</td>
<td>24VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS2HBC</td>
<td>Selectable, over or undercurrent</td>
<td>24VAC</td>
<td>5 - 50A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS30AC</td>
<td>Selectable, over or undercurrent</td>
<td>24VDC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS40A</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>0s</td>
</tr>
<tr>
<td>ECS40AC</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS40BC</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS41A</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>0s</td>
</tr>
<tr>
<td>ECS41AC</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS41BC</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS418C</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS41BD</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>2s</td>
</tr>
<tr>
<td>ECS41H</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>6s</td>
</tr>
<tr>
<td>ECS4HBC</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS4H8H</td>
<td>Selectable, over or undercurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS60AH</td>
<td>Selectable, over or undercurrent</td>
<td>230VAC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>6s</td>
</tr>
<tr>
<td>ECS60BC</td>
<td>Selectable, over or undercurrent</td>
<td>230VAC</td>
<td>0.5 - 5A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS61BC</td>
<td>Selectable, over or undercurrent</td>
<td>230VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECS6H8H</td>
<td>Selectable, over or undercurrent</td>
<td>230VAC</td>
<td>5 - 50A</td>
<td>0.150 - 7s</td>
<td>6s</td>
</tr>
<tr>
<td>ECSH21F.5C</td>
<td>Overcurrent</td>
<td>24VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
<tr>
<td>ECSH30AC</td>
<td>Overcurrent</td>
<td>24VDC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
<tr>
<td>ECSH31AD</td>
<td>Overcurrent</td>
<td>24VDC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH31F.08D</td>
<td>Overcurrent</td>
<td>24VDC</td>
<td>2 - 20A</td>
<td>0.08s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH3H.08D</td>
<td>Overcurrent</td>
<td>24VDC</td>
<td>5 - 50A</td>
<td>0.08s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH3H.08C</td>
<td>Overcurrent</td>
<td>24VDC</td>
<td>4A non-adjustable</td>
<td>0.08s</td>
<td>1s</td>
</tr>
<tr>
<td>ECSH40A</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>0s</td>
</tr>
<tr>
<td>ECSH40AC</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
<tr>
<td>ECSH40AD</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH41AC</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
<tr>
<td>ECSH41AD</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH41BC</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>1s</td>
</tr>
<tr>
<td>ECSH41F.08D</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.08s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH4HAD</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH4HAD</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.08s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH4HAD</td>
<td>Overcurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSH61AD</td>
<td>Overcurrent</td>
<td>230VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSL31A</td>
<td>Undercurrent</td>
<td>24VDC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>0s</td>
</tr>
<tr>
<td>ECSL40AC</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
<tr>
<td>ECSL40B</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.5 - 50s</td>
<td>0s</td>
</tr>
<tr>
<td>ECSL40BH</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.5 - 50s</td>
<td>6s</td>
</tr>
<tr>
<td>ECSL41A</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>0s</td>
</tr>
<tr>
<td>ECSL41AD</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSL4HAD</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSL4HAD</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSL4HAD</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSL4HAD</td>
<td>Undercurrent</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.150 - 7s</td>
<td>2s</td>
</tr>
<tr>
<td>ECSL61AH</td>
<td>Undercurrent</td>
<td>230VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>6s</td>
</tr>
<tr>
<td>ECSL6HAC</td>
<td>Undercurrent</td>
<td>230VAC</td>
<td>5 - 50A</td>
<td>0.150 - 7s</td>
<td>1s</td>
</tr>
</tbody>
</table>
**Specifications**

**Sensor**
- Type: Toroidal through hole wiring
- Mode: Over or undercurrent, switch selectable on the unit or factory fixed

**Trip Point Range**
- Guaranteed range: 0.5 - 50A in 3 adjustable ranges or fixed
- Adjustable: 0.5 - 25A: 0.5A or ±5% whichever is less;
  26 - 50A: ±2.5%

**Maximum Allowable Current**
- Steady – 50A turns;
- Inrush – 300A turns for 10s

**Trip Point Hysteresis**
- ±5%

**Trip Point vs. Temperature**
- ±5%

**Response Time**
- ≤ 75ms

**Frequency**
- 45/500 Hz

**Type of Detection**
- Peak detection

**Trip Delay**
- Type: Analog
- Adjustable: 0.150 - 7s; 0.5 - 50s (guaranteed ranges)
- Factory Fixed: +/- 10%

**Input**
- Voltage: 24, 120, or 230VAC; 12 or 24VDC
- Tolerance: 12VDC & 24VDC/AC: -15 - 20%
  120 & 230VAC: -20 - 10%
  AC Line Frequency: 50/60 Hz

**Output**
- Type: Electromechanical relay
- Form: Isolated, SPDT
- Rating: 10A resistive @ 240VAC; 1/4 hp @ 125VAC;
  1/2 hp @ 250VAC
- Life: Mechanical – 1 x 10⁶; Electrical – 1 x 10⁵

**Protection**
- Circuitry: Encapsulated
- Isolation Voltage: ≥ 2500V RMS input to output
- Insulation Resistance: ≥ 100 MΩ

**Mechanical**
- Mounting: Surface mount with two #6 (M3.5 x 0.6) screws
- Dimensions: H 88.9 mm (3.5”); W 63.5 mm (2.5”);
  D 44.5 mm (1.75”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals (5)

**Environmental**
- Operating/Storage Temperature: -40° to 60°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ~ 6.4 oz (181 g)
ECSW SERIES

Current Sensors

Description
The ECSW Series of single-phase, AC window, current sensors includes adjustable overcurrent and undercurrent trip points. Detects locked rotor, jam, loss of load, an open heater or lamp load, a broken belt, or loss of suction. LED’s aid in trip point adjustment and provide fault indication. The built-in toroidal sensor eliminates the need for an external current transformer. The output can be electrically latched after a fault, or automatically reset. Remote resetting of a latched output by removing input voltage. The unit includes switch selectable zero current detection and normally de-energized or energized output operation. Time delays are included to improve operation and eliminate nuisance tripping.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in toroidal current sensing</td>
<td>Eliminates need to install stand alone current transformer and provides isolation from monitored circuit</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
<tr>
<td>LED indication</td>
<td>Visual indication for trip point adjustment and fault indication</td>
</tr>
<tr>
<td>Multiple switch selectable features</td>
<td>User selectable zero current detection, latched, normally de-energized, or energized output adds application flexibility</td>
</tr>
<tr>
<td>Adjustable trip delay</td>
<td>Eliminates nuisance tripping and prevents rapid cycling</td>
</tr>
<tr>
<td>Isolated 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
</tbody>
</table>

Operation
When the input voltage is applied, sensing delay on startup begins and the output transfers (if normally energized is selected). Upon completion of the startup delay, sensing of the monitored current begins. As long as current is above undercurrent trip point and below the overcurrent trip point (inside the window), the output relay remains in its normal operating condition and both red LED’s are OFF. The green LED glows when the output is energized. If current varies outside the window, the associated red LED glows, and the trip delay begins. If the current remains outside the window for the full

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>TRIP POINT ADJUST.</th>
<th>TRIP DELAY</th>
<th>SENSING DELAY ON STARTUP</th>
<th>CONNECT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSW3LABT</td>
<td>24VDC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>0.1s</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>ECSW4HHT</td>
<td>120VAC</td>
<td>5 - 50A</td>
<td>0.5 - 50s</td>
<td>6s</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>ECSW4ADT</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.150 - 7s</td>
<td>2s</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>ECSW4LHT</td>
<td>120VAC</td>
<td>0.5 - 5A</td>
<td>0.5 - 50s</td>
<td>6s</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>ECSW4MCT</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.150 - 7s</td>
<td>1s</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>ECSW4MBH</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>6s</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>ECSW4MBGT</td>
<td>120VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>5s</td>
<td>Terminal blocks</td>
</tr>
<tr>
<td>ECSW6MBH</td>
<td>230VAC</td>
<td>2 - 20A</td>
<td>0.5 - 50s</td>
<td>6s</td>
<td>Terminal blocks</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 513, Figure 34.

If you don't find the part you need, call us for a custom product 800-843-8848
trip delay, the relay transfers to fault condition state. If the current returns to normal levels (inside the window) during the trip delay, the red LED goes OFF, the trip delay is reset, and the output remains in the normal condition.

**Reset:** Remove input voltage or open latch switch. If zero current detection is selected, the unit will reset as soon as zero current is detected.

**Operation With Zero Current Detection Enabled:** If the current decreases to zero within the trip delay period, then zero current is viewed as an acceptable current level. The unit’s output remains in its normal operating state. This allows the monitored load to cycle ON and OFF without nuisance tripping the ECSW. Zero current is defined as current flow of less than 250 milliamp-turns.

Note: When zero current detect is selected, the latching operation of switch SW2 is canceled; the output will not latch after a fault trip.

**Notes on Operation**
1. There is no hysteresis on the trip points. The overcurrent and undercurrent trip points should be adjusted to provide adequate protection against short cycling.
2. If the upper setpoint is set below the lower setpoint, both red LED’s will glow indicating a setting error.
3. If zero current detection is selected (SW2 ON), and the system is wired to disconnect the monitored load, the system may short cycle. After the unit trips, the load de-energizes, and zero current is detected. The ECSW resets, and the load energizes again immediately and may be short cycled.
4. The sensing delay on start up only occurs when input voltage is applied. When zero current detection is selected, the trip delay must be longer than the duration of the inrush current or the unit will trip on the inrush current.

**Typical Pump or Fan Protection Circuit Operation**

**Window Current Sensing:** With the ECSW connected as shown in the diagram, a load may be monitored and controlled for over and undercurrent. The ECSW Series’ on board CT (CS) may be placed on the line or load side of the contactor. The ECSW selection switches are set for zero current sensing (see Selector Switch SW2) and the output selection is normally de-energized (see Selector Switch SW3). The input voltage (V) is applied to the ECSW continually. As the control switch (FSW) is closed, the input voltage (V) is applied to the motor contactor coil (MCC), and the motor (M) energizes. As long as the current remains below the overcurrent and above the undercurrent trip points, the ECSW’s output contacts remain de-energized. If the load current should rise above or fall below a trip point, for the full trip delay, the normally open (NO) contact will close, energizing the control relay (CR) coil. The CR normally closed contact (CR1) opens and the MCC de-energizes and CR latches on through its normally open contacts (CR2). Reset is accomplished by momentarily opening the normally closed reset switch (RSW).

Note: If the current falls to zero within the trip delay, the ECSW remains de-energized. The sensing delay on startup occurs when input voltage is applied therefore trip delay must be longer than the duration of the motor’s inrush current. The external latching relay CR2 is required in this system to prevent rapid cycling. A timer can be added to provide an automatic reset.

**Selector Switch**

<table>
<thead>
<tr>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
<td>Not Used</td>
</tr>
<tr>
<td>SW2</td>
<td>Latched</td>
</tr>
<tr>
<td>SW3</td>
<td>Zero I</td>
</tr>
<tr>
<td></td>
<td>Output - Normally Energized</td>
</tr>
</tbody>
</table>

**Mode Selection Switches**

<table>
<thead>
<tr>
<th>SW1 = Latched or Auto reset selector</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF - Automatic reset after a fault</td>
</tr>
<tr>
<td>ON - Output relay latches after a fault trips the unit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SW2 = Zero current detection (below 250 mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF - Zero current detection disabled</td>
</tr>
<tr>
<td>ON - Zero current detection enabled</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SW3 = Output during normal operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF - Output relay de-energized</td>
</tr>
<tr>
<td>ON - Output relay energized</td>
</tr>
</tbody>
</table>
Protection Relays
Current Monitoring Relays and Transducers

Specifications

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Toroid, through hole wiring for up to #4 AWG (21.1 mm²) THHN wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Over &amp; undercurrent trip points (window current sensing)</td>
</tr>
<tr>
<td>Trip Point Range</td>
<td>Guaranteed range</td>
</tr>
<tr>
<td>Maximum Allowable Current</td>
<td>Steady - 50A turns; Inrush - 300A turns for 10s</td>
</tr>
<tr>
<td>Time Point vs Temp. &amp; Voltage</td>
<td>±5%</td>
</tr>
<tr>
<td>Response Time</td>
<td>≤ 75 ms</td>
</tr>
<tr>
<td>Frequency</td>
<td>45/500 Hz</td>
</tr>
<tr>
<td>Type of Detection</td>
<td>Peak detection</td>
</tr>
<tr>
<td>Zero Current Detection</td>
<td>&lt; 250mA turns typical</td>
</tr>
<tr>
<td>Time Delay Range</td>
<td>0.15 - 50s in 2 adjustable ranges or 0.1 - 50s fixed</td>
</tr>
<tr>
<td>Sensing Delay On Start Up</td>
<td>Adjustable: guaranteed range; Fixed: ±10%</td>
</tr>
<tr>
<td>Tolerance</td>
<td>+40% - 0%</td>
</tr>
<tr>
<td>Delay vs. Temp. &amp; Voltage Tolerance</td>
<td>±15%</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>24, 120, or 230VAC; 12 or 24VDC</td>
</tr>
<tr>
<td>Tolerance</td>
<td>12VDC &amp; 24VDC/AC -15% - 20%</td>
</tr>
<tr>
<td>120 &amp; 230VAC</td>
<td>-20% - 10%</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Output Type</td>
<td>Electromechanical relay</td>
</tr>
<tr>
<td>Mode: Switch Selectable</td>
<td>Energized during normal operation, de-energized after a fault</td>
</tr>
<tr>
<td>ON</td>
<td>De-energized during normal operation, energizes during a fault</td>
</tr>
<tr>
<td>OFF</td>
<td>Isolated, SPDT</td>
</tr>
<tr>
<td>Form</td>
<td>10A resistive @ 240VAC, 1/4 hp @ 125VAC, 1/2 hp @ 250VAC</td>
</tr>
<tr>
<td>Rating</td>
<td>Mechanical - 1 x 10⁶; Electrical - 1 x 10⁹</td>
</tr>
<tr>
<td>Life</td>
<td>Electrical</td>
</tr>
<tr>
<td>Latch Type</td>
<td>Remove input voltage</td>
</tr>
<tr>
<td>Reset Function</td>
<td>Switch selectable latching function</td>
</tr>
</tbody>
</table>

Protection

| Surge | IEEE C62.41-1991 Level A |
| Circuitry | Encapsulated |
| Isolation Voltage | ≥ 2500V RMS input to output |
| Insulation Resistance | ≥ 100 MΩ |

Mechanical

| Mounting | Surface mount with two #6 (M3.5 x 0.6) screws |
| Dimensions | H 88.9 mm (3.5”); W 63.5 mm (2.5”); D 44.5 mm (1.75”) |
| Termination | 0.197 in. (5 mm) terminal blocks for up to #12 (3.2 mm²) AWG wire |

Environmental

| Operating/Storage Temperature | -40° to 60° C/-40° to 85° C |
| Humidity | 95% relative, non-condensing |
| Weight | ≅ 6.4 oz (181 g) |
TCS SERIES
Current Sensor

Description
The TCS Series is a low cost method of go/no go current detection. It includes a solid-state output to sink or source current when connected directly to a standard PLC digital input module. Its normally open or normally closed output can also be used to control relays, lamps, valves, and small heaters rated up to 1A steady, 10A inrush. The TCS is self-powered (no external power required to operate the unit) and available with an adjustable actuation range of 2 - 20A or factory fixed actuation points from 2 - 45A.

Operation
**Normally Open:** When a current equal to or greater than the actuate current is passed through the toroidal sensor, the output closes. When the current is reduced to 95% of the actuate current or less, the output opens.

**Normally Closed:** When the current through the toroid is equal to or greater than the actuate current, the output opens. When the current is reduced below 95% of the actuate current, the output closes. To increase sensitivity, multiple turns may be made through the TCS’s toroidal sensor. The trip point range is divided by the number of turns through the toroidal sensor to create a new range. When using an external CT, select a 2VA, 0-20A output CT rated for the current to be monitored. Select TCS adjustment range 0. Pass one secondary wire lead through the TCS’ toroid and connect the secondary leads together.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self powered</td>
<td>No control voltage is required to operate the unit</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Can connect directly to PLC</td>
<td>Solid state output to sink or source current can be connected directly to a standard PLC digital input module</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
<tr>
<td>Complete isolation between sensed current and control circuit</td>
<td>Allows you to monitor a load in a separate electrical system</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OUTPUT VOLTAGE</th>
<th>ACTUATE CURRENT</th>
<th>OUTPUT FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCSG2A</td>
<td>3 to 50VDC</td>
<td>Fixed, 2A</td>
<td>Normally open</td>
</tr>
<tr>
<td>TCSGAA</td>
<td>3 to 50VDC</td>
<td>2-20A adjustable</td>
<td>Normally open</td>
</tr>
<tr>
<td>TCSGAB</td>
<td>3 to 50VDC</td>
<td>2-20A adjustable</td>
<td>Normally closed</td>
</tr>
<tr>
<td>TCSH2A</td>
<td>24 to 240VAC</td>
<td>Fixed, 2A</td>
<td>Normally open</td>
</tr>
<tr>
<td>TCSH2B</td>
<td>24 to 240VAC</td>
<td>Fixed, 2A</td>
<td>Normally closed</td>
</tr>
<tr>
<td>TCSH5B</td>
<td>24 to 240VAC</td>
<td>Fixed, 5A</td>
<td>Normally closed</td>
</tr>
<tr>
<td>TCSHAA</td>
<td>24 to 240VAC</td>
<td>2-20A adjustable</td>
<td>Normally open</td>
</tr>
<tr>
<td>TCSHAB</td>
<td>24 to 240VAC</td>
<td>2-20A adjustable</td>
<td>Normally closed</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 513, Figure 35.
### Accessories

**P1023-6 Mounting bracket**
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P1015-64 (AWG 14/16) Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### Function Diagram

- **TP** = Trip Point
- **OC** = Monitored Current
- **NO** = Normally Open Output
- **NC** = Normally Closed Output
- **R** = Reset

### Specifications

#### Sensor
- **Type**: Toroid, through hole wiring, alternating current, monitored wire must be properly insulated
- **Current to Actuate**:
  - Adjustable: - 2 - 20A, guaranteed range
  - Fixed: - 2 - 45A, +0/-20%
- **Reset Current**: ≅ 95% of the actuate current
- **Maximum Allowable Current**:
  - Steady - 50A turns
  - Inrush - 300A turns for 10s
- **Actuate Current vs. Temp. & Voltage**: ≤ ±5%
- **Response Times**:
  - Overcurrent - ≤ 200ms
  - Undercurrent - ≤ 1s
- **Burden**: < 0.5VA

#### Output
- **Type**: Solid state
- **Form**: NO or NC
- **Rating**:
  - AC - 24 to 240VAC +10/-20%
  - DC - 3 to 50VDC
- **Voltage Drop**:
  - AC NO & NC - ≅ 2.5V
  - DC NO & NC - ≅ 1.2V

#### Protection
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ

#### Mechanical
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**:
  - H 50.8 mm (2”); W 50.8 mm (2”); D 44.5 mm (1.75”)
- **Termination**:
  - 0.25 in. (6.35 mm) male quick connect terminals (2)
- **Sensor Hole**:
  - 0.36 in. (9.14 mm) for up to #4 AWG (21.1 mm2) THHN wire

#### Environmental
- **Operating/Storage Temperature**: -20° to 60°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 2.6 oz (74 g)
TCSA SERIES

Current Transducers

Description
The TCSA Series is a loop-powered, linear output current transducer that provides an output that is directly proportional to the RMS AC current passing through the onboard toroid. The TCSA provides a 4 - 20mA output over a power supply range of 10 - 30VDC. Each unit is factory calibrated for monitoring in one of four ranges; 0-5, 0-10, 0-20, or 0-50A. The 0 - 5A range allows the use of external current transformers so loads up to 1200AC amps can be monitored.

Operation
The TCSA varies the effective resistance of its output in direct proportion to the current flowing in the monitored conductor. The unit is factory calibrated so that 0 amps provides a 4mA output and full span provides a 20mA output. Zero and span adjustments are provided for minor calibration adjustments in the field (if required).

Using an External Current Transformer (CT)
Select a 2VA, 0 to 5A output CT, rated for the current to be monitored. Select TCSA5. Pass one of the CT’s secondary wire leads through the TCSA’s toroid. Connect the CT’s secondary leads together.

Wiring Diagram

For dimensional drawing see: Appendix, page 513, Figure 35.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CURRENT RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCSA5</td>
<td>0-5A</td>
</tr>
<tr>
<td>TCSA10</td>
<td>0-10A</td>
</tr>
<tr>
<td>TCSA20</td>
<td>0-20A</td>
</tr>
<tr>
<td>TCSA50</td>
<td>0-50A</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

Features
- Monitors 0 - 50A in 4 ranges
- Loop powered from 10 to 30VDC
- Linear output from 4 - 20mA
- Zero & span adjustments
- Complete isolation between sensed current & control circuit
Accessories

**P1023-6 Mounting bracket**
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P1015-64 (AWG 14/16) Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Specifications

**Sensor**
- **Type**: Toroid, through hole wiring, alternating current, monitored conductor must be properly insulated
- **Monitored AC Current Ranges**: 0 - 5A, 0 - 10A, 0 - 20A, or 0 - 50A
- **Factory Calibration**: ≤±2% of full scale
- **Maximum Allowable Current**: Steady – 50A turns; Inrush – 300A turns for 10s
- **Repeat Accuracy**: ≤0.25% of full scale under fixed conditions
- **Response Time**: ≅300ms
- **Burden**: ≤0.5VA
- **AC Line Frequency**: 20 - 100Hz / 30 - 100Hz
- **Temperature Coefficient**: ±0.05%/°C
- **Output Type**: Current directly proportional to monitored current
- **Range**: 4 - 20mA
- **Sensor Supply Voltage****: 10 to 30VDC
- **Momentary Voltage**: 40VDC for 1m
- **Zero Adjust**: 3.75 - 4.25mA
- **Span Adjust**: 18mA - 22mA
- **Adjustment**: Mini-screw, 25-turn potentiometer

**Protection**
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MO
- **Polarity**: Units are reverse polarity protected

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 44.5 mm (1.75”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals
- **Sensor Hole**: 0.36 in. (9.14 mm) for up to #4 AWG (21.1 mm²) THHN wire

**Environmental**
- **Operating/Storage Temperature**: -30° to 60°C/-40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅2.4 oz (68 g)

*Minimum loop-power supply voltage equals the minimum sensor voltage 10VDC plus the voltage drop developed across all the other loop devices at 20mA.*
**DCSA SERIES**

**Current Transducers**

---

**Description**
The DCSA Series is a loop-powered, linear output current transducer that provides an output that is directly proportional to the RMS AC current passing through the LCSC10T12 sensor. The DCSA Series provides either an analog current or voltage: 4-20 mA, 1 to 5VDC, or 2 to 10VDC. Each unit is factory calibrated for monitoring (with the LCSC10T12 connected) in one of four ranges: 0-5, 0-10, 0-20, or 0-50A. Zero and span adjustments allow field calibration if needed. The DCSA Series mounts on both DIN 1 and DIN 3 rails.

**Operation**
The DCSA Series varies the effective resistance of its output in direct proportion to the current flowing in the conductor monitored by the LCSC10T12. Connecting the power supply to terminals C & D provides a 4 to 20mA DC current. Connect the power supply to terminals C & A to get 1 to 5VDC at terminal D. Connect the power supply to terminals C & B to get 2 to 10VDC at terminal D.

**Features**
- Mounts on DIN 1 or DIN 3 rail
- 0-50A in 4 ranges using LCSC10T12 sensor
- Loop powered from 10 to 30VDC
- Linear output from 4-20mA, 1-10VDC
- Zero & span adjustments
- Separate sensor & control unit

**Accessories**
- **LCSC10T12 Toroidal Current Sensor**
  Remote monitoring of currents up to 50A.

---

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CURRENT RANGE WITH LCSC10T12</th>
<th>INPUT RANGE (F TO E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCSA5</td>
<td>0-5A</td>
<td>0-5mA AC</td>
</tr>
<tr>
<td>DCSA20</td>
<td>0-20A</td>
<td>0-20mA AC</td>
</tr>
<tr>
<td>DCSA50</td>
<td>0-50A</td>
<td>0-50mA AC</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

---

For dimensional drawing see: Appendix, page 513, Figure 36.
Specifications

Input
Ranges (without LCSC10T12 connected)
4 factory calibrated ranges in mA AC
0 - 5mA, 0 - 10mA, 0 - 20mA, or 0 - 50mA AC
Factory calibration ±0.5% of full scale
Repeat Accuracy ±0.25% of full scale under fixed conditions
Response Time ≅ 300ms
Temperature Coefficient ±0.05%/°C
Input to Output Not isolated

Output
Type Analog
Range Current directly proportional to input current
4 - 20mA, or 1 to 5VDC or 2 to 10VDC
Supply Voltage* 10 to 30VDC
Momentary Voltage 40VDC for 1m
Zero Adjust ≅ 3.75 - 4.25mA
Span Adjust 18mA - 22mA
Adjustment Mini-screw, multi-turn potentiometer

Protection
Dielectric Breakdown ≥ 2500V RMS terminals to mounting surface
Insulation Resistance ≥ 100 MΩ
Polarity Units are reverse polarity protected

Mechanical
Mounting DIN 1 & DIN 3 rail mounting
Termination Wire clamp
Environmental
Operating/Storage Temperature -30° to 60°C / -40° to 85°C
Humidity 95% relative, non-condensing
Weight ≅ 1.6 oz (45.4 g)

Output
Type Analog
Range Current directly proportional to input current
4 - 20mA, or 1 to 5VDC or 2 to 10VDC
Supply Voltage* 10 to 30VDC
Momentary Voltage 40VDC for 1m
Zero Adjust ≅ 3.75 - 4.25mA
Span Adjust 18mA - 22mA
Adjustment Mini-screw, multi-turn potentiometer

Protection
Dielectric Breakdown ≥ 2500V RMS terminals to mounting surface
Insulation Resistance ≥ 100 MΩ
Polarity Units are reverse polarity protected

Mechanical
Mounting DIN 1 & DIN 3 rail mounting
Termination Wire clamp
Environmental
Operating/Storage Temperature -30° to 60°C / -40° to 85°C
Humidity 95% relative, non-condensing
Weight ≅ 1.6 oz (45.4 g)

Accessory - LCSC10T12 Toroidal Sensor
Number of Turns 1000
Nominal Output Current Full Range 0 - 50 mA
Maximum Allowable Current Steady 50A turns; Inrush 300A turns for 10s
Burden ≤ 0.5 VA
Frequency 0 - 20A / 21 - 50A 20/100 Hz / 30/100 Hz
Sensor Hole 0.36 in. (9.14 mm) for up to #4 AWG (21.1 mm²) THHN wire
Weight ≅ 1 oz (28.3 g)

*Minimum loop-power supply voltage equals the minimum sensor voltage 10VDC plus the voltage drop developed across all the other loop devices at 20mA.

Monitored Current Amps Diagram
LCS10T12 / LPM SERIES

Current Indicators

Description
The LCS10T12 connected to the LPM12 or LPMG12 indicator is a low cost, easy to use, go/no-go indication system for the remote monitoring of current flow. The LCS10T12 is installed on an adequately insulated wire of the monitored load. Its 12in. (30.4cm) leads are connected to the LPM12 or LPMG12 panel mount indicator directly or via customer supplied wires up to 500 feet (152.4m) long.

Operation
When the monitored current is 5A turns, the panel mount LPM indicator will glow. The LCS10T12 is designed to maximize the light output of the panel mount indicator. It can be used to monitor current flow of less than 5A by passing the monitored conductor 2 or more times through the sensor.

CAUTION: The LCS10T12 must be connected to the LPM12 or LPMG12 before current flows to prevent damage or a shock hazard. Monitored wires must be properly insulated.

Panel mount indicator designed to match the output of the LCS10T12. The LPM12 and LPMG12 come with 12 in. (30.4 cm) wires and a one piece mounting clip. Both devices install quickly in a 0.25 in. (6.35 mm) hole in panels from 0.031 - 0.062 in. (0.79 - 1.6 mm) thick.

Features
- Low cost go/no go indication
- May be connected to wires up to 500 feet (152.4 m) long
- Remote monitoring of currents up to 50A
- Green or red LED indicator available

Specifications

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 - 50A AC</td>
<td>1</td>
<td>5A</td>
<td>50A</td>
<td>120A</td>
<td>0.355 in. (9.0 mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>2.5A</td>
<td>25A</td>
<td>60A</td>
<td>0.187 in. (4.7 mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1.7A</td>
<td>16.6A</td>
<td>40A</td>
<td>0.15 in. (3.8 mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>1.3A</td>
<td>12.5A</td>
<td>30A</td>
<td>0.125 in. (3.2 mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>5/X</td>
<td>50/X</td>
<td>120/X</td>
<td></td>
</tr>
</tbody>
</table>

Maximum Current 50A turns continuous
AC Line Frequency 50/60Hz
DC Resistance of Current Limiter 65 Ω

Mechanical
Sensor Hole 0.36 in. (9.14 mm) for up to #4 AWG (21.1 mm²) THHN wire
Termination 12 in. (30.4 cm) wire leads

Environmental
Operating/Storage Temperature -40° to 60°C/ -40° to 85°C

Weight
LCS: ≈ 0.8 oz (23 g)
LPM: ≈ 0.2 oz (6 g)

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCS10T12</td>
<td>AC Current Sensor</td>
</tr>
<tr>
<td>LPM12</td>
<td>Red LED Indicator</td>
</tr>
<tr>
<td>LPMG12</td>
<td>Green LED Indicator</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 513, Figure 37 and 38.

If you don’t find the part you need, call us for a custom product 800-843-8848
**Description**

The 50R Series single-phase voltage monitor has a voltage-sensing circuit which constantly monitors the single-phase power for a low voltage condition. Single-phase motors on fans, compressors, air conditioners, heat pumps, well pumps, sump pumps and small conveyor motors are all applicable to the 50R Series.

When a harmful condition is detected, the MotorSaver’s output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary voltage sensing circuitry</td>
<td>Constant monitoring of single-phase power for a low voltage condition</td>
</tr>
<tr>
<td>Adjustable trip delay (-3 models) and restart delay (-2 models) settings</td>
<td>Prevent nuisance tripping due to rapidly fluctuating power line conditions and allows staggered start up of multiple motors, after a fault, to prevent a low voltage condition</td>
</tr>
<tr>
<td>High voltage detection (-9 models)</td>
<td>Trips and resets at a fixed percentage of the setpoint: trip 110%, reset 107%.</td>
</tr>
<tr>
<td>600V rated relay contacts available on some models</td>
<td>Eliminates the need for a control transformer to step voltage down to 120 - 240V for a control circuit</td>
</tr>
</tbody>
</table>

**Wiring Diagram**

For dimensional drawing see: Appendix page 509, Figure 6.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>50R-100</td>
<td>95-120VAC</td>
<td>Fixed trip and restart delay</td>
</tr>
<tr>
<td>50R-100-2</td>
<td>95-120VAC</td>
<td>Fixed trip and variable restart delay (manual, 2-300s)</td>
</tr>
<tr>
<td>50R200</td>
<td>190-240VAC</td>
<td>Fixed trip and restart delay</td>
</tr>
<tr>
<td>50R2002</td>
<td>190-240VAC</td>
<td>Fixed trip and variable restart delay (manual, 2-300s)</td>
</tr>
<tr>
<td>50R2003</td>
<td>190-240VAC</td>
<td>Fixed restart and variable trip delay (2-30s)</td>
</tr>
<tr>
<td>50R20029</td>
<td>190-240VAC</td>
<td>Fixed trip and variable restart delay (manual, 2-300s) plus high voltage detection</td>
</tr>
<tr>
<td>50R400</td>
<td>380-480VAC</td>
<td>Fixed trip and restart delay</td>
</tr>
<tr>
<td>50R4002</td>
<td>380-480VAC</td>
<td>Fixed trip and variable restart delay (manual, 2-300s)</td>
</tr>
<tr>
<td>50R4003</td>
<td>380-480VAC</td>
<td>Fixed restart and variable trip delay (2-30s)</td>
</tr>
<tr>
<td>50R40029</td>
<td>380-480VAC</td>
<td>Fixed trip and variable restart delay (manual, 2-300s) plus high voltage detection</td>
</tr>
</tbody>
</table>
### Specifications

**Input Characteristics**

**Line Voltage**
- **50R-100**: 95-120VAC
- **50R200**: 190-240VAC
- **50R400**: 380-480VAC

**Frequency**
- 50*/60Hz

**Functional Characteristics**

**Low Voltage:**
- **Trip (% of setpoint)**: 90%
- **Reset (% of setpoint)**: 93%

**Delay Time (Nominal)**
- **Trip**: 4 seconds
- **Restart (low voltage)**: 2 seconds
- **Restart (complete power loss)**: 2 seconds

**Output Characteristics**

**Output Contact Rating**
- **(SPDT - 1 Form C)**
  - **50R-100, 50R200**: 480VA @ 240VAC
  - **50R400**: 470VA @ 600VAC

**General Purpose**
- **Pilot Duty**: 10A @ 240VAC

**General Characteristics**

**Ambient Temperature Range**
- **Operating**: -20°C to 70°C (-4° to 158°F)
- **Storage**: -40°C to 80°C (-40° to 176°F)

**Maximum Input Power**
- 5 W

**Relative Humidity**
- 10-95%, non-condensing per IEC 68-2-3

**Terminal**
- **Torque**: 7 in.-lbs.
- **Wire Size**: 12-18AWG

**Electrostatic Discharge (ESD)**
- IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- IEC 61000-4-4, Level 3, 3.5kV input power and controls

**Transient Protection (Internal)**
- IEC 61000-4-5; 1995 ±6kV

**Safety Marks**
- UL: UL508 (File #E68520)
- CE: IEC 60947-6-2

**Dimensions**
- \( H \): 74.4 mm (2.93”); \( W \): 133.9 mm (5.27”); \( D \): 74.9 mm (2.95”)

**Weight**
- 0.98 lb. (15.68 oz., 444.52 g)

**Mounting Method**
- #8 screws

---

**Special Options**

- **Opt. 2: Variable Restart Delay**: Manual, 2-300 seconds
- **Opt. 3: Variable Trip Delay**: 2-30 seconds
- **Opt. 9: High Voltage Detection Operating Points**
  - **Trip (% of Setpoint)**: 110%
  - **Reset (% of Setpoint)**: 107%

*Note: 50Hz will increase all delay timers by 20%*
Description

The 201-xxx-SP Series is an 8-pin octal-base, plug-in voltage monitor designed to protect single-phase motors regardless of size. The 201-100-SP is used on 95-120VAC, 50/60Hz motors to prevent damage caused by low voltage. The 201-200-SP is used on 190-240VAC, 50/60Hz motors. The 201-200-SP-T-9 is a pin-for-pin replacement for a Time Mark® #260 Series voltage monitor. High voltage protection is included in the 201-200-SP-T-9.

The unique microcontroller-based voltage and voltage-sensing circuit constantly monitors the voltage to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver’s output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Must use Model OT08PC socket for UL Rating!

Note: Manufacturer’s recommended screw terminal torque for the RB Series and OT Series Octal Sockets is 12 in.-lbs.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of voltage to detect harmful power line conditions, even before the motor starts</td>
</tr>
<tr>
<td>Fixed trip delay 4s</td>
<td>Prevents nuisance tripping due to rapidly fluctuating power line conditions</td>
</tr>
<tr>
<td>Advanced LED indication</td>
<td>Provides diagnostics which can be used for troubleshooting and to determine relay status</td>
</tr>
<tr>
<td>Compact design for 8-pin: DIN rail or surface mount</td>
<td>Allows flexibility in panel installation</td>
</tr>
</tbody>
</table>

Accessories

OT08PC 8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>201-100-SP</td>
<td>95-120VAC</td>
<td>SPDT, protects single phase motors</td>
</tr>
<tr>
<td>201-200-SP</td>
<td>190-240VAC</td>
<td>SPDT, protects single phase motors</td>
</tr>
<tr>
<td>201-200-SP-T-9</td>
<td>190-240VAC</td>
<td>SPDT, direct replacement for Time Mark® #260 series</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 509, Figure 8.
### Specifications

#### Input Characteristics
- **Line Voltage:**
  - 201-100-SP: 95-120VAC
  - 201-200-SP, 201-200-SP-T-9: 190-240VAC
- **Frequency:** 50/60Hz

#### Functional Characteristics
- **Low Voltage (% of setpoint):**
  - Trip: 90%
  - Reset: 93%
- **For 201-200-SP-T-9 only:**
  - **High Voltage (% of setpoint):**
    - Trip: 110%
    - Reset: 107%
- **Trip Delay Time:**
  - High/Low Voltage Fault: 4 seconds
- **Restart Delay Time:**
  - After a Fault: 2 seconds
  - After a Complete Power Loss: 2 seconds

#### Output Characteristics
- **Output Contact Rating (SPDT):**
  - Pilot Duty: 480VA @ 240VAC
  - General Purpose: 10A @ 240VAC

### General Characteristics

#### Ambient Temperature Range
- **Operating:** -40° to 70°C (-40° to 158°F)
- **Storage:** -40° to 80°C (-40° to 176°F)

#### Maximum Input Power
- 5 W

#### Transient Protection (Internal)
- 2500V for 10 ms

#### Safety Marks
- UL (OT08PC octal socket required)
- UL508 (File #E68520)
- IEC 60947-6-2

#### CE
- IEC 60947-6-2

#### Dimensions
- **H**: 44.45 mm (1.75”);
- **W**: 60.325 mm (2.375”);
- **D**: 104.775 mm (4.125”) (with socket)

#### Weight
- 0.8 lb. (12.8 oz., 362.87 g)

#### Mounting Method
- DIN rail or surface mount

#### Socket Available
- Model OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.
Description
The 201-xxx-SP-DPDT Series is an 8-pin octal-base, plug-in voltage monitor designed to protect single-phase motors regardless of size. The 201-100-SP-DPDT is used on 95-120VAC, 50/60Hz motors to prevent damage caused by low voltage. The 201-200-SP-DPDT is used on 190-240VAC, 50/60Hz motors. The units feature two isolated sets of contacts that are ideal for use with two control circuits with different voltages.

The unique microcontroller-based voltage and voltage-sensing circuit constantly monitors the voltage to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver’s output relays are deactivated after a specified trip delay. The output relays reactivate after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Must use Model OT08PC socket for UL Rating!
Note: Manufacturer’s recommended screw terminal torque for the RB Series and OT Series Octal Sockets is 12 in.-lbs.

Wiring Diagram

For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of voltage to detect harmful power line conditions, even before the motor starts</td>
</tr>
<tr>
<td>Fixed trip delay 4s</td>
<td>Prevents nuisance tripping due to rapidly fluctuating power line conditions</td>
</tr>
<tr>
<td>Advanced LED indication</td>
<td>Provides diagnostics which can be used for troubleshooting and to determine relay status</td>
</tr>
<tr>
<td>Compact design for 8-pin; DIN rail or surface mount</td>
<td>Allows flexibility in panel installation</td>
</tr>
</tbody>
</table>

Accessories
OT08PC 8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>201-100-SP-DPDT</td>
<td>95-120VAC</td>
<td>Two isolated Form C relays</td>
</tr>
<tr>
<td>201-200-SP-DPDT</td>
<td>190-240VAC</td>
<td>Two isolated Form C relays</td>
</tr>
</tbody>
</table>
Specifications

Input Characteristics
Line Voltage:
- 201-100-SP-DPDT: 95-120VAC
- 201-200-SP-DPDT: 190-240VAC

Frequency:
- 50/60Hz

Functional Characteristics
Low Voltage (% of setpoint):
- Trip: 90% +/-1%
- Reset: 93% +/-1%

Trip Delay Times:
- Low Voltage: 4 seconds

Restart Delay Times:
- After a Fault or Complete Power Loss: 2 seconds

Output Characteristics
Output Contact Rating (DPDT)
- Pilot Duty: 480VA @ 240VAC
- General Purpose: 10A @ 240VAC

General Characteristics
Ambient Temperature Range:
- Operating: -20° to 70°C (-4° to 158°F)
- Storage: -40° to 80°C (-40° to 176°F)

Maximum Input Power: 5 W
Relative Humidity: 10-95%, non-condensing per IEC 68-2-3

Standards Passed

Electrostatic Discharge (ESD)
IEC 61000-4-2, Level 3, 6kV contact, 8kV air

Radio Frequency Immunity,
- Radiated:
  - IE61000-4-4, Level 3, 3.5kV input power and controls
- Fast Transient Burst:
  - IEC 61000-4-4, Level 3, 3.5kV input power and controls

Safety Marks
UL (OT08PC octal socket required)
UL508 (File #E68520)

CE
IEC 60947-6-2

Dimensions
- H: 44.45 mm (1.75’’);
- W: 60.325 mm (2.375’’);
- D: 104.775 mm (4.125’’) (with socket)

Weight
- 0.65 lb. (10.4 oz., 294.84 g)

Mounting Method
- DIN rail or surface mount (plug in to OT08PC socket)

Socket Available
Model OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.
Description
The 202-200-SP Series voltage monitor is designed to protect single-phase motors regardless of size. It can be used with 190V-240VAC, 50/60Hz motors to prevent damage caused by incoming power problems.

A unique microcontroller-based voltage-sensing circuit constantly monitors the voltage to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver’s output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of voltage to detect harmful power line conditions, even before a motor starts</td>
</tr>
<tr>
<td>Fixed trip delay 4s</td>
<td>Prevents nuisance tripping due to rapidly fluctuating power line conditions</td>
</tr>
<tr>
<td>Adjustable restart delay</td>
<td>Allows staggered start up of multiple motors, after a fault, to prevent a low voltage condition</td>
</tr>
<tr>
<td>(Manual, 2-300s)</td>
<td></td>
</tr>
<tr>
<td>Advanced LED indication</td>
<td>Provides diagnostics which can be used for troubleshooting and to determine relay status</td>
</tr>
<tr>
<td>One screw mounting and</td>
<td>Fast installation and compact size perfect for panel assembly or OEM applications</td>
</tr>
<tr>
<td>standard 1/4” quick</td>
<td></td>
</tr>
<tr>
<td>connect terminals</td>
<td></td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>202-200-SP</td>
<td>190-240VAC</td>
<td>SPDT, high and low voltage protection</td>
</tr>
<tr>
<td>202-200-SP-NHV</td>
<td>190-240VAC</td>
<td>SPDT, low voltage protection only</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 509, Figure 7.
## Specifications

### Input Characteristics

**Line Voltage:**
- 202-200-SP, 202-200-SP-NHV: 190-240VAC

**Frequency:**
- 50*/60Hz

### Functional Characteristics

**Low Voltage (% of setpoint):**
- Trip: 90%
- Reset: 93%

**High Voltage (% of setpoint):**
- Trip: 110%
- Reset: 107%

**Trip Delay Time:**
- High and Low Voltage: 4 seconds

**Restart Delay Time:**
- After a Fault or Complete Power Loss: Manual, 2-300 seconds adj.

### Output Characteristics

**Output Contact Rating (SPDT):**
- Pilot Duty: 480VA @ 240VAC
- General Purpose: 10A @ 240VAC

---

### General Characteristics

**Temperature Range:**
- -40° to 70°C (-40° to 158°F)

**Trip & Reset Accuracy:**
- ±1%

**Repeatability:**
- ±0.5%

**Input to Output Dielectric:**
- 1480 Vrms (min.)

**Termination:**
- 0.25” male quick connect

**Maximum Input Power:**
- 5 W

**Relative Humidity:**
- 95%, non-condensing

**Transient Protection:**
- IEC 61000-4-5, ±4kV

**Safety Marks:**
- UL, UL Recognized
- UL508 (File #E68520)

**Dimensions:**
- **H:** 63.5 mm (2.5”);
- **W:** 63.5 mm (2.5”);
- **D:** 35.56 mm (1.4”)

**Weight:**
- 0.5 lb. (8 oz., 226.8 g)

**Mounting Method:**
- 1/4” socket head cap screw (customer supplied)

*Note: 50Hz will increase all delay timers by 20%.*
Description
The 460-100-SP is used on 95-120VAC, 50*/60Hz single-phase motors and the 460-200-SP is used on 190-240VAC, 50*/60Hz single-phase motors to protect them from damaging high and low voltage conditions. An adjustment knob allows the user to set a 1-500 second restart delay. The variable restart delay is also a power-up delay and can be utilized to stagger-start motors on the same system.

A unique microcontroller-based, voltage-sensing circuit constantly monitors the voltage to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver’s output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of voltage to detect harmful power line conditions, even before a motor starts</td>
</tr>
<tr>
<td>Fixed trip delay 4s</td>
<td>Prevents nuisance tripping due to rapidly fluctuating power line conditions</td>
</tr>
<tr>
<td>Adjustable restart delay (1-500s)</td>
<td>Allows staggered start up of multiple motors on the same system to prevent a low voltage condition</td>
</tr>
<tr>
<td>Advanced LED indication</td>
<td>Provides diagnostics which can be used for troubleshooting and to determine relay status</td>
</tr>
<tr>
<td>DIN rail or surface mountable</td>
<td>Allows flexibility for panel assembly</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>460-100-SP</td>
<td>95-120VAC</td>
</tr>
<tr>
<td>460-200-SP</td>
<td>190-240VAC</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 510, Figure 10.
## Specifications

### Input Characteristics

**Line Voltage**
- 460-100-SP: 95-120VAC
- 460-200-SP: 190-240VAC

**Frequency**
- 50*/60Hz

### Functional Characteristics

**Low Voltage (% of setpoint):**
- **Trip:** 90% ±1%
- **Reset:** 93% ±1%

**High Voltage (% of setpoint):**
- **Trip:** 110% ±1%
- **Reset:** 107% ±1%

**Trip Delay Time**
- 4 seconds fixed

**Restart Delay Time**
- After a Fault: 1-500 seconds adjustable
- After a Complete Power Loss: 1-500 seconds adjustable

### Output Characteristics

**Output Contact Rating (1 Form C)**
- Pilot Duty: 480VA @ 240VAC, B300
- General Purpose: 10A @ 240VAC

### General Characteristics

**Ambient Temperature Range**
- Operating: -40° to 70°C (-40° to 158°F)
- Storage: -40° to 80°C (-40° to 176°F)

**Maximum Input Power**
- 6 W

**Class of Protection**
- IP20, NEMA 1 (finger safe)

**Relative Humidity**
- 10-95%, non-condensing per IEC 68-2-3

**Terminal Torque**
- 4.5 in.-lbs.

**Wire Type**
- Stranded or solid 12-20 AWG, one per terminal

### Standards Passed

**Electrostatic Discharge (ESD)**
- IEC 61000-4-2, Level 3, 6kV contact, 8kV air

**Radio Frequency Immunity, Radiated**
- 150 MHz, 10V/m

**Fast Transient Burst**
- IEC 61000-4-4, Level 3, 3.5 kV input power and controls

**Surge**
- **IEC**
  - IEC 61000-4-5, Level 3, 4kV line-to-line;
  - Level 4, 4kV line-to-ground
- **ANSI/IEEE**
  - C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
  - Meets UL508 (2 x rated V ±1000V for 1 min)

**Hi-potential Test**
- UL508 (File #E68520)

**Safety Marks**
- UL: UL508 (File #E68520)
- CE: IEC 60947-6-2

**Enclosure**
- Polycarbonate

**Dimensions**
- **H:** 88.9 mm (3.5”); **W:** 52.93 mm (2.084”);
- **D:** 59.69 mm (2.35”)

**Weight**
- 0.9 lb. (14.4 oz., 408.23 g)

**Mounting Method**
- 35mm DIN rail or Surface Mount (¢6 or ¢8 screws)

*Note: 50 Hz will increase all delay timers by 20%*
Description

The 102A is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50/60Hz motors regardless of size. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically selects between the 200V and 400V range.

A unique microcontroller-based voltage and phase-sensing circuit constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels. The Model 102A includes advanced single LED diagnostics. Five different light patterns distinguish between faults and normal conditions.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of single-phase, low voltage, high voltage (102A-9), voltage unbalance, phase reversal, harmful power line conditions.</td>
</tr>
<tr>
<td>Auto-sensing wide voltage range</td>
<td>Automatically senses system voltage between 190 - 480VAC. Saves setup time.</td>
</tr>
<tr>
<td>Advanced LED diagnostics</td>
<td>Quick visual indicator for cause of trip. LED indications include: normal operation, power-up restart delay, reverse-phase trip, unbalance/single-phase trip, high or low voltage trip</td>
</tr>
<tr>
<td>Adjustable trip delay (102A2)</td>
<td>Prevent nuisance tripping due to rapidly fluctuating power line conditions.</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>102A</td>
<td>190-480VAC</td>
<td>Fixed low voltage trip delay (4 sec), fixed restart delay (2 sec)</td>
</tr>
<tr>
<td>102A2</td>
<td>190-480VAC</td>
<td>Has variable restart delay (manual or adjustable 2-300 seconds)</td>
</tr>
<tr>
<td>102A3</td>
<td>190-480VAC</td>
<td>Has adjustable trip delay at 2-30 seconds (unbalance and phasing trip delays remain at 2 seconds)</td>
</tr>
<tr>
<td>102A-9</td>
<td>190-480VAC</td>
<td>Has high voltage protection. High Voltage Trip is 110% of setpoint, Reset is 107% of setpoint.</td>
</tr>
<tr>
<td>102600</td>
<td>475-600VAC</td>
<td>Fixed low voltage trip delay (4 sec), fixed restart delay (2 sec)</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix page 509, Figure 6.
### Specifications

<table>
<thead>
<tr>
<th>Functional Characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>50*/60Hz</td>
</tr>
<tr>
<td><strong>Low Voltage (% of setpoint)</strong></td>
<td></td>
</tr>
<tr>
<td>Trip</td>
<td>90%</td>
</tr>
<tr>
<td>Reset</td>
<td>93%</td>
</tr>
<tr>
<td><strong>Voltage Unbalance (NEMA)</strong></td>
<td></td>
</tr>
<tr>
<td>Trip</td>
<td>6%</td>
</tr>
<tr>
<td>Reset</td>
<td>4.5%</td>
</tr>
<tr>
<td><strong>Trip Delay Time</strong></td>
<td></td>
</tr>
<tr>
<td>Low/High Voltage</td>
<td>4 seconds (standard)</td>
</tr>
<tr>
<td>Unbalance &amp; Phasing Faults</td>
<td>2 seconds</td>
</tr>
<tr>
<td><strong>Restart Delay Time</strong></td>
<td></td>
</tr>
<tr>
<td>After a Fault</td>
<td>2 seconds (standard)</td>
</tr>
<tr>
<td>After a Complete Power Loss</td>
<td>2 seconds (standard)</td>
</tr>
<tr>
<td><strong>Output Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Output Contact Rating</td>
<td>480VA @ 240VAC</td>
</tr>
<tr>
<td>Pilot Duty</td>
<td>10A @ 240VAC</td>
</tr>
</tbody>
</table>

### General Characteristics

<table>
<thead>
<tr>
<th>General Characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient Temperature Range</strong></td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>-40° to 70°C (-40° to 158°F)</td>
</tr>
<tr>
<td>Storage</td>
<td>-40° to 80°C (-40° to 176°F)</td>
</tr>
<tr>
<td><strong>Trip &amp; Reset Accuracy</strong></td>
<td>±1%</td>
</tr>
<tr>
<td><strong>Maximum Input Power</strong></td>
<td>5 W</td>
</tr>
<tr>
<td><strong>Terminal</strong></td>
<td></td>
</tr>
<tr>
<td>Torque</td>
<td>7 in.-lbs.</td>
</tr>
<tr>
<td>Wire Size</td>
<td>12-18AWG</td>
</tr>
<tr>
<td><strong>Standards Passed</strong></td>
<td></td>
</tr>
<tr>
<td>Electrostatic Discharge (ESD)</td>
<td>IEC 61000-4-2, Level 3, 6kV contact, 8kV air</td>
</tr>
<tr>
<td>Fast Transient Burst</td>
<td>IEC 61000-4-4, Level 3, 4kV input, 2kV input/output</td>
</tr>
<tr>
<td>Transient Protection (Internal)</td>
<td>IEC 61000-4-5; 1995 ±6kV</td>
</tr>
<tr>
<td>Safety Marks</td>
<td></td>
</tr>
<tr>
<td>UL</td>
<td>UL508 (File #E68520)</td>
</tr>
<tr>
<td>CSA</td>
<td>22.2 No. 14 (File #46510)</td>
</tr>
<tr>
<td>CE</td>
<td>IEC 60947-6-2</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 74.4 mm (2.93”); W 133.9 mm (5.27”); D 74.9 mm (2.95”)</td>
</tr>
<tr>
<td>Weight</td>
<td>1.05 lbs. (16.8 oz., 476.27 g)</td>
</tr>
<tr>
<td>Mounting Method</td>
<td>#8 screws</td>
</tr>
</tbody>
</table>

*Note: 50Hz will increase all delay timers by 20%.*
Description
The 201A is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50/60Hz motors regardless of size. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically selects between the 200V and 400V range. The 201A includes advanced single LED diagnostics, where color and light patterns distinguish between faults and normal conditions.

This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the 201A's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels for a specified restart delay time.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of single-phase, low voltage, voltage unbalance, phase reversal, harmful power line conditions. High voltage monitoring optional.</td>
</tr>
<tr>
<td>Compact design for 8-pin: DIN rail or surface mount</td>
<td>Allows flexibility in panel installation</td>
</tr>
<tr>
<td>Auto-sensing wide voltage range</td>
<td>Automatically senses system voltage between 190 - 480VAC. Saves setup time.</td>
</tr>
<tr>
<td>Advanced LED diagnostics</td>
<td>Quick visual indicator for cause of trip. LED indications include: normal operation, power-up restart delay, reverse-phase trip, unbalance/single-phase trip, high/low voltage trip</td>
</tr>
</tbody>
</table>

Accessories

**OT08PC Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>201A</td>
<td>190-480VAC</td>
<td>DIN rail or surface mountable</td>
</tr>
<tr>
<td>201A-9</td>
<td>190-480VAC</td>
<td>Includes high voltage detection. DIN rail or surface mountable</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 509, Figure 8.
201A SERIES

Specifications

Frequency
50/60Hz

Functional Characteristics

Low Voltage (% of setpoint)
Trip 90% ±1%
Reset 93% ±1%

Voltage Unbalance (NEMA)
Trip 6%
Reset 4.5%

Optional High Voltage (% of setpoint)
Trip 110% ±1%
Reset 107% ±1%

Trip Delay Time
High/Low Voltage Fault 4 seconds
Unbalance & Phasing Faults 2 seconds

Restart Delay Time
After a Fault 2 seconds
After a Complete Power Loss 2 seconds

Output Characteristics

Output Contact Rating (SPDT)
Pilot Duty 480VA @ 240VAC
General Purpose 10A @ 240VAC

General Characteristics

Temperature Range
-20° to 70°C (-4° to 158°F)

Trip & Reset Accuracy
±1%

Maximum Input Power
5 W

Relative Humidity
10-95%, non-condensing per IEC 68-2-3

Terminal Torque
12 in.-lbs. (for OT08-PC socket)

Wire Gauge
12-22 AWG solid or stranded

Transient Protection (Internal)
2500V for 10 ms

Standards Passed

Electrostatic Discharge (ESD)
IEC 61000-4-2, Level 3, 6kV contact, 8kV air

Radio Frequency Immunity (RFI), Radiated
150MHz, 10V/m
IEC 61000-4-4, Level 3, 3.5kV input power & controls

Fast Transient Burst
IEC 61000-4-5, Level 3, 4kV line-to-line;
Level 4, 4kV line-to-ground

Surge
CE

Immunity IEC
ANSI/IEEE C62.41 Surge and Ring Wave Compliance to
a level of 6kV line-to-line

Hi-potential Test
Meets UL508 (2 x rated V + 1000V for 1 min.)

Safety Marks
UL508 (File #E68520)
IEC 60947-6-2

Dimensions
H 44.45 mm (1.75”); W 60.33 mm (2.38”);
D (with socket) 104.78 mm (4.13”)

Weight
0.7 lbs. (11.2 oz., 317.51 g)

Mounting Method
DIN rail or surface mount
(plug in to OT08PC socket)

Socket Available
Model OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.

Note: Manufacturer’s recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Must use Model OT08PC socket for UL Rating!
Description

The 201A-AU is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50/60Hz motors regardless of size. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically selects between the 200V and 400V range. Additional adjustment knobs allow the user to set a 1-30 second trip delay, a manual restart or 1-500 second restart delay and a 2-8% voltage unbalance trip point. The Model 201A-AU includes advanced single LED diagnostics, where color and light patterns distinguish between faults and normal conditions.

This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the 201A-AU’s output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels for a specified amount or restart delay time (or manual reset).

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of loss of any phase, low voltage, high voltage, voltage unbalance, phase reversal, rapid cycling, harmful power line conditions</td>
</tr>
<tr>
<td>Compact design for 8-pin: DIN rail or surface mount</td>
<td>Allows flexibility in panel installation</td>
</tr>
<tr>
<td>Auto-sensing wide voltage range</td>
<td>Automatically senses system voltage between 190 - 480VAC. Saves setup time.</td>
</tr>
<tr>
<td>Advanced LED diagnostics</td>
<td>Quick visual indicator for cause of trip.</td>
</tr>
<tr>
<td>Adjustable voltage unbalance trip setting</td>
<td>Allows compatibility with a variety of motors and reduces nuisance tripping.</td>
</tr>
<tr>
<td>Adjustable trip &amp; restart delay settings</td>
<td>Prevent nuisance tripping due to rapidly fluctuating power line conditions.</td>
</tr>
</tbody>
</table>

Accessories

OT08PC Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>201A-AU</td>
<td>190-480VAC</td>
<td>DIN rail or surface mountable</td>
</tr>
<tr>
<td>201575-AU</td>
<td>475-600VAC</td>
<td>DIN rail or surface mountable</td>
</tr>
<tr>
<td>201A-AU-OT</td>
<td>190-480VAC</td>
<td>Sold with OT08PC socket</td>
</tr>
<tr>
<td>201-575-AU-OT</td>
<td>475-600VAC</td>
<td>Sold with OT08PC socket</td>
</tr>
</tbody>
</table>
Specifications

Frequency
50/60Hz

Functional Characteristics

Low Voltage (% of setpoint)
- Trip: 90% ±1%
- Reset: 93% ±1%

High Voltage (% of setpoint)
- Trip: 110% ±1%
- Reset: 107% ±1%

Voltage Unbalance (NEMA)
- Trip: 2.8% adjustable
  - Trip Setting Minus 1% (5-8%)
  - Trip Setting Minus 0.5% (2-4%)
- Reset:
  - 201A-AU SERIES
  - Standards Passed
    - Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air
    - Radio Frequency Immunity, Radiated: 150 MHz, 10V/m
    - Fast Transient Burst: IEC 61000-4-4, Level 3, 3.5kV input power and controls
    - Surge: IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
    - ANSI/IEEE C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
    - Hi-potential Test: IEC 60947-6-2
    - UL (OT08PC socket required)
    - CE: IEC 60947-6-2
    - Enclosure: Polycarbonate
      - H: 44.45 mm (1.75”); W: 60.325 mm (2.375”)
      - D: 104.775 mm (4.125”) (with socket)
    - Weight: 0.7 lb. (11.2 oz., 317.51 g)
    - Mounting Method: DIN rail or surface mount
    - Socket Available: OT08PC (UL Rating 600V)

General Characteristics

480VA @ 240VAC, B300

Ambient Temperature Range
- Operating: -40° to 70°C (-40° to 158°F)
- Storage: -40° to 80°C (-40° to 176°F)

Trips & Reset Accuracy
- ±1%

Maximum Input Power
- 5 W

Relative Humidity
- 10-95%, non-condensing per IEC 68-2-3

Terminal Torque
- 12 in.-lbs. (for OT08-PC socket)

Wire Gauge
- 12-22 AWG solid or stranded

Pilot Duty
- 10A @ 240VAC

General Purpose
- 480VA @ 240VAC, B300

Restart Delay Time
- High, Low and Unbalanced Voltage: 1-30 seconds adjustable
- Single-Phasing Faults: 1 second fixed

Trip Delay Time
- High, Low and Unbalanced Voltage: 1-30 seconds adjustable
- Single-Phasing Faults: 1 second fixed

Output Characteristics

Output Contact Rating
- (1-Form C)
- Pilot Duty: 480VA @ 240VAC, B300
- General Purpose: 10A @ 240VAC

Hi-potential Test
- UL508 (File #E68520)
- Safety Marks: IEC 60947-6-2
- Dimensions: Polycarbonate
  - H: 44.45 mm (1.75”); W: 60.325 mm (2.375”)
  - D: 104.775 mm (4.125”) (with socket)
- Weight: 0.7 lb. (11.2 oz., 317.51 g)
- Mounting Method: DIN rail or surface mount
- Socket Available: OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.

Note: Manufacturer’s recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Must use Model OT08PC socket for UL Rating!
Description
The 201-xxx-DPDT Series is an 11-pin octal base plug-in voltage monitor designed to protect 3-phase motors regardless of size. The 201-100-DPDT is used on 95-120VAC, 50/60Hz motors and the 201-200-DPDT is used on 190-240VAC, 50/60Hz motors to prevent damage caused by incoming voltage problems. The units feature two isolated sets of contacts that are ideal for use with two control circuits with different voltages.

The unique microcontroller-based voltage and phase-sensing circuit constantly monitors the voltages to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver’s output relays are deactivated after a specified trip delay. The output relays reactivate after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

This unit is also available with a shorter trip delay and faster restart delay. The 201-xxx-DPDT-60mS has a trip delay of 0.5 seconds and a restart delay of 60 milliseconds.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constantly monitors 3 phase voltage to protect against harmful line conditions, even before the motor is started</td>
</tr>
<tr>
<td>Compact design for 11-pin; DIN rail or surface mount</td>
<td>Allows flexibility in panel installation</td>
</tr>
<tr>
<td>Advanced LED indication</td>
<td>Provides diagnostics which can be used for troubleshooting and to determine relay status</td>
</tr>
<tr>
<td>Two isolated Form C relays (DPDT)</td>
<td>Ideal for use in systems which have two control circuits with different voltages</td>
</tr>
</tbody>
</table>

Accessories

OT11PC Octal Socket
11-pin surface & DIN rail mountable. Rated for 10A @ 300VAC

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>201-100-DPDT</td>
<td>95-120VAC</td>
<td>Fixed unbalance, trip delay 4s for low voltage fault and 2s for unbalance and phase loss, restart delay 2s</td>
</tr>
<tr>
<td>201-200-DPDT</td>
<td>190-240VAC</td>
<td>Fixed unbalance, trip delay 4s for low voltage fault and 2s for unbalance and phase loss, restart delay 2s</td>
</tr>
<tr>
<td>201-100-DPDT-60mS</td>
<td>95-120VAC</td>
<td>Fixed unbalance, trip delay 0.5s, restart delay 60mS</td>
</tr>
</tbody>
</table>
Protection Relays
Voltage Monitoring Relays

201-XXX-DPDT SERIES

Specifications

Input Characteristics
Line Voltage
201-100-DPDT, 201-100-DPDT-60mS 95-120VAC
201-200-DPDT, 201-200-DPDT-60mS 190-240VAC
Frequency
50/60Hz

Functional Characteristics
Low Voltage (% of setpoint)
Trip 90% +/- 1%
Reset 93% +/- 1%
Voltage Unbalance
Trip 6%
Reset 4.5%

Trip Delay Times
Low Voltage 4 seconds
Unbalance, Phasing Faults 2 seconds
Models with -60ms option 0.5 second

Restart Delay Times
After a Fault or Complete Power Loss 2 seconds
Models with -60mS option 60 milliseconds

Output Characteristics

Output Contact Rating (DPDT)
Pilot Duty 480VA @ 240VAC
General Purpose 10A @ 240VAC

General Characteristics
Temperature Range -40° to 70°C (-40° to 158°F)
Maximum Input Power 5 W

Standards Passed
Electrostatic Discharge (ESD) IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated 150MHz, 10V/m
Fast Transient Burst IEC 61000-4-4, Level 3, 2.5kV input power

Safety Marks
UL (OT11PC octal socket required) UL508 (File #E68520)
CE IEC 60947-6-2
Dimensions H 44.45 mm (1.75”); W 60.33 mm (2.38”);
D 104.78 mm (4.125”)
Weight 0.65 lb. (10.4 oz., 294.84 g)
Mounting Method DIN rail or surface mount (plug in to OT11PC socket)

Socket Available
Model OT11PC (UL Rated 300V)

The 300V socket can be surface mounted or installed on DIN Rail.
Must use Model OT11PC socket for UL Rating!

*Note: Manufacturer’s recommended screw terminal torque for the RB Series and OT Series Octal Sockets is 12 in.-lbs.
**Description**

The 202 Series is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50*/60Hz motors regardless of size. The 202-RP (and the 202-575-RP for 475-600VAC) monitors the phase rotation of 3-phase systems and trips on reverse-phase only. Critical applications include fan motors, scroll compressors, grinders, conveyor systems, elevators and escalators. Both products provide a user selectable nominal voltage setpoint and automatically select between the 200V and 400V range.

This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver’s output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels for a specified amount of restart delay time (or a manual reset). The 202 Series includes advanced single LED diagnostics. Five different light patterns distinguish between faults and normal conditions. The status light turns green and the relay is activated when rotation is correct.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact, quick mounting design</td>
<td>1-screw mounting saves time and space. Small footprint ideal for assembly into panels.</td>
</tr>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of single-phase, low voltage, high voltage, voltage unbalance, phase reversal, harmful power line conditions.</td>
</tr>
<tr>
<td>Auto-sensing wide voltage range (202 &amp; 202-RP)</td>
<td>Automatically senses system voltage between 90 - 480VAC. Saves setup time.</td>
</tr>
<tr>
<td>Advanced LED diagnostics</td>
<td>Quick visual indicator for cause of trip. LED indications include: normal operation, restart delay, reverse-phase trip, fault</td>
</tr>
<tr>
<td>Adjustable trip delay (202)</td>
<td>Prevent nuisance tripping due to rapidly fluctuating power line conditions.</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>202</td>
<td>190-480VAC</td>
<td>Standard protection with low/high voltage trip, voltage unbalance</td>
</tr>
<tr>
<td>202-RP</td>
<td>190-480VAC</td>
<td>Trips on reverse-phase only</td>
</tr>
<tr>
<td>202-575-RP</td>
<td>475-600VAC</td>
<td>Designed for higher voltage systems and trips on reverse-phase only</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 509, Figure 7.
## Specifications

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>50*/60Hz</td>
</tr>
<tr>
<td><strong>Functional Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Phase Sequence</strong></td>
<td>ABC</td>
</tr>
<tr>
<td><strong>Low Voltage (% of setpoint)</strong></td>
<td></td>
</tr>
<tr>
<td>Trip</td>
<td>90%</td>
</tr>
<tr>
<td>Reset</td>
<td>93%</td>
</tr>
<tr>
<td><strong>High Voltage (% of setpoint)</strong></td>
<td></td>
</tr>
<tr>
<td>Trip</td>
<td>110%</td>
</tr>
<tr>
<td>Reset</td>
<td>107%</td>
</tr>
<tr>
<td><strong>Voltage Unbalance (NEMA)</strong></td>
<td></td>
</tr>
<tr>
<td>Trip</td>
<td>6%</td>
</tr>
<tr>
<td>Reset</td>
<td>4.5%</td>
</tr>
<tr>
<td><strong>Trip Delay Time</strong></td>
<td>4 seconds</td>
</tr>
<tr>
<td><strong>High and Low Voltage Unbalance &amp; Phasing Faults</strong></td>
<td>2 seconds</td>
</tr>
<tr>
<td><strong>Restart Delay Time</strong></td>
<td></td>
</tr>
<tr>
<td>After a Fault</td>
<td>Manual, 2-300 seconds adj.</td>
</tr>
<tr>
<td>After a Complete Power Loss</td>
<td>Manual, 2-300 seconds adj.</td>
</tr>
</tbody>
</table>

## Output Characteristics

| **Output Contact Rating (SPDT)** | 480VA @ 240VAC          |
| **Pilot Duty**                   | 10A @ 240VAC            |
| **General Purpose**              |                           |
| **General Characteristics**      |                           |
| **Temperature Range**            | -40° to 70°C (-40° to 158°F) |
| **Trip & Reset Accuracy**        | ±1%                       |
| **Repeatability**                | ±0.5%                     |
| **Maximum Input Power**          | 5 W                       |
| **Relative Humidity**            | 95%, non-condensing      |
| **Transient Protection**         | IEC 61000-4-5, ±4kV      |
| **Hi-potential Test**            | Meets UL508               |
| (2x rated V+1000V for 1 minute)  | 0.25” male quick connect |
| **Termination**                  |                           |
| **UL Recognized**                | UL508 (File #E68520)     |
| **Dimensions**                   | H 63.5 mm (2.5”); W 63.5 mm (2.5”); D 35.56 mm (1.4”) |
| **Weight**                       | 0.5 lb. (8 oz., 226.8 g)  |
| **Mounting Method**              | 1/4” socket head cap screw (customer supplied) |

*Note: 50Hz will increase all delay timers by 20%. CE Pending*
Description
The 250A is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50/60Hz motors regardless of size from low and high voltage, unbalance/single-phase, and reverse-phase. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically selects between the 200V and 400V range. The 250A also features adjustable or manual restart delay.

This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels. The Model 250A includes advanced single LED diagnostics. Five different light patterns distinguish between faults and normal conditions.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of single-phase, low voltage, voltage unbalance, phase reversal, harmful power line conditions.</td>
</tr>
<tr>
<td>Auto-sensing wide voltage range</td>
<td>Automatically senses system voltage between 190 - 480VAC. Saves setup time.</td>
</tr>
<tr>
<td>Advanced LED diagnostics</td>
<td>Quick visual indicator for cause of trip. LED indications include: normal operation, power-up restart delay, reverse-phase trip, unbalance/single-phase trip, high or low voltage trip</td>
</tr>
<tr>
<td>DPDT relay output</td>
<td>Allows for versatility to meet wide application needs</td>
</tr>
<tr>
<td>Manual Reset</td>
<td>Allows for inspection of equipment before system is re-energized</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>LOW VOLTAGE TRIP</th>
<th>LOW VOLTAGE RESET</th>
<th>HIGH VOLTAGE TRIP</th>
<th>HIGH VOLTAGE RESET</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>250A</td>
<td>190-480VAC</td>
<td>90%</td>
<td>93%</td>
<td>110%</td>
<td>107%</td>
<td>Provides high and low voltage protection at fixed percentage of nominal voltage.</td>
</tr>
<tr>
<td>250600</td>
<td>475-600VAC</td>
<td>90%</td>
<td>93%</td>
<td>110%</td>
<td>107%</td>
<td>Provides high and low voltage protection at fixed percentage of nominal voltage.</td>
</tr>
<tr>
<td>250A-MET</td>
<td>190-480VAC</td>
<td>85%</td>
<td>88%</td>
<td>N/A</td>
<td>N/A</td>
<td>Designed for use with Fire Control Panels. Has 2 Form C contacts that operate independently. Left Form C energizes when voltage conditions are good and de-energize when a fault condition is detected. Right Form C only energizes during a reverse-phase condition. No high voltage protection.</td>
</tr>
<tr>
<td>250-100-MET</td>
<td>95-120VAC</td>
<td>85%</td>
<td>88%</td>
<td>N/A</td>
<td>N/A</td>
<td>Designed for use with Fire Control Panels. Has 2 Form C contacts that operate independently. Left Form C energizes when voltage conditions are good and de-energize when a fault condition is detected. Right Form C only energizes during a reverse-phase condition. No high voltage protection.</td>
</tr>
</tbody>
</table>
Specifications

Frequency
50*/60Hz Low Voltage

Functional Characteristics
Voltage Unbalance (NEMA)
Trip 6%
Reset 4.5%

Trip Delay Time
Low Voltage, High Voltage 4 seconds
Unbalance, Phasing Faults 2 seconds

Restart Delay Time
After a Fault or Complete Power Loss Manual, 2-300 seconds adj.

Output Characteristics
Output Contact Rating (DPDT - 2 Form C)
Pilot Duty 480VA @ 240VAC
General Purpose 10A @ 240VAC

Temperature Range
40° to 70°C (-40° to 158°F)

Trip & Reset Accuracy ±1%

Maximum Input Power 5 W

Relative Humidity Up to 95% non-condensing per IEC 68-2-3

Terminal Torque 7 in.-lbs.

Wire Size 12-18AWG

Transient Protection (Internal) IEC 61000-4-5;1995 ±6kV

Approvals
UL UL508 (File #E68520)
CSA CSA 22.2 No. 14 (File#46510)
CE CE IEC 60947-6-2

Dimensions H 74.4 mm (2.93”); W 133.9 mm (5.27”);
D 74.9 mm (2.95”)

Weight 1.02 lb. (16.32 oz., 462.66 g)

Mounting Method #8 screws

*Note: 50Hz will increase all delay timers by 20%. 
Description
The 350 Series is a heavy-duty voltage monitor. This product should be used when high current relays or dual contacts are required, or 480V controls are used. Since the 350 Series uses heavy-duty relays, it comes in fixed voltage range models rather than a dual auto-ranging version like the Model 250.

The 350200 has a 15A general purpose contact. The 350400 provides a SPDT (Form C) relay rated to switch up to 600V, allowing the use of 480V controls, eliminating the need for a control power transformer to step the voltage down to 120-240V. Several DPDT (two Form C contacts) relay models are also available.

The 350 microcontroller-based family of products are low cost yet highly advanced solutions to heavy-duty problems. The 350 includes advanced single LED diagnostics. Five different light patterns distinguish faults and normal operating conditions. Other options such as high voltage trip and adjustable restart delay are available.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constantly monitors 3 phase voltage to protect against harmful line conditions, even before the motor is started</td>
</tr>
<tr>
<td>Advanced LED indication</td>
<td>Provides diagnostics which can be used for troubleshooting and to determine relay status</td>
</tr>
<tr>
<td>Adjustable restart delay (-2 models) settings</td>
<td>Allows staggered start up of multiple motors, after a fault, to prevent a low voltage condition</td>
</tr>
<tr>
<td>600V rated relay contacts available on some models</td>
<td>Eliminates the need for a control transformer to step voltage down to 120 - 240V for a control circuit</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>350200</td>
<td>190-240VAC</td>
<td>SPDT, fixed trip and restart delay</td>
</tr>
<tr>
<td>3502002</td>
<td>190-240VAC</td>
<td>SPDT, fixed trip and variable restart delay (manual, 2-300s)</td>
</tr>
<tr>
<td>35020026</td>
<td>190-240VAC</td>
<td>DPDT, 2 relays (1)10a. (1) 15A; fixed trip and variable restart delay (manual, 2-300s)</td>
</tr>
<tr>
<td>35020028**</td>
<td>190-240VAC</td>
<td>DPDT, 2 relays 15A; variable restart delay (no manual reset)</td>
</tr>
<tr>
<td>35020029</td>
<td>190-240VAC</td>
<td>SPDT, fixed trip and variable restart delay (manual, 2-300s), plus high voltage detection</td>
</tr>
<tr>
<td>350400</td>
<td>380-480VAC</td>
<td>SPDT, fixed trip and restart delay</td>
</tr>
<tr>
<td>3504002</td>
<td>380-480VAC</td>
<td>SPDT, fixed trip and variable restart delay (manual, 2-300s)</td>
</tr>
<tr>
<td>35040025</td>
<td>380-480VAC</td>
<td>DPDT, fixed trip and variable restart delay (manual, 2-300s)</td>
</tr>
</tbody>
</table>

** These units are not equipped with Manual Reset.
Protection Relays
Voltage Monitoring Relays

350 SERIES

Specifications

Input Characteristics

Line Voltage
- 350200: 190-240VAC
- 350400: 380-480VAC
- 350600: 475-600VAC

Frequency
- 50*/60Hz

Functional Characteristics

Low Voltage (% of setpoint)
- Trip: 90%
- Reset: 93%

Voltage Unbalance (NEMA)
- Trip: 6%
- Reset: 4.5%

Trip Delay Time:
- Low Voltage: 4 seconds
- Unbalance & Phasing Faults: 2 seconds
- After a Fault: 2 seconds
- After a Complete Power Loss: 2 seconds

Output Characteristics

Output Contact Rating
- SPDT (350200)
  - Pilot Duty: 480VA @ 240VAC
  - General Purpose: 15A
- SPDT (350-400, 350-600)
  - Pilot Duty: 470VA @ 600VAC
  - General Purpose: 1-10A
- DPDT (-6 Option)
  - Pilot Duty: 480VA @ 240VAC Pilot Duty
  - General Purpose: 1HP @ 240V
  - 1-15A
- DPDT (-8 Option)
  - Pilot Duty: 480VA @ 240VAC Pilot Duty
  - 1HP @ 240V

General Characteristics

Ambient Temperature Range
- Operating: -40° to 70°C (-40° to 158°F)
- Storage: -40° to 80°C (-40° to 176°F)

Trip & Reset Accuracy
- ±1%

Maximum Input Power
- 5 W

Terminal
- Torque: 7 in.-lbs.
- Wire Size: 12-18AWG

Transient Protection (Internal)
- IEC 61000-4-5;1995 ±6kV

Safety Marks
- UL
  - UL508 (File #E68520)
- CSA
  - 22.2 No. 14 (File #46510)
- CE
  - IEC 60947-6-2

Dimensions
- H: 74.42 mm (2.93”);
- W: 133.86 mm (5.27”);
- D: 74.93 mm (2.95”)

Weight
- 1.05 lbs. (16.8 oz., 476.27 g)

Mounting Method
- #8 screws

Special Options

- Opt. 2: Variable Restart Delay
  - Manual, 2-300 seconds adj.
- Opt. 5: DPDT Relay
- Opt. 6: 2 Relays (1) 10A, (1) 15A
- Opt. 8: 2 Relays (2) 15A
- Opt. 9: High Voltage (% of setpoint)
  - Trip: 110%
  - Reset: 107%

*Note: 50Hz will increase all delay timers by 20%.

Littelfuse.com/350

AC SYSTEM MONITORS/LOAD SENSORS

© 2023 Littelfuse, Inc.

227
355 SERIES

3-Phase Voltage/Phase Monitor

Description
The 355 Series is a 3-phase voltage monitor with adjustable trip and restart delay, adjustable voltage unbalance and multiple diagnostic lights. It is perfect for heavy-duty applications that need both protection and simple user-friendly diagnostics. Applications include pump panels, commercial HVAC, oil rigs and others.

The 355 Series uses microcontroller technology to monitor incoming voltage and de-energize its output relay if power problems exist. The 355 Series can protect motors from damage caused by single-phasing, high and low voltage, phase reversal and voltage unbalance. It has four diagnostic LEDs that clearly show overvoltage, undervoltage, voltage unbalance, reverse-phase and normal conditions.

The 355200 is equipped with a heavy-duty 10A general purpose SPDT relay. The 355400 and 355600 are equipped with a 470VA @ 600VAC pilot duty SPDT relay. A high voltage (600V) DPDT relay output option is available with the 400V model.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constantly monitors 3 phase voltage to protect against harmful line conditions, even before the motor is started</td>
</tr>
<tr>
<td>Advanced LED indication</td>
<td>Provides diagnostics which can be used for troubleshooting and to determine relay status</td>
</tr>
<tr>
<td>Adjustable trip and restart delay settings</td>
<td>Prevent nuisance tripping due to rapidly fluctuating power line conditions and allows staggered start up of multiple motors, after a fault, to prevent a low voltage condition</td>
</tr>
<tr>
<td>Combines protection and diagnostics</td>
<td>Perfect for heavy duty applications: pump panels, commercial HVAC, and oil rigs</td>
</tr>
<tr>
<td>600V rated relay contacts available on some models</td>
<td>Eliminates the need for a control transformer to step voltage down to 120 - 240V for a control circuit</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>355200</td>
<td>190-240VAC</td>
<td>SPDT</td>
</tr>
<tr>
<td>355400</td>
<td>380-480VAC</td>
<td>SPDT</td>
</tr>
<tr>
<td>3554005</td>
<td>380-480VAC</td>
<td>DPDT</td>
</tr>
<tr>
<td>355600</td>
<td>475-600VAC</td>
<td>SPDT</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix page 509, Figure 6.
## Specifications

### Input Characteristics

| Line Voltage   | 190-240VAC | 355200  
|----------------|------------|---------  
| 380-480VAC    | 355400     |          
| 475-600VAC    | 355600     |          
| (Specify voltage range) |            |          

### Functional Characteristics

#### Low Voltage (% of setpoint)
- **Trip**: 90% ±1%
- **Reset**: 93% ±1%

#### High Voltage (% of setpoint)
- **Trip**: 110% ±1%
- **Reset**: 107% ±1%

#### Voltage Unbalance (NEMA)
- **Trip**: 2-8% adjustable
- **Reset**: Trip setting minus 1%

#### Trip Delay Time:
- **Low & High Voltage and Unbalance**: 2-30 seconds adjustable
- **Single-phasing Faults (>25% UB)**: 2 seconds
- **Restart Delay Time After a Fault or Power Loss**: Manual, 2-300 seconds adj.

### Output Characteristics

#### Output Contact Rating
- **SPDT (355200)**: 480VA at 240VAC
- **General Purpose SPDT (355400, 355600)**: 10A
- **Pilot Duty**: 470VA @ 600VAC
- **DPDT (-5 Option)**: 470VA @ 600VAC

### General Characteristics

#### Temperature Range
- Operating: -40° to 70°C (-40° to 158°F)
- Storage: -40° to 80°C (-40° to 176°F)

#### Repeat Accuracy
- ±0.1%

#### Maximum Input Power
- Terminal: 6 W

#### Wire Size
- 12-18AWG

#### Transient Protection (Internal)
- 2500V for 10 ms

#### Safety Marks
- UL: UL508 (File #E68520)

#### Dimensions
- **H**: 74.42 mm (2.93”); **W**: 133.86 mm (5.27”); **D**: 74.93 mm (2.95”)
- **Weight**: 0.94 lb. (15.04 oz., 426.38 g)
- **Mounting Method**: #8 screws

*Note: 50Hz will increase all delay times by 20%.*
Protection Relays
Voltage Monitoring Relays

455 SERIES

3-Phase Voltage/Phase Monitor

Description
The 455 Series are 3-phase voltage monitors that combine load and line side monitoring to offer complete protection. Monitoring the load side will alert the user of contactor failure or impending contactor failure. Line side monitoring will also protect the motor from damaging fault conditions that may be present prior to the motor starting. With other line/load side monitors, the motor must be started before a voltage fault is detected. With the 455, your motor is fully protected at all times.

The 455 Series are 3-phase, dual range voltage monitors that protect 190-480VAC, 50*/60Hz motors, regardless of their size. It automatically selects between the 200V and 400V range when the user selects the nominal voltage setpoint. Other adjustments include a 2-30 second trip delay, a 2-300 second restart delay (and manual restart) and a voltage unbalance trip point of 2-8%. The voltage monitor’s circuitry is powered through the line side connections, so there is no need for separate control power, making it easy to install.

Equipped with an infrared LED, the 455 Series can communicate to the optional hand-held diagnostic tool, Informer-MS to obtain valuable information such as real-time voltage, voltage unbalance on both line and load sides, motor run hours, last 20 faults, last 32 motor starts, high and low voltage trip points, voltage unbalance trip point, restart and trip delay settings, LED status and more.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load side monitoring of contactor</td>
<td>Protects motor from contactor failure or worn contacts.</td>
</tr>
<tr>
<td>Monitors contactor or starter</td>
<td>Prevents rapid cycling</td>
</tr>
<tr>
<td>Infrared LED Capable</td>
<td>Increases personnel safety line of sight monitoring using optional Informer-MS</td>
</tr>
</tbody>
</table>

Accessories

Informer-MS
A hand-held diagnostic tool designed for use with Littelfuse® 455 equipped with an infrared LED transmitter.

Informer IR Kit-36
36” infrared adapter cable attaches to the face of the unit to provide remote diagnostics without opening the panel.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>455</td>
<td>190-480VAC</td>
<td>Universal line and load side monitor</td>
</tr>
<tr>
<td>455480R</td>
<td>380-480VAC</td>
<td>Used in high voltage applications with pilot duty 470VA @ 600VAC</td>
</tr>
<tr>
<td>455575</td>
<td>475-600VAC</td>
<td>For use in Canada or NE USA where 575V utility power services are common.</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix page 509, Figure 6.
## Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>50*/60Hz</td>
</tr>
<tr>
<td><strong>Low Voltage (% of setpoint)</strong></td>
<td><strong>Trip</strong>: 90% ±1%</td>
</tr>
<tr>
<td><strong>Reset</strong></td>
<td>93% ±1%</td>
</tr>
<tr>
<td><strong>High Voltage (% of setpoint)</strong></td>
<td><strong>Trip</strong>: 110% ±1%</td>
</tr>
<tr>
<td><strong>Reset</strong></td>
<td>107% ±1%</td>
</tr>
<tr>
<td><strong>Voltage Unbalance (NEMA)</strong></td>
<td><strong>Trip</strong>: 2-8% adjustable</td>
</tr>
<tr>
<td><strong>Reset</strong></td>
<td>Trip setting minus 1%</td>
</tr>
<tr>
<td><strong>Trip Delay Time</strong></td>
<td><strong>Low &amp; High Voltage</strong> and Unbalance**</td>
</tr>
<tr>
<td><strong>Single-phasing Faults (&gt;25% UB)</strong></td>
<td>2-30 seconds adjustable</td>
</tr>
<tr>
<td><strong>Restart Delay Time</strong></td>
<td><strong>After a Fault</strong>: Manual, 2-300 seconds adj.</td>
</tr>
<tr>
<td><strong>After a Complete Power Loss</strong></td>
<td>Manual, 2-300 seconds adj.</td>
</tr>
<tr>
<td><strong>After a Motor Shut-down</strong></td>
<td>Manual, 2-300 seconds adj.</td>
</tr>
<tr>
<td><strong>Output Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Output Contact Rating (SPDT)</strong></td>
<td>Pilot Duty 480VA @ 240VAC</td>
</tr>
<tr>
<td><strong>General Purpose</strong></td>
<td>General Purpose 10A</td>
</tr>
<tr>
<td><strong>High Voltage Relay (-480R)</strong></td>
<td>Pilot Duty 470VA @ 600VAC</td>
</tr>
</tbody>
</table>

## General Characteristics

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient Temperature Range</strong></td>
<td>Operating: -40° to 70°C (-40° to 158°F)</td>
</tr>
<tr>
<td></td>
<td>Storage: -40° to 80°C (-40° to 176°F)</td>
</tr>
<tr>
<td><strong>Repeat Accuracy</strong></td>
<td>±0.1%</td>
</tr>
<tr>
<td><strong>Fixed Conditions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Input Power</strong></td>
<td>Terminal: 6 W</td>
</tr>
<tr>
<td><strong>Transient Protection</strong></td>
<td>(Internal) IEC 61000-4-5;1995 ±6kV</td>
</tr>
<tr>
<td><strong>Safety Marks</strong></td>
<td>UL508 (File #E68520)</td>
</tr>
<tr>
<td></td>
<td>CSA C22.2 No. 14 (File #46510)</td>
</tr>
<tr>
<td></td>
<td>CE IEC 60947-6-2</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td><strong>H</strong>: 74.4 mm (2.93”); <strong>W</strong>: 133.9 mm (5.27”); <strong>D</strong>: 74.9 mm (2.95”)</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>1.1 lbs. (17.6 oz., 498.95 g)</td>
</tr>
<tr>
<td><strong>Mounting Method</strong></td>
<td>#8 screws</td>
</tr>
</tbody>
</table>

*Note: 50Hz will increase all delay times by 20%.
### Description

The 460 is a 3-phase voltage monitor that protects 190-480VAC or 475-600V, 50/60Hz motors regardless of size. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically senses line voltage.

This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions such as low, high, and unbalanced voltage, loss of any phase, and phase reversal. When a harmful condition is detected, the MotorSaver® output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level for a specified amount of time (restart delay). The trip and restart delays prevent nuisance tripping due to rapidly fluctuating power line conditions.

All 460 models feature adjustable 1-30 second trip delay, 1-500 second restart delay, 2-8% voltage unbalance trip point, and one form C contact except where noted below.

### Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto-sensing wide voltage range</td>
<td>Automatically senses system voltage between 190 - 480VAC or 475-600VAC. Saves set-up time</td>
</tr>
<tr>
<td>Adjustable trip &amp; restart delay settings</td>
<td>Prevent nuisance tripping due to rapidly fluctuating power line conditions</td>
</tr>
<tr>
<td>Microcontroller based circuitry</td>
<td>Improved accuracy and higher reliability</td>
</tr>
<tr>
<td>Advanced LED diagnostics</td>
<td>Quick visual indicator for cause of trip and relay status</td>
</tr>
<tr>
<td>Adjustable voltage unbalance trip setting</td>
<td>Provides reliable protection when regenerative voltage is present</td>
</tr>
</tbody>
</table>

### Wiring Diagram

**TYPICAL WIRING DIAGRAM FOR MODEL 460 WITH MOTOR CONTROL**

For dimensional drawing see: Appendix, page 510, Figure 10.

### Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>460</td>
<td>190-480VAC</td>
<td>Automatically senses line voltage, adjustable 1-30 second trip delay, 1-500 second restart delay, and 2-8% voltage unbalance trip point</td>
</tr>
<tr>
<td>460-L</td>
<td>190-480VAC</td>
<td>Fixed 4 second trip delay and 1 second for single-phase faults, and fixed 6% voltage unbalance trip point</td>
</tr>
<tr>
<td>460-14</td>
<td>190-480VAC</td>
<td>Equipped with 2 sets of contacts: Form A (NO) and Form B (NC). Used for applications requiring 2 different voltages such as 5VDC for a PLC input and 115VAC for an alarm</td>
</tr>
<tr>
<td>460-575</td>
<td>475-600VAC</td>
<td>Commonly used in Eastern Canada and on generator units that generate 600 VAC power</td>
</tr>
<tr>
<td>460-575-14</td>
<td>475-600VAC</td>
<td>Commonly used in Eastern Canada and on generator units that generate 600 VAC power. Equipped with 2 sets of contacts: Form A and Form B</td>
</tr>
<tr>
<td>460-15</td>
<td>190-480VAC</td>
<td>Equipped with 2 sets of Form A (NO) contacts. Used on applications where two different units are to be controlled at once such as a unit that has separate contacts for a compressor and a fan</td>
</tr>
<tr>
<td>460-MR</td>
<td>190-480VAC</td>
<td>Equipped with a 2-prong connection for a normally open push button mounted outside the panel. Used in applications requiring an external manual reset button</td>
</tr>
<tr>
<td>460-VBM</td>
<td>190-480VAC</td>
<td>Fixed 6% voltage unbalance trip point. User adjustable low and high voltage trip points</td>
</tr>
<tr>
<td>460-400HZ</td>
<td>190-480VAC</td>
<td>For use with 400Hz power supply</td>
</tr>
<tr>
<td>460-OEM</td>
<td>190-480VAC</td>
<td>Bulk package of 460, 20 units</td>
</tr>
<tr>
<td>460L-OEM</td>
<td>190-480VAC</td>
<td>Bulk package of 460-L, 20 units</td>
</tr>
</tbody>
</table>
Specifications

Frequency 50/60Hz
Low Voltage (% of setpoint)
Trip 90% ±1%
Reset 93% ±1%
High Voltage (% of setpoint)
Trip 110% ±1%
Reset 107% ±1%
Voltage Unbalance (NEMA)
Trip 2-8% adjustable
Reset Trip setting minus 1% (5-8%)
Reset setting minus 0.5% (2-4%)
460L Trip Delay Time
Low, High and Unbalanced Voltage 1-30 seconds adjustable
460L Single-Phase Faults (>15% UB) 4 seconds fixed
Restart Delay Time After a Fault 1-500 seconds adjustable
After a Complete Power Loss 1-500 seconds adjustable
Output Contact Rating Form C 480VA @ 240VAC, B300
General Purpose 10A @ 240VAC
Form A & Form B 360VA @ 240VAC, B300
Pilot Duty 8A @ 240VAC

Ambient Temperature Range
Operating -20° to 70°C (-4° to 158°F)
Storage -40° to 80°C (-40° to 176°F)
Maximum Input Power 6 W
Class of Protection IP20, NEMA 1 (finger safe)
Relative Humidity 10-95%, non-condensing per IEC 68-2-3
Terminal Torque 4.5 in.-lbs.
Wire Type Stranded or solid 12-20 AWG, one per terminal
Standards Passed
Electrostatic Discharge (ESD) IEC 61000-4-2, Level 3, 6kV contact, 8kV air
RFI, Radiated IEC 61000-4-4, Level 3, 3.5kV input power and controls
Fast Transient Burst IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
Surge ANSI/IEEE C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test UL UL508 (File #E68520) Meets UL508 (2 x rated V +1000V for 1 minute)
Hi-potential Test CE IEC 60947-6-2
Enclosure Polycarbonate
Dimensions H 88.9 mm (3.5”); W 52.9 mm (2.08”); D 58.69 mm (2.35”)
Weight 0.7 lb. (317.51 g)
Mounting Method 35 mm DIN rail or Surface Mount (#6 or #8 screws)
Output Contact Rating 460-MR (manual reset) External NO pushbutton required.

Frequency
50/60Hz
Low Voltage (% of setpoint)
Trip 90% ±1%
Reset 93% ±1%
High Voltage (% of setpoint)
Trip 110% ±1%
Reset 107% ±1%
Voltage Unbalance (NEMA)
Trip 2-8% adjustable
Reset Trip setting minus 1% (5-8%)
Reset setting minus 0.5% (2-4%)
460L Trip Delay Time
Low, High and Unbalanced Voltage 1-30 seconds adjustable
460L Single-Phase Faults (>15% UB) 4 seconds fixed
Restart Delay Time After a Fault 1-500 seconds adjustable
After a Complete Power Loss 1-500 seconds adjustable
Output Contact Rating Form C 480VA @ 240VAC, B300
General Purpose 10A @ 240VAC
Form A & Form B 360VA @ 240VAC, B300
Pilot Duty 8A @ 240VAC

Ambient Temperature Range
Operating -20° to 70°C (-4° to 158°F)
Storage -40° to 80°C (-40° to 176°F)
Maximum Input Power 6 W
Class of Protection IP20, NEMA 1 (finger safe)
Relative Humidity 10-95%, non-condensing per IEC 68-2-3
Terminal Torque 4.5 in.-lbs.
Wire Type Stranded or solid 12-20 AWG, one per terminal
Standards Passed
Electrostatic Discharge (ESD) IEC 61000-4-2, Level 3, 6kV contact, 8kV air
RFI, Radiated IEC 61000-4-4, Level 3, 3.5kV input power and controls
Fast Transient Burst IEC 61000-4-5, Level 3, 3.5kV input power and controls
Surge ANSI/IEEE C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test UL UL508 (File #E68520) Meets UL508 (2 x rated V +1000V for 1 minute)
Hi-potential Test CE IEC 60947-6-2
Enclosure Polycarbonate
Dimensions H 88.9 mm (3.5”); W 52.9 mm (2.08”); D 58.69 mm (2.35”)
Weight 0.7 lb. (317.51 g)
Mounting Method 35 mm DIN rail or Surface Mount (#6 or #8 screws)
Output Contact Rating 460-MR (manual reset) External NO pushbutton required.
Description
The Model 601 is a fully-programmable voltage monitor designed to protect 3-phase motors from loss of any phase (single-phasing), phase reversal, low or high voltage, voltage unbalance, low or high frequency, and rapid cycling. It can be used as a stand-alone product or networked with an RM1000, RM2000, PLC, computer or SCADA system.

When a harmful condition is detected, the 601’s output relay is deactivated after the specified trip delay. The output relay reactivates after power line conditions return to an acceptable level for the programmed restart delay (RD2).

Eleven (11) setpoints are viewable with the 3-digit LED display or from a networked device:
- low voltage
- high voltage
- voltage unbalance
- low frequency
- high frequency
- RS485 address
- trip delay for voltage/frequency faults
- trip delay for single-phase faults
- rapid-cycle timer (RD1)
- restart delay after all faults (RD2)
- type of restart after all faults (manual or automatic)

Six (6) parameters are viewable while the motor is running:
- L1-L2 voltage
- L2-L3 voltage
- L1-L3 voltage
- average voltage
- voltage unbalance (%)
- frequency

When used with the RS485MS-2W communications module, the 601 can communicate with most Modbus RTU master devices. Voltage conditions can be monitored and setpoints can be changed remotely using Solutions software, an RM1000, RM2000 or other device.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in display</td>
<td>Provides real time information and diagnostics to help with troubleshooting</td>
</tr>
<tr>
<td>Programmable voltage and frequency settings</td>
<td>Allows usage on wide range of systems</td>
</tr>
<tr>
<td>2 programmable restart delay timers</td>
<td>Program separate restart delay time for rapid cycle protection and motor cool down</td>
</tr>
<tr>
<td>2 programmable trip delay timers</td>
<td>1 trip delay specifically for Phase Loss/Single-Phase fault condition, 1 trip delay for all other fault conditions</td>
</tr>
<tr>
<td>Programmable restart control</td>
<td>Choose between an adjustable automatic or manual restart to best meet individual application needs</td>
</tr>
<tr>
<td>Flexible reset</td>
<td>Reset options include pushbutton on relay or remote reset with optional 777-MRSW or OL-RESET remote reset kit</td>
</tr>
<tr>
<td>Remote display compatibility</td>
<td>Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations</td>
</tr>
<tr>
<td>Network communications capability</td>
<td>Compatible with RS-485 Modbus communications module</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>601</td>
<td>190-480VAC</td>
<td>Universal 3-Phase Voltage &amp; Frequency Monitor</td>
</tr>
<tr>
<td>601575</td>
<td>500-600VAC</td>
<td>Used primarily in Canada and NE USA where 575V utility power services are common</td>
</tr>
</tbody>
</table>
Accessories

RS485MS-2W Communication Module
(for limited Modbus capabilities) Required to enable the Modbus communications function on Model 77X-type products.

RM1000 Remote Monitor
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

RM2000 Remote Monitor
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

777-MRSW Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

OL-RESET Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

Specifications

Input Characteristics
- Frequency: 50/60Hz

Functional Characteristics
- Programmable Operating Points
  - LV - Low Voltage Threshold: 170V (450V*) - HV Setting
  - HV - High Voltage Threshold: LV Setting - 528V (660V*)
  - VUB - Voltage Unbalance Threshold: 2-15% or off
  - LF - Low Frequency Threshold: 35Hz - HF Setting
  - HF - High Frequency Threshold: LF Setting - 75Hz
  - TD1 - Trip Delay for Voltage/Unbalance/Frequency Faults: 1-50 seconds
  - TD2 - Trip Delay for Single-Phase Faults: 1-50 seconds
  - RD1 - Restart Delay After All Faults: 2-500 seconds
  - #RF - Type of Restart: Manual or Automatic
  - ADDR - RS-485 Address: A01-A99

Fixed Reset Points
- Overvoltage Reset: 97% of HV Setting
- Low Voltage Reset: 103% of LV Setting
- Voltage Unbalance Reset: UB Setting -1%
- Low Frequency Reset: LF Setting +0.6Hz
- High Frequency Reset: HF Setting -0.6Hz

Output Characteristics
- Output Contact Rating: 480VA @ 240VAC

General Characteristics
- Temperature Range: -20° to 70°C (-4° to 158°F)
- Accuracy: Voltage ±1%; Timing 5% ±1 second
- Repeatability: Voltage ±0.5%
- Maximum Input Power: 5 W
- Transient Protection (Internal): 2500 V for 10 ms

Safety Marks
- UL: UL508 (File #E68520)
- CSA: C22.2 No. 14 (File #46510)
- CE: IEC 60947-6-2
- Dimensions: H 77.47 mm (3.05”); W 97.79 mm (3.85”); D 128.27 mm (5.05”)
- Weight: 1.2 lbs. (19.2 oz., 544.31 g)
- Mounting Method: Surface mount (4 - #8 screws) or DIN rail mount

The 601 can be preprogrammed prior to installation by applying at least 120V to the L1 and L2 terminals.

*575V Model
Description
The 601-CS-D-P1 3-phase power monitor is a fully programmable electronic power monitor designed to monitor 3-phase systems. The 601-CS-D-P1 has a single relay that can be configured as a general purpose network output or to trip on ground faults. The 601-CS-D-P1 monitors ground fault current, phase currents, phase voltages, power factor and frequency. The RS485MS-2W communications module allows the 601-CS-D-P1 to communicate using the Modbus RTU protocol. The Modbus connection can be used to monitor power parameters, setup the device or control the fault relay. A DeviceNet™ communications I/O module (CIO-601CS-DN-P1) is available as well. This CIO module only works with the 601-CS-D-P1 unit. It is used for sending the information from the 601-CS-D-P1 over a DeviceNet™ network. It also provides I/O capabilities and the ability to set the parameters of the 601-CS-D-P1.

Note: This product must be used with an external Zero-Sequence CT for proper operation (not included).

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in display</td>
<td>Visual indication for programming and viewing real-time parameters for nominal voltage, voltage unbalance, current, current unbalance, ground fault warning, ground fault trip, and ground fault motor acceleration</td>
</tr>
<tr>
<td>15 Programmable parameters to control the device operation</td>
<td>Allows the user to customize the protection required for their system</td>
</tr>
<tr>
<td>2 programmable trip delay timers</td>
<td>Program separate trip delay time for motor acceleration and ground fault</td>
</tr>
<tr>
<td>Network communications capability</td>
<td>Compatible with Modbus RTU and DeviceNet™ protocols with the use of separate communications module</td>
</tr>
</tbody>
</table>

Accessories

CIO-601CS-DN-P1 Module
Convenient, cost-effective DeviceNet™ interface device capable of providing discrete control and monitoring of motor starters, drives and other devices over a DeviceNet™ network.

For dimensional drawing see: Appendix page 507, Figure 1.
Protection Relays
Voltage Monitoring Relays

601-CS-D-P1

Specifications

Input Characteristics
Line Voltage  200-480VAC
Frequency  50/60Hz
Motor Full Load Amp Range  0.5-175A (direct) 176-800A (CTs required)
Input Ground Fault Current  0.5-10A

Output Characteristics
Output Contact Rating (SPDT)  480VA @ 240VAC
Pilot Duty  480VA @ 240VAC
General Purpose  10A @ 240VAC
Expected Life  1 x 10^6 operations
Mechanical  1 x 10^6 operations at rated load
Electrical  1 x 10^6 operations

General Characteristics
Ambient Temperature Range
Operating  -20° to 70°C (-4° to 158°F)
Storage  -40° to 80°C (-40° to 176°F)
Accuracy at 25° C (77° F)
Voltage  +/-1% of nominal voltage
Current  +/-3% (<175A direct)
GF Current  +/-3%
Repeatability
Voltage  +/-0.5% of nominal voltage
Current  +/-1% (<175A direct)

Maximum Input Power  10 W
Pollution Degree  3
Class of Protection  IP20
Relative Humidity  10-95%, non-condensing per IEC 68-2-3
Terminal Torque  7in.-lbs.

Output Contact Rating (SPDT)  480VA @ 240VAC
Pilot Duty  480VA @ 240VAC
General Purpose  10A @ 240VAC
Expected Life  1 x 10^6 operations
Mechanical  1 x 10^6 operations at rated load
Electrical  1 x 10^6 operations

General Characteristics
Ambient Temperature Range
Operating  -20° to 70°C (-4° to 158°F)
Storage  -40° to 80°C (-40° to 176°F)
Accuracy at 25° C (77° F)
Voltage  +/-1% of nominal voltage
Current  +/-3% (<175A direct)
GF Current  +/-3%
Repeatability
Voltage  +/-0.5% of nominal voltage
Current  +/-1% (<175A direct)

Maximum Input Power  10 W
Pollution Degree  3
Class of Protection  IP20
Relative Humidity  10-95%, non-condensing per IEC 68-2-3
Terminal Torque  7in.-lbs.

Standards Passed

Electrostatic Discharge (ESD)  IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Conducted  IEC 61000-4-6, Level 3 10V
Radio Frequency Immunity, Radiated  IEC 61000-4-3, Level 3, 10 V/m
Fast Transient Burst  IEC 61000-4-4, Level 3, 3.5kV input power
Short Circuit Rating  100kA rms, SYM, 600VAC max.
Surge Immunity IEC  IEC 61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
High Potential Test  Meets UL508 (2 x rated V +1000V for 1 minute)
Safety Marks
UL  UL508 (File #E68520)
CE  IEC 60947-1, IEC 60947-5-1

Max Conductor Size (with insulation)  0.65”
Dimensions
H 77.47 mm (3.05”); W 97.79 mm (3.85”); D 128.27 mm (5.05”)
Weight  1.2 lbs. (19.2 oz., 544.31 g)
Mounting Method  Surface mount (4 - #8 screws) or DIN rail mount

© 2023 Littelfuse, Inc.
Littelfuse.com/601csdp1

© 2023 Littelfuse, Inc.
Littelfuse.com/601csdp1
Description
The WVM Series provides protection against premature equipment (motor) failure caused by voltage faults on the 3-phase line. The WVM’s microcontroller design provides reliable protection even if regenerated voltages are present. It combines dependable fault sensing with a 10 fault memory and a 6 LED status display. Part instrument, part control, the WVM protects your equipment when you’re not there and displays what happened when you return. The WVM is fully adjustable and includes time delays to prevent nuisance tripping and improve system operation. Time delays include a 0.25 to 30s adjustable trip delay, an adjustable 0.25 to 64m (in 3 ranges) restart delay, plus a unique 3 to 15s true random start delay. The random start delay prevents voltage sags caused by simultaneous restarting of numerous motor loads after a power outage.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring to protect against phase loss, phase reversal, over voltage, under voltage, unbalance, and short cycling</td>
</tr>
<tr>
<td>Fault memory</td>
<td>Stores the 10 most recent faults, which provides diagnostics for troubleshooting</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides visual indication of existing relay/fault status or faults stored in memory</td>
</tr>
<tr>
<td>Switch selectable automatic restart, delayed automatic restart, and manual reset</td>
<td>Allows user adjustment to handle unique application requirements</td>
</tr>
<tr>
<td>Random start delay</td>
<td>Prevents voltage sags caused by simultaneous restarting of multiple motor loads after a power outage</td>
</tr>
</tbody>
</table>

Operation
The output relay is energized when all conditions are acceptable and the WVM is reset. A restart and/or random start delay may occur before the output relay is energized.

Field Adjustment: Select the line voltage listed on the motor’s name plate. This automatically sets the over and undervoltage trip points. No further adjustment should be required to achieve maximum equipment protection.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>UNBALANCE</th>
<th>TRIP DELAY</th>
<th>SWITCH SELECTABLE RESET METHOD</th>
<th>RESTART DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>WVM011AL</td>
<td>500 to 600VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault trip</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM611AH</td>
<td>200 to 240VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault trip</td>
<td>0.25 - 64m</td>
</tr>
<tr>
<td>WVM611AL</td>
<td>200 to 240VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault trip</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM611RL</td>
<td>200 to 240VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault correction</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM811AH</td>
<td>355 to 425VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault correction</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM811AL</td>
<td>355 to 425VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault correction</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM911AL</td>
<td>400 to 480VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault trip</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM911AL-60</td>
<td>400 to 480VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault trip</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM911AN</td>
<td>400 to 480VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault tripe</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM911RH</td>
<td>400 to 480VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault correction</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM911RL</td>
<td>400 to 480VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault correction</td>
<td>0.25 - 64s</td>
</tr>
<tr>
<td>WVM911RN-60</td>
<td>400 to 480VAC</td>
<td>2 - 10%</td>
<td>0.25 - 30s</td>
<td>Auto restart upon fault correction</td>
<td>6 - 300s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Read Memory: Fault(s) stored in the memory are indicated when the yellow LED is flashing, up to 10 faults are noted.

Memory Reset: To clear the memory of all faults stored, rotate selector to Clear Memory for 5 seconds. The yellow LED will turn off.

Memory Overload: Only the 10 most recent faults are retained.

Random Start Delay: A new 3 to 15s random start delay is selected by the microcontroller when a fault is corrected and when the operating voltage (L1, L2, L3) is applied to the WVM. A random start delay does not occur when the reset is manual.

Automatic Restart: Upon fault correction, the output will re-energize after a random start delay.

Automatic Restart Upon Fault Trip: When a fault is sensed for the full trip delay, the output de-energizes and a restart delay is initiated. This delay locks out the output for the delay period. Should the fault be corrected by the end of the restart delay, the output will re-energize after a random start delay. A restart delay will also occur when operating voltage (L1, L2, L3) is applied to the WVM.

Manual Reset: After a fault condition is corrected, the WVM can be manually reset. There are two methods; a customer supplied remote switch, or the onboard selector switch.

Manual Reset (Onboard): Rotate selector switch from the Manual Reset position to Auto Restart w/Delay then back again to Manual Reset within 3 seconds. The output will immediately energize.

Remote Reset: Reset (Restart) is accomplished by a momentary contact closure across terminals 1 & 2. The output will immediately energize. Remote switch requirements are ≥10mA @ 20VDC and the reset terminals are not isolated from line voltage. A resistance of ≤20KΩ across terminals 1 & 2 will cause automatic restart.

Automatic Restart Upon Fault Correction: (P/N includes an R)

When a fault is sensed for the full trip delay, the output relay de-energizes. Upon correction of the fault, a restart delay begins. At the end of this delay, the output will re-energize after a random start delay. If a fault occurs during restart timing, the restart time delay will be reset to zero, and the output will not energize until the restart delay is completed.

Accessories

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Specifications

<table>
<thead>
<tr>
<th>Line Voltage</th>
<th>Operating Voltage</th>
<th>Model</th>
<th>Adj. Line Voltage Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase delta or wye with no connection to neutral</td>
<td>240</td>
<td>200-240VAC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>380</td>
<td>355-425VAC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>480</td>
<td>400-480VAC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>500-60-0VAC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AC Line Frequency</th>
<th>50/60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overvoltage, Undervoltage, &amp; Voltage Unbalance</td>
<td>109-113% of adjusted voltage</td>
</tr>
<tr>
<td></td>
<td>-2% of trip point</td>
</tr>
<tr>
<td></td>
<td>88-92% of adjusted voltage</td>
</tr>
<tr>
<td></td>
<td>+2% of trip point</td>
</tr>
<tr>
<td></td>
<td>Adjustable from 2-10%*</td>
</tr>
<tr>
<td></td>
<td>Adjustable from 0.25 - 30s ±15%</td>
</tr>
<tr>
<td></td>
<td>≥ 15% unbalance</td>
</tr>
<tr>
<td></td>
<td>≤ 200 ms</td>
</tr>
<tr>
<td></td>
<td>3 - 15s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Random Start Delay Range</th>
<th>Reset (Restart) Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Range</td>
<td>0.25-64s ±15%</td>
</tr>
<tr>
<td>Normal Range</td>
<td>6-300s ±15%</td>
</tr>
<tr>
<td>High Range</td>
<td>0.25-64m ±15%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fault Memory Type</th>
<th>Nonvolatile RAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Stores last 10 faults</td>
</tr>
<tr>
<td>Status Indicators</td>
<td>6 LEDs provide existing status &amp; memory readout</td>
</tr>
</tbody>
</table>

| Note: 50% of operating line voltage must be applied to L1 & L2 for operation of status indicators |

<table>
<thead>
<tr>
<th>Output Type</th>
<th>Electromechanical relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Isolated, SPDT</td>
</tr>
<tr>
<td>Rating</td>
<td>10A resistive @ 250VAC; 6A inductive (0.4 PF) @ 250VAC</td>
</tr>
<tr>
<td>Life Protection</td>
<td>Mechanical - 1 x 10^8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase Reversal/Failure</th>
<th>ASME A17.1 Rule 210.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motors and Generators</td>
<td>NEMA MG1 14.30, 14.35</td>
</tr>
<tr>
<td>Surge</td>
<td>IEEE 62.41-1991 Level B</td>
</tr>
<tr>
<td>Isolation Voltage</td>
<td>≥ 2500V RMS input to output</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanical Mounting</th>
<th>Surface with 2 or 4 #8 (M4 x 0.7) screws</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>H 175.3 mm (6.9”), W 111.8 mm (4.4”), D 61.0 mm (2.4”)</td>
</tr>
<tr>
<td>Termination</td>
<td>Screw terminals with captive wire clamps for up to #12 AWG (3.2 mm²) wire</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Operating/Storage Temperature</th>
<th>-40° to 65°C / -40° to 85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>25 oz (709 g)</td>
</tr>
</tbody>
</table>

* Unbalance reset is 90% of the unbalance setting (i.e. VUB at 5% reset is 4.5%)
Description
The DLMU Series is a universal voltage, 3-phase voltage monitor. It continuously measures the voltage of each of the three phases with microcontroller accuracy and compares the value to preset trip points. It separately senses phase reversal and loss; over, under and unbalanced voltages; and over or under frequency. Protection is assured during periods of large average voltage fluctuations or when regenerated voltages are present. The unit trips within 200ms when phase loss is detected. Adjustable time delays are included to prevent nuisance tripping and short cycling of sensitive equipment. The isolated, 10A, SPDT and 2A alarm output relay contacts trip when a phase voltage exceeds the trip limits for the trip delay. Nominal line voltage, voltage unbalance, and time delays are knob adjustable. The phase loss setpoint and the acceptable frequency range are fixed. Both delta and wye systems can be monitored; no connection to neutral is required.

Features & Benefits

**FEATURES**
- Proprietary microcontroller based circuitry
- Universal line voltage range
- DIN rail (35mm) or surface mounting
- LED indication
- User adjustable time delays

**BENEFITS**
- Constant monitoring to protect against phase loss, phase reversal, over voltage, under voltage, unbalance, short cycling and over/under frequency
- Flexibility to work in 200 to 480VAC or 500 to 600VAC applications
- Installation flexibility
- Provides diagnostics of relay, fault and time delay status
- Prevents nuisance tripping and short cycling of sensitive equipment

Accessories

- LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
  Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC
- 0KLK002.T Midget Fuse (2 Amp)
  10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc
- C103PM (AL) DIN Rail
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>OUTPUT</th>
<th>RESTART FUNCTION</th>
<th>VOLTAGE UNBALANCE</th>
<th>TRIP DELAY</th>
<th>RESTART DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLMHBRAAA</td>
<td>500 to 600VAC</td>
<td>SPDT &amp; NO</td>
<td>Staggered restart</td>
<td>Adjustable 2 - 10%</td>
<td>Adjustable 1 - 30s</td>
<td>Adjustable 0.6 - 300S</td>
</tr>
<tr>
<td>DLMUBLAAA</td>
<td>200 to 480VAC</td>
<td>SPDT &amp; NO</td>
<td>Lockout, min off time</td>
<td>Adjustable 2 - 10%</td>
<td>Adjustable 1 - 30s</td>
<td>Adjustable 0.6 - 300S</td>
</tr>
<tr>
<td>DLMUBNAAN</td>
<td>200 to 480VAC</td>
<td>SPDT &amp; NO</td>
<td>No restart delay</td>
<td>Adjustable 2 - 10%</td>
<td>Adjustable 1 - 30s</td>
<td>None</td>
</tr>
<tr>
<td>DLMUBRAAA</td>
<td>200 to 480VAC</td>
<td>SPDT &amp; NO</td>
<td>Staggered restart</td>
<td>Adjustable 2 - 10%</td>
<td>Adjustable 1 - 30s</td>
<td>Adjustable 0.6 - 300S</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Operation
Upon application of line voltage, the output is de-energized and the restart delay begins. If all the 3-phase voltages are within the acceptable range, the output energizes at the end of the restart delay. The microcontroller circuitry automatically senses the voltage range, and selects the correct operating frequency (50 or 60Hz). The over and undervoltage trip points are set automatically. When the measured value of any phase voltage exceeds the acceptable range limits (lower or upper) the trip delay begins. At the end of the trip delay the output relay de-energizes. If the phase voltage returns to an acceptable value before the trip delay expires, the trip delay is reset and the output remains energized. Under, over, and unbalanced voltages plus over or under frequency must be sensed for the complete trip delay before the unit trips. The unit trips in 200ms when phase loss or reversal are sensed. The unit will not energize if a fault is sensed as the line voltage is applied.

Reset: Reset is automatic upon correction of the voltage or frequency fault or phase sequence.

Restart Delay Options
L = Lockout or minimum OFF time. The restart delay begins when the output trips. The unit cannot be re-energized until the restart delay is complete. This provides a minimum off time or lockout time to allow equipment sensitive to short cycling, time to reset. If the fault is corrected after the restart delay is complete the output energizes immediately. The restart delay also occurs when line voltage is applied/reapplied.

R = Restart Delay on fault correction. The restart delay begins when line voltage is reapplied or when a voltage fault is corrected. This option is normally selected when staggered restarting of multiple motors on a power system is required.

N = No Restart Delay. 0.6 second initialization delay on application of line voltage applies.

Restart Notes: All restart options remain reset when the following conditions are detected:

1. Phase loss (phase unbalance greater than 25%)
2. Average line voltage less than 120VAC
3. Phase reversal

The restart delay begins when the condition is corrected.

LED Operation
The LED flashes green during the restart delay, then glows green when the output energizes. It flashes red during the trip delay then glows red when the output de-energizes. It flashes red/green if phase reversal is sensed. If a fault is sensed during the restart delay, the LED will glow red during that portion or the full restart delay.

Specifications

Line Voltage
Type
3-phase delta or wye with no connection to neutral

Operating Voltage
200-480VAC

<table>
<thead>
<tr>
<th>Range</th>
<th>Voltage</th>
<th>Line Frequency</th>
<th>Line Voltage Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>240</td>
<td>200-240</td>
<td>50/60Hz</td>
<td></td>
</tr>
<tr>
<td>380</td>
<td>340-420</td>
<td>50Hz</td>
<td></td>
</tr>
<tr>
<td>480</td>
<td>400-480</td>
<td>60Hz</td>
<td>550VAC</td>
</tr>
<tr>
<td>600</td>
<td>500-600</td>
<td>50/60Hz</td>
<td>600VAC</td>
</tr>
</tbody>
</table>

AC Line Frequency
Phase Loss
Response Time
Undervoltage & Voltage Unbalance
Type

Overvoltage
TripVoltage
Reset Voltage

Undervoltage
Trip Voltage
Reset Voltage
Voltage Unbalance

Reset on balance
Trip Delay
Active On

Range

Tolerance
Restart Delay Range

Tolerance
Over/Under Frequency
Phase Sequence
Response Time - Phase Reversal & Phase Loss Reset
Output

Form C
Form C Rating

Form A
Form A Rating
Life

Isolated Electromechanical Relay
Isolated, SPDT
10A resistive @ 240VAC;
8A resistive @ 277VAC; NO-1/4 hp @ 120VAC;
1/3 hp @ 240VAC

Isolated, NO, SPST
2A @ 277VAC
Mechanical - 1 x 10⁶; Electrical - 1 x 30³

© 2023 Littelfuse, Inc.
<table>
<thead>
<tr>
<th>Protection</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase Reversal/Failure</td>
<td>ASME A17.1 Rule 210.6</td>
</tr>
<tr>
<td>Motors and Generators</td>
<td>NEMA MG1 14:30, 14:35</td>
</tr>
<tr>
<td>Surge</td>
<td>IEEE C62.41-1991 Level B</td>
</tr>
<tr>
<td>Isolation Voltage</td>
<td>≥ 2500V RMS input to output</td>
</tr>
<tr>
<td>Mechanical</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>Surface mount with 2 #8 (M4 x 0.7) screw or snap on 35mm DIN Rail</td>
</tr>
<tr>
<td></td>
<td>Note: 0.25 in. (6.35 mm) spacing between units or other devices is required</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
</tr>
<tr>
<td>H 110 mm (4.33”); W 75 mm (2.95”); D 50 mm (1.97”)</td>
<td></td>
</tr>
<tr>
<td>Termination</td>
<td>Screw terminals with captive wire clamps for up to #14 AWG (2.5 mm²) wire</td>
</tr>
<tr>
<td>Terminal Torque</td>
<td>4.4 in.-lbs.</td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
</tr>
<tr>
<td>Operating/Storage</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>-40° to 60°C / -40° to 85°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>95% relative, non-condensing</td>
</tr>
<tr>
<td>Weight</td>
<td>≈ 8.6 oz (244 g)</td>
</tr>
</tbody>
</table>
HLMU SERIES

Description
The HLMU Series is a universal voltage, encapsulated, 3-phase voltage monitor. It continuously measures the voltage of each of the three phases with microcontroller accuracy and compares the value to preset trip points. It separately senses phase reversal and loss; over, under and unbalanced voltages; and over or under frequency. Protection is assured during periods of large average voltage fluctuations, or when regenerated voltages are present. The unit trips within 200ms when phase loss is detected. Adjustable time delays are included to prevent nuisance tripping and short cycling of sensitive equipment. The isolated, 10A, DPDT relay contacts trip when a phase voltage exceeds the trip limits for the trip delay. Nominal line voltage, voltage unbalance, and time delays are knob adjustable. The phase loss setpoint and the acceptable frequency range are fixed. Both delta and wye systems can be monitored; no connection to neutral is required.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring to protect against phase loss, phase reversal; over, under, and unbalanced voltage; over and under frequency</td>
</tr>
<tr>
<td>Universal line voltage range</td>
<td>Flexibility to work in 200 to 480VAC applications</td>
</tr>
<tr>
<td>DIN rail (35mm) or surface mounting</td>
<td>Installation flexibility</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides diagnostics of relay, fault and time delay status</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Finger-safe terminal blocks</td>
<td>Meets IEC 61000 safety requirements</td>
</tr>
</tbody>
</table>

Accessories

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWER-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 VAC/500 VDC

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OUTPUT</th>
<th>RESTART FUNCTION</th>
<th>VOLTAGE UNBALANCE</th>
<th>TRIP DELAY</th>
<th>RESTART DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLMUDLAAA</td>
<td>DPDT</td>
<td>Lockout, min off time</td>
<td>Adjust. 2 - 10%</td>
<td>Adjust. 1 - 30s</td>
<td>Adjust. 0.6 - 300s</td>
</tr>
<tr>
<td>HLMUDN0405N</td>
<td>DPDT</td>
<td>No restart delay</td>
<td>Fixed, 4%</td>
<td>Fixed, 5s</td>
<td>None</td>
</tr>
<tr>
<td>HLMUDNAAN</td>
<td>DPDT</td>
<td>No restart delay</td>
<td>Adjust. 2 - 10%</td>
<td>Adjust. 1 - 30s</td>
<td>None</td>
</tr>
<tr>
<td>HLMUDRAAA</td>
<td>DPDT</td>
<td>Staggered restart</td>
<td>Adjust. 2 - 10%</td>
<td>Adjust. 1 - 30s</td>
<td>Adjust. 0.6 - 300s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 513, Figure 31.
**Operation**

Upon application of line voltage, the output is de-energized and the restart delay begins. If all the three-phase voltages are within the acceptable range, the output energizes at the end of the restart delay. The microcontroller circuitry automatically senses the voltage range, and selects the correct operating frequency (50 or 60Hz). The over and under voltage trip points are set at ± 10% of the adjusted line voltage. When the measured value of any phase voltage exceeds the acceptable range limits (lower or upper) the trip delay begins. At the end of the trip delay the output relay de-energizes. If the phase voltage returns to an acceptable value before the trip delay expires, the trip delay is reset and the output remains energized. Under, over, and unbalanced voltages plus over or under frequency must be sensed for the complete trip delay before the unit trips. The unit trips in 200ms when phase loss or reversal are sensed. The unit will not energize if a fault is sensed as the line voltage is applied.

**Reset**: Reset is automatic upon correction of the voltage or frequency fault or phase sequence.

**Restart Delay Options**

L = Lockout or minimum OFF time. The restart delay begins when the output trips. The unit cannot be re-energized until the restart delay is complete. This provides a minimum off time or lockout time to allow equipment sensitive to short cycling, time to reset. If the fault is corrected after the restart delay is complete, the output energizes immediately. The restart delay also occurs when line voltage is applied/reapplied.

R = Restart Delay on fault correction. The restart delay begins when line voltage is reapplied or when a voltage fault is corrected. This option is normally selected when staggered restarting of multiple motors on a power system is required.

N = No Restart Delay. 0.6 second initialization delay on application of line voltage applies.

**Restart Notes**: All restart options remain reset when the following conditions are detected:

1. Phase loss (phase unbalance greater than 25%)
2. Average line voltage less than 120VAC
3. Phase reversal

The restart delay begins when the condition is corrected.

**LED Operation**

The LED flashes green during the restart delay, then glows green when the output energizes. It flashes red during the trip delay then glows red when the output de-energizes. It flashes red/green if phase reversal is sensed. If a fault is sensed during the restart delay, the LED will glow red during that portion or the full restart delay.

**Specifications**

**Line Voltage**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase delta or wye with no connection to neutral</td>
<td></td>
</tr>
</tbody>
</table>

**Operating Voltage**

<table>
<thead>
<tr>
<th>Range</th>
<th>Voltage Adj. Range</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>200-480VAC</td>
<td>200-240VAC, 240-420VAC, 420-480VAC</td>
<td>50 or 60Hz</td>
</tr>
</tbody>
</table>

**Line Voltage Max.**

550VAC

**AC Line Frequency**

50/60 Hz automatically detected

**Protection Relays**

**Voltage Monitoring Relays**

**HLMU Series**

**AC System Monitors/Load Sensors**

**Specifications**

**Line Voltage**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase delta or wye with no connection to neutral</td>
<td></td>
</tr>
</tbody>
</table>

**Operating Voltage**

<table>
<thead>
<tr>
<th>Range</th>
<th>Voltage Adj. Range</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>200-480VAC</td>
<td>200-240VAC, 240-420VAC, 420-480VAC</td>
<td>50 or 60Hz</td>
</tr>
</tbody>
</table>

**Line Voltage Max.**

550VAC

**AC Line Frequency**

50/60 Hz automatically detected

**Phase Loss**

≥ 25% unbalance

**Response Time**

≤ 200ms

**Undervoltage & Voltage Unbalance**

- Type: Voltage detection with delayed trip & automatic reset
- Overvoltage: 109 - 113% of the adjusted line voltage
- Trips Voltage: 88 - 92% of the adjusted line voltage
- Reset Voltage: ≤ ±3% of the trip voltage
- Voltage Unbalance: Adjustable 2 - 10% or specify fixed unbalance of 2 - 10% in 1% increments
- Trip Setpoint: ≤ ±0.7% unbalance

**Reset on Balance**

- Active On: Over/undervoltage, voltage unbalance, over/under frequency
- Range: Adjustable from 1 - 30s or specify fixed delay 1 - 30s in 1s increments
- Tolerance: ± 15%

**Restart Delay**

- Range: Adjustable from 0.6 - 300s; if no restart delay is selected a 0.6s initialization delay applies
- Tolerance: ± 15%

**Over/Under Frequency**

- Range: ±4%; Reset ±3%; 50/60 Hz
- Type: Type A, B, C, L1, L2, L3

**Phase Sequence**

≤ 200 ms

**Response Time-Phase Reversal & Phase Loss**

- Reset: Automatic
- Type: Isolated Electromechanical Relay
- Form: DPDT
- Rating: 10A resistive @ 240VAC; 8A resistive @ 277VAC; NO-1/4 hp @ 120VAC; 1/3 hp @ 240VAC

**Life**

- Mechanical - 1 x 10^6
- Electrical (at 10A) - DPDT - 1 x 30^3

**Protection**

Phase Reversal/Failure Motors and Generators

ASME A17.1 Rule 210.6
NEMA MG1 14:30, 14:35
IEEE C62.41-1991 Level B
≥ 2500V RMS input to output
Encapsulated

Circuitry

**Environmental**

Surface mount with one #10 (M5 x 0.7) screw
Note: 0.25 in.(6.35 mm) spacing between units or other devices is required

**Dimensions**

- H 76.7 mm (3.0”)
- W 50.8 mm (2.0”)
- D 41.7 mm (1.64”)

**Termination**

Screw terminal connection up to 12 AWG (3.3 mm²) wire

**Environmental Temperature**

-40° to 60°C / -40° to 85°C

**Humidity**

95% relative, non-condensing

**Weight**

≈ 3.9 oz (111 g)
Protection Relays
Voltage Monitoring Relays

PLMU11

Voltage Monitor

Description
The PLMU11 continuously measures the voltage of each of the three phases to provide protection for 3-phase motors and sensitive loads. Its microcontroller senses under and overvoltage, voltage unbalance, phase loss, and phase reversal. Protection is provided even when regenerated voltages are present. Universal voltage operation and standard base connection allows the PLMU11 to replace hundreds of competitive part numbers.

Operation
Upon application of power, a 0.6s random start delay begins and the PLMU11 measures the voltage levels and line frequency and selects the voltage range. The output relay is energized and the LED glows green when all voltages are acceptable and the phase sequence is correct. LED flashes green during trip delay, glows red when output de-energizes. Undervoltage, overvoltage, and voltage unbalance must be sensed for continuous trip delay before the relay de-energizes. Re-energization is automatic upon fault correction. The output relay will not energize if a fault condition is sensed as 3-phase input voltage is applied. The LED alternately flashes red/green when phase reversal is sensed. Line voltage is selected with the knob, setting the over and under voltage trip points. Voltage range is automatically selected by the microcontroller.

Wiring Diagram

For dimensional drawing see: Appendix, page 513, Figure 32.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick octal 8-pin mounting</td>
<td>Small footprint with universal mounting; ideal replacement for hundreds of competitive part numbers.</td>
</tr>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring of single-phase, low voltage, high voltage, voltage unbalance, phase reversal.</td>
</tr>
<tr>
<td>LED diagnostics</td>
<td>Quick visual indicator for cause of trip. LED indications include: normal operation, trip delay, phase reversal, fault</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC voltages</td>
</tr>
<tr>
<td>Simple 3-wire connection for delta or wye systems</td>
<td>Allows flexibility across wide range of systems</td>
</tr>
<tr>
<td>ASME A17.1 Rule 210.6</td>
<td>Complies with safety codes for elevators, escalators, moving walkways</td>
</tr>
<tr>
<td>NEMA MG1 14:30, 14:35</td>
<td>Complies with safety codes for motors and generators</td>
</tr>
<tr>
<td>IEEE C62.41-1991 Level B</td>
<td>Complies with safety codes for surge and voltage protection</td>
</tr>
</tbody>
</table>
## Accessories

**BZ1 Front Panel Mount Kit**
Provides an easy method of through-the-panel mounting of 8-pin or 11-pin plug-in timers, flashers, and other controls.

**OT08PC Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

**LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders**
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

**0KLK002.T Midget Fuse (2 Amp)**
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

## Specifications

### Line Voltage
**Type**
3-phase delta or wye with no connection to neutral

**Line Voltage**
200 to 480VAC ±15%, 50/60 Hz ±2 Hz

**Adjustable Voltage Ranges (Automatic Range Selection)**
- 200 to 240VAC, 50/60 Hz
- 340 to 420VAC, 50 Hz
- 400 to 480VAC, 60 Hz

**Maximum Voltage**
552VAC

**Phase Sequence**
ABC

**Power Consumption**
≤ 5W

### Overvoltage, Undervoltage, & Voltage Unbalance

**Type**
Voltage detection with delayed trip and automatic reset

**Overvoltage & Undervoltage**

**Undervoltage Trip Point**
88 - 92% of adjusted line voltage

**Reset Voltage**
+2% of trip voltage

**Overvoltage Trip Point**
109 - 113% of adjusted line voltage

**Reset Voltage**
-2% of trip voltage

**Voltage Unbalance Trip Point**
Adjustable from 2 - 10%

### Trip Delay Range
Adjustable from 0.25 - 30s

### Random Start Delay
≤ 0.6s

### Phase Reversal & Phase Loss Trip Time
≤ 150ms

### Phase Loss Setpoint
≥ 15% unbalance

### Reset Type
Automatic

### Output Type
Energized when voltages are acceptable

### Type
Electromechanical relay

### Form
Isolated, SPDT

### Rating
10A resistive @ 240VAC; 1/4 hp @ 125VAC; 1/3 hp @ 250VAC, max. 277VAC

### Life
Mechanical - 1 x 10⁶; Electrical - 1 x 10⁵

### Protection
**Surge**
IEEE C62.41-1991 Level B

**Isolation Voltage**
≥ 2500V RMS input to output

### Mechanical
**Mounting**
Plug-in socket rated 600VAC

**Termination**
Octal 8-pin plug-in

**Dimensions**
- H: 77.0 mm (3.03”)
- W: 60.7 mm (2.39”)
- D: 45.2 mm (1.78”)

### Environmental
**Operating/Storage Temperature**
-40° to 60°C / -40° to 85°C

**Weight**
≈ 8.6 oz (244 g)

*CAUTION: Select an octal socket rated for 600VAC operation.
Protection Relays
Voltage Monitoring Relays

PLM SERIES

Voltage Monitor

Description
The PLM Series is a 3-phase voltage monitor that continuously monitors each of the three phases. Monitors both delta and wye systems and no connection to neutral is required. The microcontroller circuit design protects against undervoltage, voltage unbalance, phase loss and phase reversal. Protection is assured when regenerated voltages are present.

Operation
The output relay is energized and the LED glows green when all voltages are acceptable and the phase sequence is correct. Under and unbalanced voltages must be sensed for a continuous trip delay period before the relay de-energizes. Reset is automatic upon correction of the fault condition. The output relay will not energize if a fault condition is sensed as power is applied. The LED flashes red during the trip delay, then glows red when the output de-energizes. The LED flashes green/red if phase reversal is sensed.

Field Adjustment
Set voltage adjustment knob at the desired operating line voltage for the equipment. This adjustment automatically sets the undervoltage trip point. Apply power. If the PLM fails to energize, (LED glows red) check wiring of all three phases, voltage, and phase sequence. If phase sequence is incorrect, the LED flashes green/red. To correct this, swap any two line voltage connections at the mounting socket. No further adjustment should be required.

Features & Benefits

For dimensional drawing see: Appendix, page 512, Figure 23.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>VOLTAGE UNBALANCE (FIXED)</th>
<th>TRIP DELAY (FIXED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLM6405</td>
<td>240VAC</td>
<td>4%</td>
<td>5 sec</td>
</tr>
<tr>
<td>PLM6502</td>
<td>240VAC</td>
<td>5%</td>
<td>2 sec</td>
</tr>
<tr>
<td>PLM6805</td>
<td>240VAC</td>
<td>8%</td>
<td>5 sec</td>
</tr>
<tr>
<td>PLM8405</td>
<td>380VAC</td>
<td>4%</td>
<td>5 sec</td>
</tr>
<tr>
<td>PLM9405</td>
<td>480VAC</td>
<td>4%</td>
<td>5 sec</td>
</tr>
<tr>
<td>PLM9502</td>
<td>480VAC</td>
<td>5%</td>
<td>2 sec</td>
</tr>
<tr>
<td>PLM9805</td>
<td>480VAC</td>
<td>8%</td>
<td>5 sec</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
## Specifications

### Line Voltage

- **Type**: 3-phase delta or wye with no connection to neutral

### Operating Voltage

<table>
<thead>
<tr>
<th>Model</th>
<th>Adj. Line Voltage Range</th>
<th>Line Voltage Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>240</td>
<td>200-240VAC</td>
<td>270VAC</td>
</tr>
<tr>
<td>380</td>
<td>360-430VAC</td>
<td>480VAC</td>
</tr>
<tr>
<td>480</td>
<td>400-480VAC</td>
<td>530VAC</td>
</tr>
</tbody>
</table>

### AC Line Frequency

- **Phase Sequence**: ABC
- **Power Consumption**:
  - 2W for 240V units
  - 3W for 380 - 480V units

### Low Voltage & Voltage Unbalance

- **Type**: Voltage detection with delayed trip & automatic reset
- **Low Voltage Trip**: 88 - 92% of adjusted line voltage
- **Reset Voltage**: Plus 3% of trip voltage
- **Voltage Unbalance Trip**: Factory fixed from 4 - 8%
- **Reset on Balance**: -0.7% unbalance typical
- **Trip Delay Range**: Factory fixed from 2 - 20s
- **Tolerance**: ±15%

### Phase Reversal & Phase Loss

- **Response Time**: ≤ 200ms
- **Phase Loss**: > 35% unbalance
- **Reset**: Automatic

### Output

- **Type**: Electromechanical relay
- **Form**: Isolated, SPDT
- **Rating**:
  - 10A resistive @ 240VAC, 277VAC max;
  - 1/2 Hp @ 240VAC, 1/4 Hp @ 120VAC
  - Mechanical - 1 x 10³; Electrical - 1 x 10⁶

### Life Protection

- **Surge**: IEEE C62.41-1991 Level B
- **Isolation Voltage**: ≥ 2500V RMS input to output

### Mechanical

- **Mounting**: 8-pin plug-in socket rated 600VAC

### Environmental

- **Operating/Storage Temperature**: -40° to 60°C / -40° to 85°C
- **Weight**: 4.4 oz (125 g)

---

*CAUTION: Select an octal socket rated for 600VAC operation.*

---

### Accessories

#### BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- pin or 11-pin plug-in timers, flashers, and other controls.

#### OT08PC Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

#### LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

#### 0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

#### C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.
Protection Relays
Voltage Monitoring Relays

TVW SERIES

Description
The TVW Series Provides protection for motors and other sensitive loads. Continuously measures the voltage of each of the three phases using a microcontroller circuit design that senses under and overvoltage, voltage unbalance, phase loss, and phase reversal. Protection is provided even when regenerated voltages are present. Includes a trip delay to prevent nuisance tripping and a restart delay to prevent short cycling after a momentary power outage.

Operation
Upon application of line voltage, the restart delay begins. The output is de-energized during restart delay. Under normal conditions, the output energizes after the restart delay. Undervoltage, overvoltage, and voltage unbalance must be sensed for the complete trip delay period before the output de-energizes. The restart delay begins as soon as the output de-energizes. If the restart delay is completed when a fault is corrected, the output energizes immediately. The output will not energize if a fault is sensed as the input voltage is applied. If the voltage selector is set between two voltage marks (i.e. between 220 and 230V), the LED will flash red rapidly. The TVW provides fault protection at the lower of the two line voltages (i.e. 220V).

Reset: Reset is automatic upon correction of a fault.

LED Operation
The LED flashes green during the restart delay, then glows green when the output energizes. It flashes red during the trip delay then glows red when the output de-energizes. It flashes red/green if phase reversal is sensed. If the voltage selector knob is between settings, it rapidly flashes red.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring to protect against phase loss, phase reversal; over, under, and unbalanced voltage; short cycling</td>
</tr>
<tr>
<td>Compact design measures 2 in. (50.8mm) square</td>
<td>Perfect for OEM applications where cost, size and ease of installation are important</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides diagnostics of relay, fault and time delay status</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration and humidity</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>VOLTAGE UNBALANCE</th>
<th>TRIP DELAY</th>
<th>RESTART DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVW5103SSS</td>
<td>208 to 240VAC Selectable</td>
<td>Fixed, 10%</td>
<td>Fixed, 3s</td>
<td>Fixed, 5s</td>
</tr>
<tr>
<td>TVW575S1M</td>
<td>208 to 240VAC Selectable</td>
<td>Fixed, 7%</td>
<td>Fixed, 5s</td>
<td>Fixed, 1m</td>
</tr>
<tr>
<td>TVW6510S0.4S</td>
<td>208, 220, 230, 240VAC</td>
<td>Fixed, 5%</td>
<td>Fixed, 10s</td>
<td>Fixed, 0.4s</td>
</tr>
<tr>
<td>TVW8510S0.4S</td>
<td>380, 400 &amp; 415VAC</td>
<td>Fixed, 5%</td>
<td>Fixed, 10s</td>
<td>Fixed, 0.4s</td>
</tr>
<tr>
<td>TVW9510S0.4S</td>
<td>430, 440, 460, 480VAC</td>
<td>Fixed, 5%</td>
<td>Fixed, 10s</td>
<td>Fixed, 0.4s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 514, Figure 44.

Wiring Diagram

L1 = Phase A
L2 = Phase B
L3 = Phase C
NO = Normally Open
NC = Normally Closed
C = Common, Transfer Contact

Relay contacts are isolated.

F = 2A Fast acting fuses are recommended, but not required

F = 2A Fast acting fuses are recommended, but not required
**Accessories**

- **LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders**
  - Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

- **0KLK002.T Midget Fuse (2 Amp)**
  - 10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect**
  - These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **C103PM (AL) DIN Rail**
  - 35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  - Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

- **VRM6048 Voltage Reduction Module**
  - Allows the voltage monitor to monitor a 3-phase 550 to 600VAC Line.

**Specifications**

<table>
<thead>
<tr>
<th>Line Voltage</th>
<th>3-phase delta or wye with no connection to neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage/Tolerance</td>
<td>208 to 480VAC in 4 ranges/-30% - 20%</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50 - 100 Hz</td>
</tr>
<tr>
<td>Phase Sequence</td>
<td>ABC</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Approx. 2W for 240V units</td>
</tr>
<tr>
<td>Approx. 3W for 480V units</td>
<td></td>
</tr>
<tr>
<td>Overvoltage, Undervoltage, &amp; Voltage Unbalance</td>
<td>Voltage detection with delay trip &amp; automatic reset</td>
</tr>
<tr>
<td>Undervoltage Trip Point</td>
<td>88 - 92% of the selected line voltage</td>
</tr>
<tr>
<td>Reset Voltage</td>
<td>+3% of trip voltage</td>
</tr>
<tr>
<td>Overvoltage Trip Point</td>
<td>109 - 113% of the selected line voltage</td>
</tr>
<tr>
<td>Reset Voltage</td>
<td>-3% of trip voltage</td>
</tr>
<tr>
<td>Trip Variation vs Temperature</td>
<td>≤ ±2%</td>
</tr>
<tr>
<td>Voltage Unbalance</td>
<td>Factory fixed, from 4 - 10%</td>
</tr>
<tr>
<td>Reset On Balance</td>
<td>-0.7% unbalance</td>
</tr>
<tr>
<td>Trip Delay Range</td>
<td>Fixed from 0.2 - 100s ±15% or ±0.1s, whichever is greater</td>
</tr>
<tr>
<td>Restart Delay Range</td>
<td>Fixed from 0.4s - 999m ±15% or ±0.2s, whichever is greater</td>
</tr>
<tr>
<td>Phase Reversal &amp; Phase Loss Response</td>
<td>≤ 200ms; automatic reset</td>
</tr>
<tr>
<td>Phase Loss</td>
<td>≥ 25% unbalance</td>
</tr>
<tr>
<td>Output Type</td>
<td>Isolated, SPDT</td>
</tr>
<tr>
<td>Rating</td>
<td>10A resistive @ 125VAC, 5A @ 250VAC, 1/4 hp @ 125VAC</td>
</tr>
<tr>
<td>10A resistive @ 240VAC, 1/4 hp @ 125VAC, 1/3 hp @ 250VAC, max. voltage 277VAC</td>
<td></td>
</tr>
<tr>
<td>Mechanical - 1 x 10⁶; Electrical - 1 x 10⁵</td>
<td></td>
</tr>
<tr>
<td>Life Protection</td>
<td>ASME A17.1 Rule 210.6</td>
</tr>
<tr>
<td>Phase Reversal/Failure Motors and Generators</td>
<td>NEMA MG1 14:30, 14:35</td>
</tr>
<tr>
<td>Surge Dielectric Breakdown</td>
<td>IEEE C62.41-1991 Level B</td>
</tr>
<tr>
<td>208 to 240VAC</td>
<td>≥ 1500V RMS input to output terminals</td>
</tr>
<tr>
<td>380 to 480VAC</td>
<td>≥ 2500V RMS input to output terminals</td>
</tr>
<tr>
<td>Mechanical Mounting</td>
<td>Surface mount with one #8 (M5 x 0.8) screw</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 50.8 mm (2.0&quot;), W 50.8 mm (2.0&quot;), D 31.75 mm (1.25&quot;)</td>
</tr>
<tr>
<td>Termination</td>
<td>0.25 in. (6.35 mm) male quick connect terminals</td>
</tr>
<tr>
<td>Environmental Operating/Storage Temperature</td>
<td>-40° to 55°C / -40° to 85°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>95% relative, non-condensing</td>
</tr>
<tr>
<td>Weight</td>
<td>≅ 2.8 oz (79 g)</td>
</tr>
</tbody>
</table>
**Protection Relays**

**Voltage Monitoring Relays**

**TVM SERIES**

**Description**

The TVM Series Provides protection for motors and other sensitive loads. Continuously measures the voltage of each of the three phases using a microcomputer circuit design that senses under and overvoltage, voltage unbalance, phase loss, and phase reversal. Protection is provided even when regenerated voltages are present. Includes a trip delay to prevent nuisance tripping and a restart delay to prevent short cycling after a momentary power outage.

**Operation**

Upon application of line voltage, the restart delay begins. The output relay is de-energized during restart delay. Under normal conditions, the output energizes after restart delay. Undervoltage, overvoltage, and voltage unbalance must be sensed for continuous trip delay period before the output is de-energized. The output will not de-energize if a fault is corrected during the trip delay. The restart delay begins as soon as the output relay de-energizes. If the restart delay is completed when the fault is corrected, the output relay will energize immediately.

The output relay will not energize if a fault or phase reversal is sensed as 3-phase input voltage is applied.

**Reset:** Reset is automatic upon correction of a fault.

**LED Operation**

The LED flashes green during the restart delay, then glows green when the output energizes. It flashes red during the trip delay then glows red when the output de-energizes. It flashes red/green if phase reversal is sensed.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary microcontroller based circuitry</td>
<td>Constant monitoring to protect against phase loss, phase reversal, over, under, and unbalanced voltage; short cycling</td>
</tr>
<tr>
<td>Compact design measures 2 in. (50.8mm) square</td>
<td>Perfect for OEM applications where cost, size and ease of installation are important</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides diagnostics of relay, fault and time delay status</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration and humidity</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>VOLTAGE UNBALANCE</th>
<th>TRIP DELAY</th>
<th>RESTART DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVM208A100.5S3S</td>
<td>208VAC</td>
<td>10%</td>
<td>0.5s</td>
<td>3s</td>
</tr>
<tr>
<td>TVM230A101S1S</td>
<td>230VAC</td>
<td>10%</td>
<td>1s</td>
<td>1s</td>
</tr>
<tr>
<td>TVM460A41S5M</td>
<td>460VAC</td>
<td>4%</td>
<td>1s</td>
<td>5m</td>
</tr>
<tr>
<td>TVM460A75S2M</td>
<td>460VAC</td>
<td>7%</td>
<td>5s</td>
<td>2m</td>
</tr>
<tr>
<td>TVM480A45S5S</td>
<td>480VAC</td>
<td>4%</td>
<td>5s</td>
<td>5s</td>
</tr>
<tr>
<td>TVM480A100.5S3S</td>
<td>480VAC</td>
<td>10%</td>
<td>0.5s</td>
<td>3s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 514, Figure 44.
Protection Relays
Voltage Monitoring Relays

TVM SERIES

Accessories

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littefuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VRM6048 Voltage Reduction Module
Allows the voltage monitor to monitor a 3-phase 550 to 600VAC Line.

Specifications

Line Voltage
Type
3-phase delta or wye with no connection to neutral

Input Voltage
AC Line Frequency
50 - 100 Hz
Phase Sequence
ABC

Power Consumption
Approx. 2W for 240V units
Approx. 3W for 480V units

Overvoltage, Undervoltage, & Voltage Unbalance

Overvoltage & Undervoltage
Voltage detection with delay trip & automatic reset

Undervoltage Trip Point
Reset Voltage
≥ +3% of trip voltage

Overvoltage Trip Point
Reset Voltage
109 - 113% of the selected line voltage
≤ -3% of trip voltage

Trip Variation vs Temperature
Voltage Unbalance
Factory fixed from 4 - 10%

Reset On Balance
Reset Voltage
≈ ±0.7% unbalance

Trip Delay Range
Reset On Balance
Fixed from 0.2 - 100s ±15% or ±0.1s, whichever is greater

Restart Delay Range
Reset On Balance
Fixed from 0.5s - 999ms ±15% or ±0.2s, whichever is greater

Phase Reversal & Phase Loss Response
Output
≤ 200ms; automatic reset
≥ 25% unbalance

Type
Isolated SPDT relay contacts

Rating
208 to 240VAC (55°C)
10A resistive @ 125VAC, 5A @ 250VAC, 1/4 hp @ 125VAC

380 to 480VAC
10A resistive @ 240VAC, 1/4 hp @ 125VAC, 1/3 hp @ 250VAC, max. voltage 277VAC

Mechanical
Mounting
ASME A17.1 Rule 210.6

Surge
NEMA MG1 14:30, 14:35

Dielectric Breakdown
IEEE C62.41-1991 Level B

208 to 240VAC
≥ 1500V RMS input to output terminals

380 to 480VAC
≥ 2500V RMS input to output terminals

Environmental
Operating/Storage
Temperature
-40° to 55°C / -40° to 85°C

Humidity
95% relative, non-condensing

Weight
2.8 oz (79 g)
Description

The PLR Series provides a cost effective means of preventing 3-phase motor startup during adverse voltage conditions. Proper A-B-C sequence must occur in order for the PLR's output contacts to energize. In addition, the relay will not energize when an undervoltage or phase loss condition is present. The PLR Series protects a motor against undervoltage operation. The adjustment knob sets the undervoltage trip point.

Operation

The output relay is energized and the LED glows when all voltages are acceptable and the phase sequence is correct. Undervoltage must be sensed for a continuous dropout delay period before the relay de-energizes. Reset is automatic upon correction of the fault condition. The output relay will not energize if a fault condition is sensed as power is applied.

Field Adjustment: Turn the adjustment knob fully counterclockwise and apply three-phase power. The LED should be ON. Increase adjustment until the LED goes OFF. Decrease adjustment until LED glows again. If nuisance tripping occurs, decrease the adjustment slightly.

NOTE: When properly adjusted and operating in an average system, a voltage unbalance of 10% or more is required for phase loss detection. When a phase is lost while the motor is running, a voltage will be induced into the open phase nearly equal in magnitude to the normal phase-to-phase voltage. This condition is known as regeneration. When regenerated voltages are present, the voltage unbalance during single phasing may not exceed 10% for some motors. The PLR Series may not provide protection under this condition. For systems that require superior phase loss protection, select the PLMU Series.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous monitoring</td>
<td>Prevents 3-phase motor startup when undervoltage or phase loss condition is present</td>
</tr>
<tr>
<td>Industry standard 8-pin octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
<tr>
<td>LED indication</td>
<td>Quick visual indication of output status and correct phase sequence</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR120A</td>
<td>95 to 140VAC</td>
</tr>
<tr>
<td>PLR240A</td>
<td>190 to 270VAC</td>
</tr>
<tr>
<td>PLR380A</td>
<td>340 to 450VAC</td>
</tr>
<tr>
<td>PLR480A</td>
<td>380 to 500VAC</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 23.
## PLR SERIES

### Accessories

**BZ1 Front Panel Mount Kit**
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

**OT08PC Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

**LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders**
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC.

**0KLK002.T Midget Fuse (2 Amp)**
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

### Specifications

#### Line Voltage

<table>
<thead>
<tr>
<th>Type</th>
<th>3-phase delta or wye with no connection to neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Voltage</td>
<td></td>
</tr>
<tr>
<td>120VAC</td>
<td>85 to 130VAC</td>
</tr>
<tr>
<td>240VAC</td>
<td>170 to 240VAC</td>
</tr>
<tr>
<td>380VAC</td>
<td>310 to 410VAC</td>
</tr>
<tr>
<td>480VAC</td>
<td>350 to 480VAC</td>
</tr>
</tbody>
</table>

#### Undervoltage Dropout Adj. Range

- 85 to 130VAC
- 170 to 240VAC
- 310 to 410VAC
- 350 to 480VAC

#### Line Voltage Max.

- 143VAC
- 270VAC
- 480VAC
- 530VAC

#### AC Line Frequency

- 50/60Hz
- ABC

#### Phase Sequence

- ≤ 400ms
- ≤ 100ms
- 2%

#### Response Times

- Pull-in: ≤ 400ms
- Drop-out: ≤ 100ms
- Hysteresis: η 2%
- Pull-in/Drop-out: η 2%

#### Output Type

- Electromechanical relay, energized when all voltages are acceptable
- SPDT
- Form
- Rating
- Maximum Voltage
- Protection

#### Phase Reversal/Failure

- Motor and Generators
- ASME A17.1 Rule 210.6
- NEMA MG1 14:30, 14:35
- IEEE C62.41-1991 Level B

#### Surge

- ≥ 1500V RMS input to output
- ≥ 2500V RMS input to output

#### Isolation Voltage

- 120 & 240VAC
- 380 & 480VAC

#### Mechanical

- Dimensions
- H 81.3 mm (3.2”);
- W 60.7 mm (2.39”);
- D 45.2 mm (1.78”)
- Mounting:
- Termination
- Plug-in socket
- Octal 8-pin, plug-in

#### Environmental

- Operating/Storage Temperature
- 0° to 55°C / -40° to 85°C
- Weight
- ≅ 6 oz (170 g)

*CAUTION: Select an octal socket rated for 600VAC operation.
Description
The PLS Series is a low cost phase sensitive control that provides an isolated contact closure when the proper A-B-C phase sequence is applied. Protects sensitive 3-phase equipment and equipment operators from reverse rotation. Designed to be compatible with motor overloads or other 3-phase equipment protection devices. Protection for equipment control centers where frequent reconnection or electrical code makes reverse rotation protection essential. Examples include: mobile refrigerated containers, construction equipment, hoists, pumps, conveyors, elevators and escalators.

Operation
The internal relay and LED are energized when the phase sequence is correct. The output relay will not energize if the phases are reversed. Reset is automatic upon correction of the fault.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous monitoring</td>
<td>Cost effective protection of 3-phase equipment and operators from reverse rotation. Meets reverse rotation protection code requirements.</td>
</tr>
<tr>
<td>Universal motor compatibility</td>
<td>Designed to be compatible with motor overloads or other 3-phase equipment protection devices</td>
</tr>
<tr>
<td>Industry standard 8-pin octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
<tr>
<td>Factory calibrated</td>
<td>Easy to install. No field adjustment needed</td>
</tr>
<tr>
<td>LED indicator</td>
<td>Provides visual indication of relay status</td>
</tr>
</tbody>
</table>

Accessories

**BZ1 Front Panel Mount Kit**
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

**Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

**LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders**
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 Vac/500 Vdc

**0KLL002.T Midget Fuse (2 Amp)**
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLS120A</td>
<td>120VAC</td>
</tr>
<tr>
<td>PLS240A</td>
<td>208/240VAC</td>
</tr>
<tr>
<td>PLS480A</td>
<td>440/480VAC</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848.

For dimensional drawing see: Appendix, page 513, Figure 33.
## Specifications

### Line Voltage

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Voltage</td>
<td>3-phase delta or wye with no connection to neutral</td>
</tr>
<tr>
<td>120V AC</td>
<td>95V AC, 135V AC</td>
</tr>
<tr>
<td>208/240V AC</td>
<td>175V AC, 255V AC</td>
</tr>
<tr>
<td>380/415V AC</td>
<td>310V AC, 430V AC</td>
</tr>
<tr>
<td>440/480V AC</td>
<td>380V AC, 500V AC</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60Hz</td>
</tr>
<tr>
<td>Phase Sequence</td>
<td>ABC</td>
</tr>
<tr>
<td>Pull-in</td>
<td>≤ 300ms</td>
</tr>
<tr>
<td>Drop-out</td>
<td>≤ 50ms</td>
</tr>
</tbody>
</table>

### Output

- Type: Electromechanical relay, energized when the phase sequence is correct
- Form: Isolated SPDT
- Rating:
  - 120 & 240V AC: 10A resistive @ 240VAC
  - 380 & 480V AC: 8A resistive @ 240VAC
- Maximum Voltage: 250VAC

### Protection

- Isolation Voltage:
  - 120 & 240V AC: ≥ 1500V RMS input to output
  - 380 & 480V AC: ≥ 2500V RMS input to output

### Mechanical

- Mounting: Plug-in socket
- Dimensions:
  - H: 81.3 mm (3.2”)
  - W: 60.7 mm (2.39”)
  - D: 45.2 mm (1.78”)
- Termination: Octal 8-pin plug-in

### Environmental

- Operating/Storage Temperature: -40° to 55°C / -40° to 85°C
- Weight: ≅ 6 oz (170 g)

*CAUTION: Select an octal socket rated for 600VAC operation.*
HLVA6I23

Single-Phase Monitor

Description

The HLVA6I23 is a single-phase undervoltage monitor designed to protect sensitive equipment from brownout or undervoltage conditions. Time delays are included to prevent nuisance tripping and short cycling. The 30A, 1hp rated, SPDT relay contacts allow direct control of motors, solenoids and valves. The output relay can be ordered with isolated SPDT contact to allow monitoring of one voltage and switching a separate voltage. Two undervoltage trip point ranges allow monitoring of 110 to 120VAC or 208 to 240VAC systems.

Operation

Upon application of input voltage the output relay remains de-energized. When the input voltage value is above the pull-in voltage, the restart delay begins. At the end of the restart delay, the output relay energizes. When the input voltage falls below the trip point, the trip delay begins. If the input voltage remains below the pull-in voltage for the entire trip delay the relay de-energizes. If the input voltage returns to a value above the pull-in voltage, during the trip delay, the trip delay is reset and the relay remains energized. If the input voltage falls below the trip point voltage during the restart delay, the delay is reset and the relay remains de-energized. Reset is automatic upon correction of an undervoltage fault.

Reset: Removing input voltage resets the output relay and the time delays.

Features

- 30A, SPDT, NO output contacts
- 100 to 240VAC input voltage
- 70 to 220VAC adjustable undervoltage trip point in 2 ranges
- Restart delays from 3 - 300s
- Trip delay 1 - 20s fixed
- Isolated or non-isolated relay contacts

For dimensional drawing see: Appendix, page 512, Figure 17.

Accessories

<table>
<thead>
<tr>
<th>P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect</th>
<th>C103PM (AL) DIN Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.</td>
<td>35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P1023-6 Mounting bracket</th>
<th>P1023-20 DIN Rail Adapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 90° orientation of mounting slots makes installation/removal of modules quick and easy.</td>
<td>Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P1015-18 Quick Connect to Screw Adapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.</td>
</tr>
</tbody>
</table>
Specifications

**Input**
- **Min & Max RMS Voltage**: 70 to 264VAC
- **AC Line Frequency**: 50/60 Hz
- **Power Consumption**: AC ≤ 4VA

**Undervoltage Sensing**
- **Type**: Peak voltage sensing
- **Ranges**
  - (4) 70 to 120VAC
  - (6) 170 to 220VAC

**Trip Point Accuracy**
- ± 3% of trip point

**Time Delay**
- **Restart Delays**: 3 - 300s adjustable
- **Trip Delay**: 1 - 20s fixed in 1s increments
- **Repeat Accuracy**: ±0.5% or 20ms, whichever is greater

**Tolerance**
- (Factory Calibration): ±5%

**Reset Time**
- ≤ 150ms

**Time Delay vs. Temp. & Voltage**
- ±10%

**Output**
- **Type**: Electromechanical relay
- **Form**: SPDT

**Ratings**
- **General Purpose**
  - 125/240VAC: 30A, 15A
  - 125/240VAC: 30A, 15A
- **Resistive**
  - 28VDC: 20A, 10A
- **Motor Load**
  - 125VAC: 1 hp*, 1/4 hp**
  - 240VAC: 2 hp**, 1 hp**

**Life**
- Mechanical: 1 x 10^6
- Electrical: 1 x 10^6, **3 x 10^6**, **6,000**

**Protection**
- **Surge**: IEEE C62.41-1991 Level A
- **Circuitry**: Encapsulated
- **Isolation Voltage**: ≥ 1500V RMS input to output; isolated units
- **Insulation Resistance**: ≥ 100 MΩ

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**
  - H: 76.7 mm (3”)
  - W: 51.3 mm (2”)
  - D: 38.1 mm (1.5”)
- **Termination**: 0.25 in. (6.35 mm) male quick connects

**Environmental**
- **Operating/Storage Temperature**: -40° to 60°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≈ 3.9 oz (111 g)

---

**Function Diagram**

- **tr** = Restart Delay
- **td** = Trip Delay
- **PI** = Pull-in 105% or trip point
- **TP** = Trip Point
- **V** = Monitored Voltage
- **IV** = Input voltage
- **C-NO** = Normally Open Contacts
- **C-NC** = Normally Closed Contacts

---

**Diagram Notes**

The function diagram illustrates the electrical behavior and connections of the HLVA6I23 relay under various conditions.
KVM SERIES

Description
The KVM Series is a single-phase undervoltage monitor designed to protect sensitive equipment against brownout undervoltage conditions. The compact design and encapsulated construction make the KVM Series an excellent choice for OEM equipment.

Operation
The output relay is energized and the LED glows green when the input voltage is above the reset voltage threshold. If the input voltage drops below the undervoltage setpoint, the output relay and LED will de-energize. The output relay will remain de-energized as long as the input voltage is below the reset voltage. Reset is automatic when the input voltage returns to a normal range.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous monitoring</td>
<td>Low cost single-phase undervoltage (brownout) protection</td>
</tr>
<tr>
<td>Compact design measures 2 in.</td>
<td>Perfect for OEM applications where, cost, size and ease of installation are important</td>
</tr>
<tr>
<td>(50.8mm) square</td>
<td></td>
</tr>
<tr>
<td>LED indication</td>
<td>Quick visual indication of output status</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

P1015-64 (AWG 14/16) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>MAXIMUM LINE VOLTAGE</th>
<th>UNDERSVOLTAGE SETPOINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>KVM4</td>
<td>132VAC</td>
<td>Adjustable, 78 to 99VAC</td>
</tr>
<tr>
<td>KVM6</td>
<td>264VAC</td>
<td>Adjustable, 156 to 199VAC</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 16.

If you don’t find the part you need, call us for a custom product 800-843-8848
## Specifications

### Line Voltage
- **Type**: Single phase
- **Input Voltage**: 110 to 120VAC or 220 to 240VAC
- **AC Line Frequency**: 50/60 Hz
- **Power Consumption**: 2.5W @ 132VAC; 4.5W @ 264VAC
- **Power Off Reset Time**: ≤ 150ms

### Undervoltage Detection
- **Undervoltage Setpoint**
  - KVM4: 78 to 99VAC
  - KVM6: 156 to 199VAC
- **Undervoltage Reset Point**
  - KVM4: Fixed at 104VAC
  - KVM6: Fixed at 209VAC

### Repeatability
- ± 0.5% under fixed conditions
- ±1% over temperature range
- ±2% at 25°C

### Voltage Sensing Accuracy

### Output
- **Type**: Electromechanical relay
- **Form**: SPDT
- **Rating**: 8A resistive @ 120VAC, 1/3 hp @ 120/240VAC
- **Life**: Mechanical - $1 \times 10^6$; Electrical - $1 \times 10^5$
- **LED Indicator**: Glows green when output is energized

### Surge Protection
- IEEE C62.41-1991 Level A

### Circuitry
- Encapsulated

### Isolation Voltage
- ≥ 1500V RMS input to output

### Insulation Resistance
- ≥ 100 MΩ minimum

### Mechanical

### Mounting
- Surface mount with one #10 (M5 x 0.8) screw
- H: 50.8 mm (2.0”); W: 50.8 mm (2.0”);
- D: 30.7 mm (1.21”)
- 0.25 in. (6.35 mm) male quick connect terminals

### Environmental

### Operating/Storage
- Temperature: -25 to 55°C / -40 to 85°C
- Humidity: 95% relative, non-condensing
- Weight: 2.6 oz (74 g)

---

### Function Diagram

[Diagram showing TP = Undervoltage Setpoint and R = Reset Point]
REMOTE INDICATION & MONITORING

Improve safety for service and operations personnel by allowing control and monitoring of the relay without opening the electrical cabinet.

- RM1000 Series Remote Monitor ........................................... 262
- RM2000 Series Remote Monitor ........................................... 264
- Informer Remote Diagnostics Tool ........................................ 266
- Informer-MS Remote Diagnostics Tool ................................. 268
Description
The RM1000 Series is a motor-monitoring device to be used in conjunction with the 777 family of products (excluding the P1 Series), 77C family of products and the 601 voltage monitors, via Modbus protocol with a communications module. The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring.

The RM1000 Series can monitor up to 16 MotorSaver® and/or PumpSaver® units through an RS-485 network using Modbus RTU protocol. A second communication port allows monitoring and control of up to 99 MotorSaver® and/or PumpSaver® units from a computer, PLC, DCS or SCADA system and can be accessed from the host computer or PLC with the RM1000 acting as a repeater for any of its motor protectors. In addition to the monitoring functions, the RM1000 can be used to reset a tripped MotorSaver® or PumpSaver®.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM1000</td>
<td>NEMA 3R and/or UL Type 12</td>
</tr>
<tr>
<td>RM1000-3R</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>RM1000 NEMA 4</td>
<td>NEMA 4X</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 508, Figure 4.

The RM1000 Series is easily mounted remotely and improves safety for service and operations personnel by allowing them to control and monitor the device without opening the electrical cabinet. Using the RM1000 is a simple, cost-effective method for aiding compliance with arc flash safety regulations. The enclosure and keypad assembly is water and ultraviolet light resistant. The enclosure is NEMA 3R or NEMA 4X (optional) rated. The RM1000 and RM1000 NEMA 4 also carry a UL Type 12 rating, whereas the RM1000-3R does not carry the UL Type 12 rating due to added weep holes. The added weep holes in the RM1000-3R make it suitable for applications subjected to condensing moisture/humidity.
RM1000 SERIES

Features
Displays:
- Individual line currents and average current
- Current and voltage unbalance
- Individual phase voltages and average voltage
- Displays last four faults, trip reason, and restart timer status
- MotorSaver® and/or PumpSaver® setpoints
- Run-hours on each motor
- Warning of pending (imminent) faults
Controls:
- Reset run-hour meter
- Reset MotorSaver® or PumpSaver®
- Change setpoints from the RM1000
Convenience:
- Power from RS485MS-2W communications module
- Monitor up to 16 777s with one display
- NEMA 3R outdoor rated
- Secondary steel enclosure available

Specifications

Input Characteristics
Control Power
12-24VDC (Supplied by RS485MS-2W)

Functional Characteristics
Communication
Port #1 for 777(s)  Port #2 for PC, PLC, etc.
Baud Rate
1200-28800, 1200-28800
Setup
None, Odd, or Even Parity, None, Odd, or
Even Parity
1 or 2 Stop Bits 1 or 2 Stop Bits
Protocol
Modbus RTU  Modbus RTU
Serial Interface
RS-485  RS-485
Available Addresses
1-99 addresses (max 16 per RM1000)
Responds to all port #1

Mechanical Life
100,000 actuations
Overlay Material
Polyester
UV Exposure w/o degradation
2000 hrs
Terminal Torque (depluggable terminal block)
3 in.-lbs.
Panel Thickness
0.03” min, 0.12” max

General Characteristics
Ambient Temperature Range
Operating -40° to 70°C (-40° to 158°F)
Storage -40° to 80°C (-40° to 176°F)
Maximum Input Power
100mA
Class of Protection
RM1000, RM1000 NEMA 4
NEMA 3R and/or UL Type12,
RM1000-3R
NEMA 3R only
Relative Humidity
Up to 85%, non-condensing
Safety Marks
UL UL508 (File #E68520)
CSA 22.2 No. 14 (File #48510)
CE IEC 60947-6-2
Enclosure Material
Black polycarbonate
Display
Liquid Crystal with extended temp. range
Size
2 rows x 16 characters
Keypad
Six 0.5” stainless steel dome buttons for tactile feedback

Dimensions
H 91.92 mm (3.62”); W 115.42 mm (4.54”);
D 22.86 mm (0.9”) 1.5 lbs. (24 oz., 680.39 g)

Mounting Method
Surface mountable on backplane using 4 screws

Accessories
RS485-RS232 Converter with cable & plug
Allows RS485 devices to be connected to a PC via the RS232 (serial) port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

RS485-USB
Converter with cable & plug/RS232:USB
Allows RS485 devices to be connected to a PC via the USB port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

RM1000 ENCL
Steel enclosure for protecting the RM1000 remote communications monitor from adverse affects of weather and vandalism, while allowing normal communications connections to the RM1000 unit.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.
**Description**

The RM2000 Series is a motor-monitoring device to be used in conjunction with the 777 family of products (excluding the P1 Series), 77C family of products and the Model 601 voltage monitors, via Modbus protocol with a communications module. The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring.

The RM2000 has membrane keypad controls which allow both monitoring and control of a 777 MotorSaver® through an RS-485 network using Modbus RTU protocol. A second communication port allows monitoring and control of up to 99 RM2000 devices from a PLC, DCS, or SCADA system or a PC with Solutions software installed. The RM2000 will act as a repeater for its motor protector when accessed from the host computer or PLC. In addition to the monitoring functions, the RM2000 can be used to reset a tripped MotorSaver® or PumpSaver®.

The RM2000 is easily mounted remotely and improves safety for service and operations personnel by allowing them to control and monitor the device without opening the electrical cabinet. Using the RM2000 is a simple, cost-effective method for aiding compliance with arc flash safety regulations. The enclosure and keypad assembly is water and ultraviolet light resistant.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM2000</td>
<td>Remote display monitor for 777 family relays</td>
</tr>
<tr>
<td>RM2000-CBM+</td>
<td>Coal Bed Methane Special. Optimizes gas production from coal bed methane wells while protecting submersible pump</td>
</tr>
<tr>
<td>RM2000-RTDW</td>
<td>Includes additional input for ground-fault module</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 508, Figure 5.
Features

Displays:
- Average current, individual line currents and current unbalance
- Current to ground
- Average voltage, line-line voltages and voltage unbalance
- Instantaneous power
- Power factor
- Last four faults
- All parameters programmed into 777 MotorSaver®
- Remaining restart delay times

Controls:
- Start and stop buttons
- Key lock input to prevent setpoint changes
- Change 777 setpoints from keypad

The RM2000 is also equipped with a real-time clock, which allows access to the following motor management information (most readings can be reset):
- Total motor run-time
- Time and date of last four faults, along with voltage and current at time of trip
- Time and date of last 10 motor starts
- Total number of motor restarts
- Minimum time between any two starts with time and date
- Run-time since last start
- kWh consumed
- kVARs consumed

Specifications

Input Characteristics

Control Voltage
115VAC ±10%; 50/60Hz

Transient Protection
2500V for 10ms

(Internal)

Functional Characteristics

Communication
Port #1 for 777
1200-28800

Port #2 for PC, PLC, etc.
1200-28800

Baud Rate
Even Parity
None, Odd, or Even Parity

Setup
1 Stop Bit
1 or 2 Stop Bits

Protocol
Modbus RTU
Modbus RTU

RS-485
RS-485

Serial Interface
Available Addresses
01
A01-A99

Real-time Clock
Battery Back-up Life
10 years @ 25°C without external power
Stores up to 4 faults with time and date stamp, includes voltages and currents at time of trip

Last fault memory
2 independent electro-mechanical
Form C (SPDT)

Configuration
Contact Material
Silver/Tin Oxide

Output Characteristics

Pilot Duty Rating
RM2000-RTDW version only
240VA @ 120VAC

General Purpose Rating
5A @ 120VAC

General Characteristics
Ambient Temperature Range
Operating
-20° to 70°C (-4° to 158°F)

Storage
-30° to 70°C (-22° to 158°F)

Maximum Input Power
3 W

Class of Protection
NEMA 3R and/or UL Type 12

Relative Humidity
Up to 85%, non-condensing

Safety Marks
UL
UL508 (File #E68520)

CSA
C22.2 No. 14 (File #46510)

CE
IEC 60947-6-2

Enclosure
Material
Black polycarbonate

Display
Liquid crystal with extended temp. range

Size
2 rows x 20 characters

Lighting
LED Backlight

Keypad
Eight 0.5” stainless steel dome buttons for tactile feedback

Mechanical Life
100,000 actuations

Overlay Material
Polyester

UV Exposure
w/o degradation
2000 hrs.

Terminal Torque
(depluggable terminal block)
3 in.-lbs.

Dimensions
H 162.56 mm (6.4”); W 154.94 mm (6.1”);
D 27.94mm (1.1”)

Weight
1.2 lbs. (19.2 oz., 544.31 g)

Mounting Method
Surface mountable on backplane using
4 screws

Accessories

RS485-RS232 Converter with cable & plug
Allows RS485 devices to be connected to a PC via the RS232 (serial) port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

RS485-USB
Converter with cable & plug/RS232:USB
Allows RS485 devices to be connected to a PC via the USB port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.
Description
The Informer is a hand-held diagnostic tool designed for use with single-phase models equipped with infrared LED transmitters (111-Insider-P; 231-Insider-P; 232-Insider; 111P; 233P; 233P-1.5; 234-P and 235P).

The Informer uses an infrared receiver to access information sent from the relay which can be helpful for troubleshooting the system.

Each Littelfuse single-phase model listed above is equipped with an infrared LED that transmits valuable information from the device. To retrieve this information, the Informer’s receiver must be directed toward the unit’s LED transmitter and be within 8 feet of the unit. The green COMM STATUS light indicates when the Informer is receiving data from the unit. If communication is lost, the Informer will display the last values it received. The Informer will automatically shut off after 2 minutes of non-use.

An infrared adapter (IR Kit-12) is included with all new and updated Informers. This adapter allows communication with the unit without opening the panel door (for select models).

Features & Benefits
The Informer displays:
- Model number
- Real-time voltage, current, and power
- Drywell and overload trip points
- Calibration voltage
- Restart delay setpoint and restart delay time remaining
- CT size (if applicable)
- Number of pump starts
- Total run-time
- Fault history for last 20, most recent, faults
- Voltage, current, power, and run-time for each fault at time of the fault
- Highest and lowest voltage and current since last calibration

Accessories
Informer IR Kit-12
12” infrared adapter cable attaches to the face of the unit to provide remote diagnostics without opening the panel. Included with the Informer.
### Specifications

#### Functional Characteristics

**Power**
- Input: 9 Volts DC
  - (requires one 9-volt alkaline battery)

**Auto Shut-off**
- 2 minutes

**Communication**
- **Signal**: Infrared
- **Range**: 1-8 ft. (approx. 0.25 ft. when using IR Kit)
- **Data Update**: 4 seconds

#### General Characteristics

**Temperature Range**
- 0 to 60°C (32° to 140°F)

**Accuracy**
- **Voltage**: ±2%
- **Current**: ±2%
- **Power**: ±4%

**Maximum Input**
- 0.25 W

**Resolution**
- **Voltage**: 1.0VAC

**Display**
- Liquid crystal

**Size**
- 2 rows x 16 characters

**Keypad**
- Three 0.5” diameter buttons

**Mechanical Life**
- 100,000 actuations min.

**Overlay Material**
- Polyester

**Enclosure**
- **Dimensions**:
  - H 139.70 mm (5.50”);
  - W 91.44 mm (3.60”);
  - D 28.70 mm (1.13”)

**Weight**
- 0.375 lb. (6 oz., 170.10 g) (w/out battery);
  - 0.70 lb. (11.2 oz., 317.51 g) (total package)

**Material**
- Black ABS 94HB
INFORMER-MS

Remote Diagnostic Tool for use with the 455
3-Phase, Dual-Range Voltage Monitor

Description
The Informer-MS is a hand-held diagnostic tool designed for use with the Littelfuse 455.*
The Informer-MS uses an infrared receiver to read valuable information transmitted from the 455*, which can be helpful for troubleshooting the system. A green communication status light indicates the Informer-MS is receiving data from the 455. If communication is lost, the Informer-MS will display the last values it received.

*Model 455s manufactured after 03/01/06 are equipped with the infrared LED transmitter. Models manufactured prior to this date are not compatible with the Informer-MS.
An infrared adapter (IR Kit-36) can be purchased to allow communication with the Model 455 without opening the panel door.

Features
The Informer-MS displays:
- Real-time, line and load side voltage
- Real-time, line and load side voltage unbalance
- Motor run hours
- Last 20 faults
- Last 32 motor starts
- High and low voltage trip points
- Voltage unbalance trip point
- Restart and trip delay settings
- Voltage at last fault
- Communication status LED
- Auto shut off
- Last fault with trip conditions

Accessories
Informerr IR Kit-36
36” infrared adapter cable attaches to the face of the model 455 to provide remote diagnostics without opening the panel.

Specifications
Functional Characteristics

<table>
<thead>
<tr>
<th>Power</th>
<th>9 Volts DC (requires one 9-volt alkaline battery)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>0.25 Watt (max.)</td>
</tr>
<tr>
<td>Auto Shut-off</td>
<td>2 minutes</td>
</tr>
<tr>
<td>Communication</td>
<td>Infrared</td>
</tr>
<tr>
<td>Signal</td>
<td>1-8 ft. (approx. 0.25 ft. when using IR Kit)</td>
</tr>
<tr>
<td>Range</td>
<td>4 seconds</td>
</tr>
</tbody>
</table>

General Characteristics

| Temperature Range | 0 to 60°C (32° to 140°F) |
| Resolution | ±2%                       |
| Voltage | 1.0VAC                     |
| Maximum Input | 0.25 W                     |
| Voltage Unbalance | 1%                      |
| Time | 1 minute increments         |
| Trip Delay | 2 second increments       |
| Restart Delay | 2 second increments       |
| Display (liquid crystal) | 2 rows x 16 characters |
| Size | 2 rows x 16 characters     |
| Keypad | (three 0.5” dia. buttons) |
| Mechanical Life | 100,000 actuations min.   |
| Overlay Material | Polyester                |
| Enclosure |                     |
| Dimensions | H 139.70 mm (5.50”); W 91.44 mm (3.60”); D 28.70 mm (1.13”) |
| Weight | 0.375 lb. (6 oz., 170.10 g) (w/out battery); 0.70 lb. (11.2 oz., 317.51 g) (total package) |
| Material | Black ABS 94HB         |

For dimensional drawing see: Appendix, page 510, Figure 9.
COMMUNICATION MODULES

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS485MS-2W</td>
<td>Communication Module</td>
<td>270</td>
</tr>
<tr>
<td>CIO-MB/CIO-120-MB</td>
<td>Communication Module</td>
<td>271</td>
</tr>
<tr>
<td>CIO-DN-P/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIO-120-DN-P</td>
<td>Devicenet™ Interface</td>
<td>273</td>
</tr>
<tr>
<td>CIO-777-PR</td>
<td>Profibus Interface</td>
<td>275</td>
</tr>
<tr>
<td>CIO-EN</td>
<td>Modbus-TCP and Modbus-RTU Interface</td>
<td>276</td>
</tr>
<tr>
<td>COM 4-20</td>
<td>Output Module for use with Model 777-AccuPower</td>
<td>277</td>
</tr>
</tbody>
</table>
RS485MS-2W

Communication Module

Description
The RS485MS-2W is required to enable the Modbus communications function on Model 77x-type products. This module is required when the RM1000, RM2000 or other Modbus capable device is used with 77x-type products.

Features
- Optical isolation from line potentials
- Powered by the 77x product
- RS-485 compliant bus drive capability
- Remote reset input connection
- Power connection for the Model RM1000

Accessories
- RS485-RS232 Converter with cable & plug
  Allows RS485 devices to be connected to a PC via the RS232 (serial) port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.
- RS485-USB Converter with cable & plug/RS232:USB
  Allows RS485 devices to be connected to a PC via the USB port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

Refer to the manual for basic and extended network diagrams.
For dimensional drawing see: Appendix, page 507, Figure 2.

Specifications

Functional Specifications
- Remote Reset (for optional use with 777 Series)
  Normally open pushbutton rated 24VDC, 10mA (min.)
- General Characteristics
  - Ambient Operating Temperature
    -20° to 50°C (-4° to 122°F)
  - Terminal (depluggable terminal block)
    Torque: 3 in.-lbs. (max.)
    Wire AWG: 12-20 AWG
  - Class of Protection: IP20
  - Relative Humidity: 10-95%, non-condensing per IEC 68-2-3
- Standards Passed
  - Electrostatic Discharge (ESD)
    IEC 61000-4-2, Level 3, 6kV contact, 8kV air
  - Radio Frequency
    Immunity, Radiated
    150 MHz, 10V/m
  - Fast Transient Burst
    IEC 61000-4-4, Level 3, 4KV input power
  - Hi-Potential Test
    Meets UL508 (2 x rated V + 1000V for 1 min)

Surge
- Input Power
  IEC 61000-4-5, Level 1
- Inputs/Data Lines
  IEC 61000-4-5, Level 2

Safety Marks
- UL
  UL508 (File #E68520)
- CE
  IEC 60947

Enclosure
- Polycarbonate

Dimensions
- H 52.83 mm (2.08”)
- W 73.66 mm (2.9”)
- D 19.56 mm (.77”)
- Weight: 0.26 lb. (4.16 oz., 117.93 g)
- Mounting Method: 9-pin D-Sub connector on the side of a 777-Series

For dimensional drawing see: Appendix, page 507, Figure 2.
**Description**

The CIO-MB/CIO-120-MB Modules are convenient and cost-effective Modbus-RTU interfaces capable of providing discrete control and monitoring of an overload relay over a Modbus network.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact size 3.46&quot; H x 1.0&quot; W x 5.0&quot; D</td>
<td>Easily adapts to existing as well as new applications</td>
</tr>
<tr>
<td>Flexible addressing standard allows function as stand-alone interface or in conjunction with 777 series overload relay</td>
<td>Provides flexibility for control and monitoring</td>
</tr>
<tr>
<td>Remote reset option</td>
<td>Additional remote reset input allows user to reset 777 series relays without opening the panel</td>
</tr>
<tr>
<td>DIN rail or surface mountable</td>
<td>Allows installation flexibility</td>
</tr>
<tr>
<td>Unpluggable terminal block connections</td>
<td>Allows user to wire terminal blocks before installing the module and reduces field wiring</td>
</tr>
</tbody>
</table>

**Specifications**

**Functional Specifications**

Remote Reset (for use with optional 777 Series)

- Normally open pushbutton rated 24VDC, 10mA (min.)
- Power Requirements:
  - Voltage: 24VDC +10%
  - Current: 95mA (max.) 70mA (typical)
  - Power: 2.28 W (max.) 1.7 W (typical)
- Ethernet Controller Capability: IEEE 802.3
- Input Characteristics
  - General Purpose (4)
    - Voltage Range: CIO-MB 12-24VDC, CIO-120-MB 90-130VAC
    - Current: 2mA (typical)
  - Output Characteristics
    - SPDT (1), SPST (1)
    - Pilot Duty: 480VA & 240VAC, B300
    - General Purpose: 5A @ 240VAC
- General Characteristics
  - Ambient Operating Temperature: -20° to 70°C (-4° to 158°F)
  - Terminal (depluggable terminal block) Torque: 3 in.-lbs. (max.)
  - Wire AWG: 12-20 AWG
  - Class of Protection: IP20, NEMA 1 (finger safe)
  - Relative Humidity: 10-95%, non-condensing per IEC 68-2-3

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIO-MB</td>
<td>12 to 24VDC</td>
</tr>
<tr>
<td>CIO-120-MB</td>
<td>90 to 130VAC</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 507, Figure 3.
CIO-MB / CIO-120-MB

Standards Passed

**Electrostatic Discharge (ESD)**
IEC 61000-4-2, Level 3, 6kV contact, 8kV air

**Radio Frequency Immunity, Radiated**
150 MHz, 10V/m

**Fast Transient Burst**
IEC 61000-4-4, Level 3, 4kV input power

**Hi-Potential Test**
Meets UL508 (2 x rated V + 1000V for 1 min)

**Surge**

**Input Power**
IEC 61000-4-5, Level 1

**Inputs/Data Lines**
IEC 61000-4-5, Level 2

**Safety Marks**

**UL**
UL508 (File #E68520)

**CSA**
C22.2 (File #46510)

**CE**
IEC 60947-6-2

**Enclosure**
Polycarbonate

**Dimensions**

- **H** 86.36 mm (3.40”)
- **W** 25.40 mm (1.00”)
- **D** 138.68 mm (5.46”)

  (w/depluggable connectors)

**Weight**
0.25 lb. (4 oz., 113.4 g)

**Mounting Methods**
DIN Rail or surface mount (w/two #8 screws)
CIO-DN-P / CIO-120-DN-P
Communication Link to PLC/SCADA/Monitoring Systems

Description
The CIO-DN-P/CIO-120-DN-P are convenient and cost-effective Devicenet™ interfaces capable of providing discrete control and monitoring of motor starters, drives and other devices over a Devicenet™ network.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact size</td>
<td>Easily adapts to existing as well as new applications</td>
</tr>
<tr>
<td>Flexible addressing standard</td>
<td>Provides flexibility for control and monitoring</td>
</tr>
<tr>
<td>Flexible addressing standard</td>
<td>as stand-alone interface or in conjunction with 777 series overload relay</td>
</tr>
<tr>
<td>Remote reset option</td>
<td>Additional remote reset input allows user to reset 777 series relays without opening the panel</td>
</tr>
<tr>
<td>DIN rail or surface mountable</td>
<td>Allows installation flexibility</td>
</tr>
<tr>
<td>Unpluggable terminal block connections</td>
<td>Allows user to wire terminal blocks before installing the module and reduces field wiring</td>
</tr>
</tbody>
</table>

Wiring Diagram
TYPICAL WIRING FOR CIO-DN-P

For dimensional drawing see: Appendix, page 507, Figure 3.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIO-DN-P</td>
<td>12 to 24VAC</td>
</tr>
<tr>
<td>CIO-120-DN-P</td>
<td>90 to 130VAC</td>
</tr>
</tbody>
</table>

© 2023 Littelfuse, Inc.
**Specifications**

<table>
<thead>
<tr>
<th>Input Characteristics</th>
<th>Power Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage (nominal)</td>
<td>24VDC</td>
</tr>
<tr>
<td>Current</td>
<td>137mA (max.)</td>
</tr>
<tr>
<td>Power</td>
<td>2.28 W (max.)</td>
</tr>
</tbody>
</table>

**Digital Inputs**

<table>
<thead>
<tr>
<th>Voltage Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIO-DN-P</td>
</tr>
<tr>
<td>12-24 VAC</td>
</tr>
<tr>
<td>CIO-120-DN-P</td>
</tr>
<tr>
<td>90-130VAC</td>
</tr>
</tbody>
</table>

| Frequency             | 50/60Hz |
| Maximum Current       | 2mA (typical) |
| Remote Reset          | 24VDC, 10mA (min.), NO pushbutton |

**Output Characteristics**

<table>
<thead>
<tr>
<th>Form A &amp; Form C Contactors</th>
</tr>
</thead>
<tbody>
<tr>
<td>480VA @ 240VAC, B300</td>
</tr>
</tbody>
</table>

**General Purpose**

| 5A @ 240VAC               |

**General Characteristics**

| Temperature Range         | -20° to 70°C (-4° to 158°F) |
| Relative Humidity         | 10-95%, non-condensing      |
| Wire Gauge                | Solid or stranded, 12-20 AWG|
| Terminal Torque           | 3 in.-lbs.                  |
| Hi-Potential Test (relays to other circuits) | (2 x rated V + 1000V for 1 minute) |

**EMC Standards**

<table>
<thead>
<tr>
<th>Electrostatic Discharge (ESD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61000-4-2, Level 3, 6kV contact, 8kV air</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radio Frequency Immunity, Radiated</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61000-4-4, Level 3, 4kV input power</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fast Transient Burst</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL508 (File #E68520), C22.2 (File #46510)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polycarbonate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 86.36 mm (3.4”); W 25.4 mm (1.0”); D 138.68 mm (5.46”)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 lb. (4 oz., 113.4 g) (w/depluggable connectors)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mounting Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN Rail or surface mount (w/two #8 screws)</td>
</tr>
</tbody>
</table>
Description
The CIO-777-PR Module is a convenient and cost-effective Profibus interface capable of providing discrete control and monitoring of motor starters, drives and other devices over a Profibus network.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact size</td>
<td>Easily adapts to existing as well as new applications</td>
</tr>
<tr>
<td>3.4” H x 1.0” W x 5.46” D</td>
<td>Flexible addressing standard allows function as stand-alone interface or in conjunction with 777 series overload relay</td>
</tr>
<tr>
<td>Profiles addressing</td>
<td>Provides flexibility for control and monitoring</td>
</tr>
<tr>
<td>Remote reset option</td>
<td>Additional remote reset input allows user to reset 777 series relays without opening the panel</td>
</tr>
<tr>
<td>DIN rail or surface mountable</td>
<td>Allows installation flexibility</td>
</tr>
<tr>
<td>Built-in sub-D connector</td>
<td>Provides a quick and easy connection to a network and reduces field wiring</td>
</tr>
</tbody>
</table>

Specifications

**Input Characteristics**

- **Power Requirements**
  - Voltage (nominal): 12-24VDC
  - Current: 150mA (max.)
  - Power: 3.6 W (max.)
- **Digital Inputs**
  - Voltage Range: 12-24VAC
  - Maximum Current: 2mA (typical)
  - Remote Reset: 24VDC, 10mA, (min.), NO pushbutton

**Output Characteristics**

- **Form A & Form C Contactors**
  - Pilot Duty: 480VA @ 240VAC, B300
  - General Purpose: 5A @ 240VAC
- **General Characteristics**
  - Ambient Temperature Range
    - Operating: -20° to 70°C (-4° to 158°F)
    - Storage: -40° to 80°C (-40° to 176°F)
  - Relative Humidity: 10-95%, non-condensing per IEC 68-2-3
  - Wire Gauge: Solid or stranded, 12-20 AWG
  - Terminal Torque: 3 in.-lbs.
  - Hi-Potential Test (relays to other circuits): Meets UL508 (2 x rated V + 1000V for 1 min.)

**EMC Standards**

- Electrostatic Discharge (ESD): IEC 61000-4-2, Level 3, 6kV contact, 8kV air
- Radio Frequency Immunity, Radiated: 150 MHz, 10V/m
- Fast Transient Burst: IEC 61000-4-4, Level 3, 4kV input power

**Safety Marks**

- UL, ULC Listed
- UL508 (File #E68520)
- CSA C22.2 (File #46510)

**Enclosure**

- Polycarbonate

**Dimensions**

- H 86.36 mm (3.4”); W 25.4 mm (1.0”); D 138.68 mm (5.46”)
- (w/depluggable connectors)

**Weight**

- 0.25 lb. (4 oz., 113.4 g)
- (w/depluggable connectors)

**Mounting Methods**

- DIN Rail or surface mount (w/ two #8 screws)
**Description**

The CIO-EN Module (non-POE) is a convenient and cost-effective Modbus-TCP and Modbus-RTU interface capable of providing discrete control and monitoring of an overload relay over a Modbus network.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact size 3.4&quot; H x 1.0&quot; W x 5.46&quot; D</td>
<td>Easily adapts to existing as well as new applications</td>
</tr>
<tr>
<td>Flexible addressing standard allows function as stand-alone interface or in conjunction with 777 series overload relay</td>
<td>Provides flexibility for control and monitoring</td>
</tr>
<tr>
<td>Remote reset option</td>
<td>Additional remote reset input allows user to reset 777 series relays without opening the panel</td>
</tr>
<tr>
<td>DIN rail or surface mountable</td>
<td>Allows installation flexibility</td>
</tr>
<tr>
<td>Built in Ethernet jack</td>
<td>Reduces field wiring</td>
</tr>
</tbody>
</table>

**Specifications**

**Input Characteristics**

- **Power Requirements:**
  - Voltage: 24VDC +10%
  - Current: 95mA (max.) 70mA (typical)
  - Power: 2.28 W (max.) 1.7 W (typical)
- **Digital Inputs**
  - General Purpose (4)
  - Voltage Range: 12-24VDC
  - Current: 2mA (typical)
- **Functional Specifications**
  - Remote Reset (for use with optional 777 Series): Normally open pushbutton rated 24VDC, 10mA (min.)
- **Ethernet Controller**
  - IEEE 802.3
- **Output Characteristics**
  - SPDT (1), SPST (1)
  - Pilot Duty: 480VA & 240VAC, B300
  - General Purpose: 5A @ 240VAC
- **General Characteristics**
  - Ambient Operating Temperature: -20° to 70°C (-4° to 158°F)
  - Terminal (depluggable terminal block):
    - Torque: 3 in.-lbs. (max.)
    - Wire AWG: 12-20 AWG
    - Class of Protection: IP20, NEMA 1 (finger safe)
    - Relative Humidity: 10-95%, non-condensing per IEC 68-2-3
    - Radio Frequency Immunity, Radiated: 150 MHz, 10V/m
    - Hi-Potential Test: Meets UL508 (2 x rated V + 1000V for 1 min)
    - Surge: IEC 61000-4-5, Level 1
    - Safety Marks: UL508 (File #E68520)
- **Dimensions**
  - H: 86.36 mm (3.4”);
  - W: 25.4 mm (1.0”);
  - D: 138.68 mm (5.46”)
- **Weight**
  - 0.25 lb. (4 oz., 113.4 g)
- **Mounting Methods**
  - DIN Rail or surface mount (w/two #8 screws)

For dimensional drawing see: Appendix, page 507, Figure 3.
COM 4-20

Communication Link to PLC/SCADA/ Monitoring Systems

Description
The COM 4-20 Output Module is intended for use with ONLY the Model 777-AccuPower output power monitor. The module will send a 4-20mA signal proportional to the output power. It can also be used to send the input power by setting the efficiency setting on the 777-AccuPower monitor to one. This module allows communication to a PLC with an analog input and no Modbus input.

Features
- Powered by the 777-AccuPower
- Scalable 4-20mA output proportional to Hp or kW
- Signal can be used for displays, controllers, or PLCs

Wiring Diagram
4-20mA OUTPUT MODULE

For dimensional drawing see: Appendix, page 507, Figure 2.

Specifications

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Characteristics</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>4-20mA</td>
</tr>
<tr>
<td>General Characteristics</td>
<td></td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-20° to 50°C (-4° to 122°F)</td>
</tr>
<tr>
<td>Terminal (depluggable terminal block)</td>
<td></td>
</tr>
<tr>
<td>Torque</td>
<td>3 in.-lbs. (max.)</td>
</tr>
<tr>
<td>Wire AWG</td>
<td>12-20 AWG</td>
</tr>
<tr>
<td>Class of Protection</td>
<td>IP20</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>10-95%, non-condensing per IEC 68-2-3</td>
</tr>
<tr>
<td>Standards Passed</td>
<td></td>
</tr>
<tr>
<td>Electrostatic Discharge</td>
<td>IEC 61000-4-2, Level 3, 6kV contact, 8kV air</td>
</tr>
<tr>
<td>Radio Frequency</td>
<td></td>
</tr>
<tr>
<td>Immunity, Radiated</td>
<td>IEC 61000-4-4, Level 3, 4kV input power</td>
</tr>
<tr>
<td>Fast Transient Burst</td>
<td>Meets UL508 (2 x rated V + 1000V for 1 min)</td>
</tr>
<tr>
<td>Hi-Potential Test</td>
<td></td>
</tr>
<tr>
<td>Surge</td>
<td></td>
</tr>
<tr>
<td>Input Power</td>
<td>IEC 61000-4-5, Level 1</td>
</tr>
<tr>
<td>Inputs/Data Lines</td>
<td>IEC 61000-4-5, Level 2</td>
</tr>
<tr>
<td>Safety Marks</td>
<td></td>
</tr>
<tr>
<td>UL</td>
<td>UL508 (File #E68520)</td>
</tr>
<tr>
<td>CE</td>
<td>IEC 60947</td>
</tr>
<tr>
<td>Enclosure</td>
<td>Polycarbonate</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
</tr>
<tr>
<td>Mounting Method</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.25 lb. (4 oz., 113.4 g)</td>
</tr>
<tr>
<td>Mounting Method</td>
<td>#8 screws; mount to side of 777-AccuPower unit</td>
</tr>
</tbody>
</table>
TIME DELAY RELAYS

The largest selection of time delay relays known since 1968 for its reliable designs that provide long service lives with low maintenance costs. Versatile multifunction time delay relays give you the option of choosing among functions and time delay ranges to ensure that you receive the perfect timer to fit your needs. Electromechanical relay-output time delay relays are available with a number of different functions and assure isolation between input and output, as well as no voltage drop across output contact. Solid-state time delay relays have no moving parts to arc and wear out over time, giving them a lifespan of up to 100x that of a relay-output timer. In addition, all solid state time delay relays are fully encapsulated to protect against shock, vibration, humidity, etc.

Timer Function Guide ................................................................. 280

Multifunction
TRDU Series ........................................................................... 281
TRU Series ........................................................................... 283
ASQU / ASTU Series ............................................................... 286
DSQU / DSTU Series .............................................................. 288

Dedicated
On Delay
T10 SERIES ........................................................................... 290

Delay-on-Make
ERDM Series ........................................................................... 291
HRDM Series ........................................................................... 293
KRDM Series ........................................................................... 295
KRPS Series ........................................................................... 297
KSD1 Series ........................................................................... 300
KSDU Series ........................................................................... 302
KSPS Series ........................................................................... 304
MSM Series ........................................................................... 307
ORM Series ........................................................................... 309
PRLM Series ........................................................................... 311
TDM / TDMH / TDML Series .................................................. 313
TDU / TDUH / TDUL Series .................................................... 315
TH1 Series ........................................................................... 317
THD18410.5S ........................................................................ 319
TMV8000 / TSU2000 Series .................................................... 321
TRM Series ........................................................................... 323
TS1 Series ........................................................................... 325
TSD1 Series ........................................................................... 327

Delay-on-Make, Normally Closed
TS441165 .................................................................................. 329

Delay-on-Break
HRDB Series ........................................................................... 331
HRPS / HRIS Series ................................................................. 333
KRDB Series ........................................................................... 335
KSDB Series ........................................................................... 337
ORB Series ........................................................................... 339
TDB / TDBH / TDBL Series ..................................................... 341
TDUB Series ........................................................................... 343
THDB Series ........................................................................... 345
TRB Series ........................................................................... 347
TSB Series ........................................................................... 349
TSDB Series ........................................................................... 351

Single Shot
HRDS Series ........................................................................... 353
HSPZ22SL ........................................................................... 355
KRDS Series ........................................................................... 357
KSDS Series ........................................................................... 359
ORS Series ........................................................................... 361
PRS85 .................................................................................. 363
TDS / TDSH / TDSL Series ..................................................... 365
TDUS Series ........................................................................... 366
THC / THS Series ................................................................. 368
THDS Series ........................................................................... 370
TRS Series ........................................................................... 372
TSDS Series ........................................................................... 374
TSS Series ........................................................................... 376
Time Delay Relays

TIME DELAY RELAYS

Interval
ERDI Series ............................................................... 378
HRDI Series .............................................................. 380
KRD1 Series ............................................................. 382
KSD2 Series ............................................................. 384
KSPU Series .............................................................. 386
TDI / TDIH / TDIL Series ........................................ 388
TDUI / TDUIH / TDUIL Series ..................................... 390
THD2 Series ............................................................. 392
THD7 Series ............................................................. 394
TS2 / TS6 Series ....................................................... 396
TSD2 Series ............................................................. 398
TSD6 Series ............................................................. 400
TSD7 Series ............................................................. 402
Retriggerable Single Shot
KRD9 Series ............................................................. 404
TSD94110SB ............................................................ 406
Recyle
ERD3425A ............................................................... 407
ESDR Series ............................................................. 409
HRDR Series ............................................................. 412
KRD3 Series ............................................................. 414
KRD3R Series ........................................................... 416
KSD3 Series ............................................................. 418
KSDR Series ............................................................. 420
KSPD Series ............................................................. 422
RS Series ................................................................. 424
TDR Series ............................................................... 426
THD3C42A ............................................................... 428
TSD3411S ................................................................. 430
TSDR Series ............................................................. 432

Percentage
PTHF4900DK .......................................................... 434

Dual Function
TDMB Series ............................................................ 436
ESD52233 ............................................................... 438
KRPD Series ............................................................. 440

HVAC
CT Series ............................................................... 442
T2D120A15M ........................................................... 444
TA Series ................................................................. 446
TAC1 Series ............................................................. 448
TL Series ................................................................. 450
TSA141300 .............................................................. 452

Coin Vending
HRV Series ............................................................. 453

For More Information... and to download our HVAC Timer Application Guide, visit Littelfuse.com/timedelayrelays

© 2023 Littelfuse, Inc.
**Selecting a Timer’s Function**

Selecting one of the five most common timing functions can be as easy as answering three questions on the chart below. If you have trouble answering these questions, try drawing a connection diagram that shows how the timer and load are connected. Time diagrams and written descriptions of the five most popular functions, plus other common functions. Instantaneous contacts, accumulation, pause timing functions, and flashing LED’s are included in some units to expand the versatility of the timer. These expanded operations are explained on the product’s catalog page. Time diagrams are used on these pages along with text and international symbols for functions.

**Function Selection Guide**

**Selection Questions**

1) The timing starts when the initiate (starting) contacts are:
   - A) Closed
   - B) Opened

2) What is the status of the output (or load) during timing?
   - A) On
   - B) Off
   - C) On/Off

3) Will the load de-energize (or remain de-energized) if the initiate (starting) contacts are opened during timing?
   - A) Yes
   - B) No

**Understanding Time Diagrams**

Time diagrams are used to show the relative operation of switches, controls, and loads as time progresses. Time begins at the first vertical boundary. There may be a line indicating the start of the operation or it may just begin with the transition of the device that starts the operation. Each row in the time diagram represents a separate component. These rows will be labeled with the name of the device or its terminal connection numbers. In a bistable or digital system, the switches, controls, or loads can only be ON or OFF. The time lines are drawn to represent these two possible conditions. Vertical lines are used to define important starting or ending points in the operation.

The example to the right is the most common type of time diagram in use in North America. It shows the energizing of loads, and the closing of switches and contacts by an ascending vertical transition of the time line. Opening switches or contacts or de-energizing loads are represented by descending vertical transitions.

**International Timing Function Symbols**

- = Delay-on-Make; ON-delay
- = Delay-on-Break; OFF-delay
- = Delay-on-Make and Break; ON and OFF-delay
- = Interval; Impulse-ON
- = Trailing Edge Interval; Impulse-OFF
- = Single Shot; Pulse Former
- = Flasher - ON Time First; Recycling Equal Times - ON First
- = Flasher - OFF Time First; Recycling Equal Times - OFF First
- = Recycling - Unequal Times; Pulse Generator
- = Recycling - Unequal Times Starting with ON or OFF
- = Recycling - Unequal Times Starting with OFF or ON
- = Delay-on-Make and Interval; Single Pulse Generator
Description
The TRDU Series is a versatile universal time delay relay with 21 selectable single and dual functions. The dual functions replace up to three timers required to accomplish the same function. Both the function and the timing range are selectable with switches located on the face of the unit. Two LED's indicate input voltage and output status. This device offers full 10A isolated relay output contacts in either SPDT or DPDT. The TRDU replaces hundreds of part numbers, thereby, reducing your stock inventory requirements.

21 Functions
Five switches are provided to set one of 10 single or 11 dual modes of operation.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 timing functions</td>
<td>Replace hundreds of parts and reduce stocking requirements</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.1%</td>
</tr>
<tr>
<td>User selectable time delay</td>
<td>Timing settings are switch selectable 0.1s - 1,705h in eight ranges for added flexibility</td>
</tr>
<tr>
<td>Isolated 10A, SPDT or DPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>LED indicators</td>
<td>Provides visual indication of input voltage and relay status</td>
</tr>
</tbody>
</table>

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

NDS-11 11-pin Socket
11-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

PSC8 or PSC11 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use PSC8 with NDS-8 Octal Socket or PSC11 with NDS-11 Socket. Sold in sets of two.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

If you don’t find the part you need, call us for a custom product 800-843-8848

*Limited to 8 operating functions in 8-pin DPDT units.
**Specifications**

**Time Delay**
- **Type**: Microcontroller
- **Range**: Switch Selectable**
  - Single Functions: 0.1s - 1,705h in 8 ranges
  - Dual Functions: 0.1s - 3,100m each in 8 ranges
- **Adjustments**: Multiplier: 3 position DIP switches select
  - 0.1, 1, 10, or 100 in s or m
- **Setting Accuracy**: ±1% or 50ms, whichever is greater
- **Repeat Accuracy**: ±0.1% or 20ms, whichever is greater
- **Timing Functions**: Five switches are provided to set one of twenty-one single or dual functions
  - ≤ 50ms
  - 120VAC: 75ms
- **Reset Time**: ≤ 50ms
- **Initiate Time**: 120VAC: 75ms
- **Time Delay vs Temp. & Voltage**: ±1%

**Indication**
1) Input voltage applied 2) Output relay status

**Input**
- **Voltage**: 12VDC, 24VAC/DC, 120VAC, or 230VAC
- **Tolerance**: 12VDC & 24VAC/DC: -15% - 20%; 120 & 230VAC: -20% - 10%
- **AC Line Frequency**: 50/60Hz
- **Power Consumption**: 24 to 230V ≤ 3W; 12VDC ≤ 2W

**Output**
- **Type**: Electromechanical relay
- **Form**: SPDT or DPDT
- **Rating**: 10A resistive @ 120/240VAC & 28 VDC; 1/3 hp @ 120/240VAC
- **Life**: Mechanical – 1 x 10⁷; Electrical – 1 x 10⁴

**Protection**
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected
- **Mechanical Mounting**: Plug-in socket
  - H 76.7 mm (3.1”); W 60.7 mm (2.39”); D 45.2 mm (1.87”)
- **Operating/Storage Temperature**: -20° to 65°C / -40° to 85°C
- **Weight**: ≅ 5.8 oz (164 g)

**Function Diagrams**

**Single Functions**
- DELAY-ON-MAKE / INTERVAL
- DELAY-ON-MAKE / SINGLE SHOT
- DELAY-ON-BREAK
- DELAY-ON-MAKE / RECYCLE

**Dual Functions**
- DELAY-ON-MAKE / DELAY-ON-BREAK
- DELAY-ON-MAKE / RECYCLE
- DELAY-ON-MAKE / INTERVAL

**Legend**
- V = Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- = Undefined

---

For CE approved applications, power must be removed from the unit when a switch position is changed.
Time Delay Relays
Multifunction

TRDU SERIES

Single Functions

<table>
<thead>
<tr>
<th>Function Description</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAILING EDGE SINGLE SHOT (IMPULSE-OFF)</td>
<td><img src="TRDU_Single_TRailing_1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>INVERTED SINGLE SHOT</td>
<td><img src="TRDU_Single_Inverted_1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>INVERTED DELAY-ON-BREAK</td>
<td><img src="TRDU_Single_Inverted_Delay_1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>RETRIGGERABLE SINGLE SHOT (MOTION DETECTOR) (PSD)</td>
<td><img src="TRDU_Single_Retriggerable_1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>ACCUMULATIVE DELAY-ON-MAKE</td>
<td><img src="TRDU_Single_Accumulative_1.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Dual Functions

<table>
<thead>
<tr>
<th>Function Description</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERVAL / RECYCLE (ON TIME FIRST)</td>
<td><img src="TRDU_Dual_INTERVAL_Recycle_1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>TRAILING EDGE SINGLE SHOT (IMPULSE-OFF)</td>
<td><img src="TRDU_Dual_TRailing_1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>INVERTED SINGLE SHOT</td>
<td><img src="TRDU_Dual_Inverted_1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>SINGLE SHOT / RECYCLE (ON TIME FIRST)</td>
<td><img src="TRDU_Dual_Single_Recycle_1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>INTERVAL / DELAY-ON-MAKE</td>
<td><img src="TRDU_Dual_INTERVAL_Delay_1.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

KEY

- **V**: Voltage
- **R**: Reset
- **S1**: Initiate Switch
- **NO**: Normally Open Contact
- **NC**: Normally Closed Contact
- **TD, TD1, TD2**: Complete Time Delay
- **t**: Partial Time Delay
- **DOM**: Delay-on-Make
- **DOB**: Delay-on-Break
- **REC**: Recycle
- **SS**: Single Shot
- **INT**: Interval
- **M**: Minutes
- **S**: Seconds
- **=**: Undefined time
- **x**: Multiplier

LEGEND

- 5 Switches for Function Selection
- 3 Switches for Time Delay Range

NOTE: The time delay range is the same for both functions when dual functions are selected.

* 9 Functions included in the 8 pin DPDT models
**Description**

The TRU Series is a multifunction, knob adjustable, Universal Time Delay Relay. It includes six of the most popular timing functions selected by a slide switch. The time delay is knob adjustable and the time delay range is switch selectable. The repeat accuracy is $+0.1\%$. Both function and time range can be selected on the top face of the unit. In addition to multifunctioning and multiple time ranges, the TRU Series features universal input voltage; 19 to 264VAC and 19 to 30VDC and full 10A output relay. The TRU Series can directly replace up to 1000 competitive time delay relay models.

**Operation**

A six position slide switch selects delay-on-make, interval, single shot, recycling (ON time first, equal recycle delays), delay-on-break, and retriggerable single shot. 8-pin DPDT base wiring is limited to delay-on-make, interval, and recycling functions. All six functions are available in the 8-pin SPDT and 11-pin DPDT versions.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy $+/-0.1%$ or $+/-20$ms, whichever is greater</td>
</tr>
<tr>
<td>6 time ranges (0.1s to 1,000m)</td>
<td>Broad range will satisfy most requirements</td>
</tr>
<tr>
<td>Knob adjustable time delay</td>
<td>Allows user to fine tune time delay based on application needs</td>
</tr>
<tr>
<td>Universal input voltage</td>
<td>Makes it versatile for use in most applications</td>
</tr>
<tr>
<td>Multifunction</td>
<td>Provides the most common standard timing functions</td>
</tr>
<tr>
<td>LED Indicators</td>
<td>Provide visual indication of input voltage and relay status</td>
</tr>
<tr>
<td>10A isolated output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>BASE WIRING</th>
<th>FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRU1</td>
<td>19 to 264VAC, 19 to 30VDC</td>
<td>8-pin DPDT</td>
<td>3</td>
</tr>
<tr>
<td>TRU2</td>
<td>19 to 264VAC, 19 to 30VDC</td>
<td>8-pin SPDT</td>
<td>6</td>
</tr>
<tr>
<td>TRU3</td>
<td>19 to 264VAC; 19 to 30VDC</td>
<td>11-pin DPDT</td>
<td>6</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 21.
**Accessories**

**BZ1 Front Panel Mount Kit**
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

**NDS-8 Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

**NDS-11 11-pin Socket**
11-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

**PSC8 or PSC11 Hold-down Clips**
Securely mounts plug-in controls in any position. Provides protection against vibration. Use PSC8 with NDS-8 Octal Socket or PSC11 with NDS-11 Socket. Sold in pairs.

**Specifications**

**Time Delay**
- **Type**: Digital integrated circuitry
- **Range**: Switch Selectable
  - 0.1s - 1000m in 6 ranges:
    1) 0.1 - 10s
    2) 1 - 100s
    3) 10 - 1000s
    4) 0.1 - 10m
    5) 1 - 100m
    6) 10 - 1000m

**Adjustments**
- **Multiplier**: 4 position DIP switch selects x0.1, x1, x10, and sec. or min.
- **Time Setting**: Onboard knob adjustment with 1 - 100 reference dial
- **Two LEDs indicate**
  - Input knob adjustment with 1 - 100 reference dial
  - Output relay status
  - ±0.1% or ±20ms, whichever is greater
  - ≤ 300ms
- **Repeat Accuracy**: ±2%

**Input**
- **Voltage - Universal**: 19 to 264VAC and 19 to 30VDC
- **Input Range**: 50/60Hz

**Output**
- **Type**: Electromechanical relay
- **Form**: SPDT or DPDT, isolated
- **Rating**: 10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
- **Mechanical**: 1 x 10³; **Electrical**: 1 x 10⁴
- **Protection**: Transient 38 joules
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Polarity**: DC units are reversed polarity protected

**Environmental**
- **Mounting**: Plug-in socket
- **Dimensions**: H 87.3 mm (3.44”); W 60.7 mm (2.39”); D 45.2 mm (1.78”)
- **Termination**: Octal 8-pin plug-in or magnal 11-pin plug-in
- **Operating/Storage Temperature**: -20° to 65°C / -30° to 85°C
- **Weight**: 6 oz (170 g)
Description

The ASQU and ASTU Series of 17.5 mm, knob adjustable, universal solid-state timers offer multiple functions, voltages, and time delay ranges. Choose one of 5 functions and 4 time delay ranges via 4 selection switches located on face of the unit. Adjustment through the time range is accomplished by an onboard knob.

The ASQU Series has quick connect terminals and the ASTU Series has terminal blocks.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal AC or DC voltage</td>
<td>Choose from 24 to 240VAC or 9 to 110VDC models</td>
</tr>
<tr>
<td>Compact 17.5mm size</td>
<td>Allows for high rail density</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / -1%</td>
</tr>
<tr>
<td>Multifunction: 5 timing functions</td>
<td>Reduce stocking requirements</td>
</tr>
<tr>
<td>Knob Adjustable Time Delay</td>
<td>Field adjustable delay ranging from 0.1s - 100m</td>
</tr>
<tr>
<td>0.7A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Mounting fasteners included</td>
<td>Each unit ships with both surface and DIN rail quick mount adapters</td>
</tr>
<tr>
<td>Watchdog circuitry</td>
<td>Self monitoring and self correcting for improved performance</td>
</tr>
</tbody>
</table>

Accessories

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect

These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P0500-178 Surface Mount Adapter

P0500-179 DIN Rail Mount Adapter

For use with the ASxx/DSxx Series timers.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>CONNECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASQUA3</td>
<td>24 to 240VAC</td>
<td>Quick Connects</td>
</tr>
<tr>
<td>ASQUD3</td>
<td>9 to 110VDC</td>
<td>Quick Connects</td>
</tr>
<tr>
<td>ASTUA3</td>
<td>24 to 240VAC</td>
<td>Terminal Blocks</td>
</tr>
<tr>
<td>ASTUD3</td>
<td>9 to 110VDC</td>
<td>Terminal Blocks</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848.

For dimensional drawing see: Appendix, page 512, Figure 22.
Specifications

Time Delay
Type Microcontroller based with ceramic resonator and watchdog circuitry
Adjustment Knob with dial; 2 switches select 1 of 4 multipliers
Range* 0.1 - 10s, 1 - 100s, 10 - 1000s, 100 - 1000m
Repeat Accuracy ±1% or ±50ms, whichever is greater
Tolerance ±2% or ±50ms, whichever is greater
(Factory Calibration)
Reset Time ≤ 300ms
Initiate Time Single Shot & Delay-on-Break: ≤ 32ms
Time Delay vs Temp. & Voltage ±2%, or ±50ms, whichever is greater
Input Voltage
AC: 24 to 240VAC; -20% - 10%
DC: 9 to 110VDC; -0% - 20% @ -25°C
9.4 to 110VDC; -0% - 20% @ -40°C
50/60Hz / ≤ 10%

AC Line Frequency/DC Ripple
Output Type Solid state
Form NO
Voltage Drop AC ≈ 2.5V @ 0.7A; DC ≈ 1.5V @ 0.7A
Protection Surge IEEE C62.41-1991 Level A
Circuitry Encapsulated
Dielectric Breakdown ≥ 2000V RMS terminals to mounting surface
Polarity DC units are reverse polarity protected
Mechanical Mounting Two base adaptors are available
DIN Rail Snap on to 32 mm DIN 1 & 35 mm DIN 3 rail
Surface Two #6 (M3.5 x 0.6) screws or quick mount fasteners
Dimensions H 76.2 mm (3.0”); W 17.52 mm (0.69”);
D 61.2 mm (2.41”)
Termination ASQU 0.25 in. (6.35 mm) male quick connect terminals
ASTU 0.197 in. (5 mm) push-on terminal blocks for up to #14 AWG (2.5 mm²) wire

Environmental Operating/Storage Temperature -40° to 60°C / -40° to 85°C
Humidity 95% relative, non-condensing
Weight ≈ 4 oz (113 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.
Description
The DSQU and DSTU Series of 17.5 mm, DIP switch adjustable, universal solid-state timers offer multiple functions, voltages, and time delay ranges. Choose one of 5 functions and 4 time delay ranges via 4 selection switches located on face of the unit. Six switches adjust the time delay through the selected range.

The DSQU Series has quick connect terminals and the DSTU Series has terminal blocks.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal AC or DC voltage</td>
<td>Choose from 24 to 240VAC or 9 to 110VDC models</td>
</tr>
<tr>
<td>Compact 17.5mm size</td>
<td>Allows for high rail density</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy ±1%</td>
</tr>
<tr>
<td>Multifunction: 5 timing functions</td>
<td>Reduce stocking requirements</td>
</tr>
<tr>
<td>DIP switch adjustable time delay</td>
<td>Field adjustable delay ranging from 0.1s - 63m</td>
</tr>
<tr>
<td>0.7A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Mounting fasteners included</td>
<td>Each unit ships with both surface and DIN rail quick mount adapters</td>
</tr>
<tr>
<td>Watchdog circuitry</td>
<td>Self monitoring and self correcting for improved performance</td>
</tr>
</tbody>
</table>

Accessories
P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P0500-178 Surface Mount Adapter
P0500-179 DIN Rail Mount Adapter
For use with the ASxx/DSxx Series timers.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>CONNECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSQUA3</td>
<td>24 - 240VAC</td>
<td>Quick Connects</td>
</tr>
<tr>
<td>DSQUD3</td>
<td>9 - 110VDC</td>
<td>Quick Connects</td>
</tr>
<tr>
<td>DSTUA3</td>
<td>24 - 240VAC</td>
<td>Terminal Blocks</td>
</tr>
<tr>
<td>DSTUD3</td>
<td>9 - 110VDC</td>
<td>Terminal Blocks</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Specifications

**Time Delay**
Type: Microcontroller based with ceramic resonator and watchdog circuitry

**Adjustment**
6 switches adjust the time delay;
2 switches select 1 of 4 multipliers

**Range**
- \( t \times 0.1s = 0.1 - 6.3s \) in 0.1s increments
- \( t \times 1s = 10 - 630s \) in 10s increments
- \( t \times 1m = 1 - 63m \) in 1ms increments

Repeat Accuracy: ±0.1% or ±20ms, whichever is greater
Setting Accuracy: ±2% or ±50ms, whichever is greater
Reset Time: ≤ 300ms
Initiate Time: Single Shot & Delay-on-Break: ≤ 32ms

t vs Temp. & Voltage: ±2% or ±50ms, whichever is greater

**Input**
Voltage:
- AC: 24 to 240VAC; -20% - 10%
- DC: 9 to 110VDC; -0% - 20% @ -25°C
- 9.4 to 110VDC; -0% - 20% @ -40°C

AC Line Frequency/DC Ripple: 50/60Hz / ≤ 10%

**Output**
Type: Solid state
Form: NO
Rating: 0.7A steady state, 10A inrush
Voltage Drop:
- AC: ≅ 2.5V @ 0.7A;
- DC: ≅ 1.5V @ 0.7A

Protection
Surge: IEEE C62.41-1991 Level A
Circuitry: Encapsulated
Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
Polarity: DC units are reverse polarity protected

**Mechanical**
Mounting:
- Two base adaptors are available
- DIN Rail: Snap on to 32 mm DIN 1 & 35 mm DIN 3 rail
Surface:
- Two #6 (M3.5 x 0.6) screws or quick mount fasteners

Dimensions:
- H 76.2 mm (3.0”);
- W 17.52 mm (0.69”);
- D 61.2 mm (2.41”)

Termination:
- DSQU: 0.25 in. (6.35 mm) male quick connect terminals
- DSTU: 0.197 in. (5 mm) push-on terminal blocks for up to #14 AWG (2.5 mm²) wire

**Environmental**
Operating/Storage Temperature: -40° to 60°C / -40° to 85°C
Humidity: 95% relative, non-condensing
Weight: ≅ 4.2 oz (119 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.
**T10 SERIES**

**Solid-State On-Delay Timer**

**Description**

The T10 Series on-delay timer is a solid-state electronic device that provides accurate and reliable timing for control circuits up to 460VAC. The T10 features a user-selectable time delay from 6 seconds to 10 minutes (0.5 to 12 seconds on the T10S400 model) and SPDT output contacts. When power is applied to the T10, it immediately begins its timing cycle. During this time, the indicator LED alternates between red and green and the output contacts remain inactive. When the timing cycle is complete, the indicator LED turns solid green and the output contacts are activated. The output contacts will remain activated until power is removed from the T10.

The SPDT contact ratings are 480V @ 240VAC on the 115V and 230V models, and 470VA @ 600VAC on the 460V model.

**Features & Benefits**

- Status LED
- 600V control relay on 460V models

**Specifications**

**Input Characteristics**

- **Frequency**: 50*/60Hz

**Functional Characteristics**

- **Timing Range**
  - T10100, T10200, T10400: 6 seconds to 10 minutes
  - T10S400: 0.5 seconds to 12 seconds

- **Repeat Accuracy**
  - Fixed Condition: ±1%

**Output Characteristics**

- **Output Contact Rating (SPDT)**
  - Pilot Duty:
    - T10100, T10200: 480VA @ 240VAC
    - T10400, T10S400: 470VA @ 600VAC

**General Characteristics**

- **Maximum Input Power**: 5 W
- **Terminal Torque**: 7 in.-lbs.
- **Wire Size**: 12-18AWG
- **Safety Marks**: UL
  - **Dimensions**: H: 74.4 mm (2.93"), W: 133.9 mm (5.27"), D: 74.9 mm (2.95")
  - **Weight**: 0.94 lb. (15.04 oz., 426.38 g)

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>T10120</td>
<td>115VAC</td>
<td>0.1 to 10 minute range, 240 VAC rated output contacts</td>
</tr>
<tr>
<td>T10200</td>
<td>230VAC</td>
<td>0.1 to 10 minute range, 240 VAC rated output contacts</td>
</tr>
<tr>
<td>T10400</td>
<td>460VAC</td>
<td>0.1 to 10 minute range, 600 VAC rated output contacts</td>
</tr>
<tr>
<td>T10S400</td>
<td>460VAC</td>
<td>0.5 to 12 second range, 600 VAC rated output contacts</td>
</tr>
</tbody>
</table>

*Note: 50Hz will increase all delay timers by 20%.

For dimensional drawing see: Appendix page 509, Figure 6.
**Description**

The ERDM Series is a combination of digital electronics and a reliable electromechanical relay. These devices offer a DPDT relay output for relay logic circuits, and isolation of input to output voltages. Cost effective for OEM applications, such as random starting, sequencing ON, switch de-bouncing, anti-short cycling, and other common delay-on-make applications.

**Operation (Delay-on-Make)**

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

**Reset**: Removing input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital integrated circuitry with electromechanical relay</td>
<td>Repeat Accuracy + / - 0.5%</td>
</tr>
<tr>
<td>Isolated 10A, DPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-16, P1004-16-XVersa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERDM123</td>
<td>12VDC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>ERDM126</td>
<td>12VDC</td>
<td>Onboard knob</td>
<td>0.6 - 60s</td>
</tr>
<tr>
<td>ERDM128</td>
<td>12VDC</td>
<td>Onboard knob</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>ERDM222</td>
<td>24VAC</td>
<td>Onboard knob</td>
<td>0.1 - 5s</td>
</tr>
<tr>
<td>ERDM410S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>30s</td>
</tr>
<tr>
<td>ERDM4210</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>1 - 100m</td>
</tr>
</tbody>
</table>

- **ERDM422**
  120VAC
  Onboard knob
  0.1 - 5s

- **ERDM423**
  120VAC
  Onboard knob
  0.1 - 10s

- **ERDM425**
  120VAC
  Onboard knob
  0.3 - 30s

- **ERDM427**
  120VAC
  Onboard knob
  0.1 - 5m

- **ERDM429**
  120VAC
  Onboard knob
  0.2 - 15m

If you don’t find the part you need, call us for a custom product 800-843-8848

© 2023 Littelfuse, Inc.
Time Delay Relays
Dedicated — Delay-on-Make

Specifications

| Time Delay | Type | Digital integrated circuitry |
| Range | 0.1s - 500m in 11 adjustable ranges or 0.1s - 1000m fixed |
| Adjustment | Fixed, onboard or external adjust |
| Repeat Accuracy | ±0.5% |
| Tolerance | ≤ ±10% |
| Recycle Time | ≤ 150ms |
| Time Delay vs Temp. & Voltage | ≤ ±2% |
| Input Voltage | 12, 24, or 120VDC; 24, 120, or 230VAC |
| Tolerance | 12VDC & 24VDC/AC -15% - 20%; 120VAC/DC & 230VAC -20% - 10% |
| AC Line Frequency | 50/60 Hz |
| Output Type | Isolated relay contacts |
| Form | DPDT |
| Rating | 10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC |
| Life | Mechanical - 1 x 10⁷; Full Load - 1 x 10⁶ |
| Protection Isolation Voltage | ≥1500V RMS input to output |
| Insulation Resistance | ≥100 MΩ |
| Polarity | DC units are reverse polarity protected |
| Mechanical | Surface mount with two #6 (M3.5 x 0.6) screws |
| Mounting | Dimensions | H 88.9 mm (3.5”); W 63.5 mm (2.5”); D 43.2 mm (1.7”) |
| Termination | 0.25 in. (6.35 mm) male quick connect terminals |
| Environmental Operating/Storage Temperature | -40° to 65°C / -40° to 85°C |
| Weight | ≅ 5.7 oz (162 g) |

Selection Guides

<table>
<thead>
<tr>
<th>Rₜ Selection Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired Time Delay*</td>
</tr>
<tr>
<td>Seconds</td>
</tr>
<tr>
<td>Megam</td>
</tr>
<tr>
<td>0.01</td>
</tr>
<tr>
<td>0.02</td>
</tr>
<tr>
<td>0.03</td>
</tr>
<tr>
<td>0.04</td>
</tr>
<tr>
<td>0.05</td>
</tr>
<tr>
<td>0.06</td>
</tr>
</tbody>
</table>

* When selecting an external Rₜ add at least 20% for tolerance of unit and the Rₜ;

<table>
<thead>
<tr>
<th>Rₜ Selection Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired Time Delay*</td>
</tr>
<tr>
<td>Minutes</td>
</tr>
<tr>
<td>Megam</td>
</tr>
<tr>
<td>0.01</td>
</tr>
<tr>
<td>0.02</td>
</tr>
<tr>
<td>0.03</td>
</tr>
<tr>
<td>0.04</td>
</tr>
<tr>
<td>0.05</td>
</tr>
<tr>
<td>0.06</td>
</tr>
</tbody>
</table>

* When selecting an external Rₜ add at least 20% for tolerance of unit and the Rₜ;

Function Diagram

V = Voltage  
NO = Normally Open Contact  
NC = Normally Closed Contact  
TD = Time Delay  
R = Reset  
= Undefined Time
**HRDM SERIES**

**Delay-on-Make Timer**

**Description**

The HRDM Series combines an electromechanical relay output with microcontroller timing circuitry. It offers 12 to 230V operation in five ranges and factory fixed, onboard, or external adjustable time delays with a repeat accuracy of ±0.5%. The output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blower motors, heaters, etc. This series is ideal for OEM applications where cost is a factor.

**Operation (Delay-on-Make)**

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Isolated, 30A, SPDT, NO output contacts</td>
<td>Allows direct operation of heavy loads: compressors, pumps, blower motors, heaters.</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRDM120</td>
<td>12VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>HRDM312S</td>
<td>24VDC</td>
<td>Fixed</td>
<td>12s</td>
</tr>
<tr>
<td>HRDM413M</td>
<td>120VAC</td>
<td>Fixed</td>
<td>3m</td>
</tr>
<tr>
<td>HRDM415M</td>
<td>120VAC</td>
<td>Fixed</td>
<td>5m</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 17.
External Resistance vs. Time Delay

<table>
<thead>
<tr>
<th>Resistance (kΩ)</th>
<th>Time Delay (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>25</td>
<td>0.1</td>
</tr>
<tr>
<td>50</td>
<td>0.25</td>
</tr>
<tr>
<td>75</td>
<td>0.5</td>
</tr>
<tr>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>125</td>
<td>2</td>
</tr>
<tr>
<td>150</td>
<td>5</td>
</tr>
<tr>
<td>175</td>
<td>10</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
</tr>
<tr>
<td>225</td>
<td>50</td>
</tr>
<tr>
<td>250</td>
<td>75</td>
</tr>
<tr>
<td>275</td>
<td>100</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the Rt terminals; as the resistance increases, the time delay increases. When selecting an external Rt, add the tolerances of the timer and the Rt for the full time range adjustment.

Examples: 1. To delay 5 s, select time delay range 1 and a 50 kΩ resistor. For 1 to 100 s use a 100 kΩ resistor.

Specifications

**Time Delay**
- **Type**: Microcontroller circuitry
- **Range**: 0.1s - 100ms in 5 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5% or 20 ms, whichever is greater
- **Tolerance (Factory Calibration)**: ±1%, ±5%
- **Reset Time**: ≤ 150ms
- **Time Delay vs Temp. & Voltage**: ±2%

**Input**
- **Voltage**: 12 or 24 VDC; 24, 120, or 230 VAC
- **Tolerance**: -15% - 20% 24 to 230 VAC
- **AC Line Frequency**: 50/60 Hz
- **Power Consumption**: AC ≤ 4VA; DC ≤ 2W

**Output**
- **Type**: Electromechanical relay
- **Form**: Non-isolated, SPDT
- **Ratings**
  - **General Purpose**: 125/240 VAC - 30A / 15A
  - **Resistive**: 125/240 VAC - 30A / 15A
  - **28 VDC**: 10A
  - **Motor Load**: 125 VAC - 1 hp / 1/4 hp**
  - **240 VAC**: 2 hp**

**Life**
- **Mechanical**: 1 x 10⁶ cycles
- **Electrical**: 1 x 10⁶ cycles; *3 x 10⁴ cycles; **6,000 cycles

**Protection**
- **Surge**: IEEE C62.41-1991 Level A
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: 3 x 2 x 1.5 in. (76.7 x 51.3 x 38.1mm)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- **Operating/Storage Temperature**: -40° to 60°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ~ 3.9 oz (111 g)
**Time Delay Relays**

**Dedicated — Delay-on-Make**

**KRDM SERIES**

**Description**

The KRDM Series is a compact time delay relay measuring only 2 in. (50.8 mm) square. Its solid-state timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDM Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

**Operation (Delay-on-Make)**

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

**P1004-95, P1004-95-X Versa-Pot**

Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

**P1023-6 Mounting bracket**

The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P0700-7 Versa-Knob**

Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**Wiring Diagram**

![Wiring Diagram](image)

V = Voltage  
C = Common, Transfer Contact  
NO = Normally Open  
NC = Normally Closed

A knob is supplied for adjustable units, or RT terminals 4 & 5 for external adjust. See external adjustment vs time delay chart. Relay contacts are isolated.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRDM1110S</td>
<td>12VDC</td>
<td>Fixed</td>
<td>10s</td>
</tr>
<tr>
<td>KRDM130S</td>
<td>12VDC</td>
<td>Fixed</td>
<td>30s</td>
</tr>
<tr>
<td>KRDM120</td>
<td>12VDC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDM121</td>
<td>12VDC</td>
<td>Onboard knob</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>KRDM2110M</td>
<td>24VAC/DC</td>
<td>Fixed</td>
<td>10m</td>
</tr>
<tr>
<td>KRDM215M</td>
<td>24VAC/DC</td>
<td>Fixed</td>
<td>5m</td>
</tr>
<tr>
<td>KRDM220</td>
<td>24VAC/DC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDM221</td>
<td>24VAC/DC</td>
<td>Onboard knob</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>KRDM223</td>
<td>24VAC/DC</td>
<td>Onboard knob</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>KRDM310.2S</td>
<td>24VDC</td>
<td>Fixed</td>
<td>0.2s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRDM4110M</td>
<td>120VAC</td>
<td>Fixed</td>
<td>10m</td>
</tr>
<tr>
<td>KRDM4110S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>10s</td>
</tr>
<tr>
<td>KRDM4145S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>45s</td>
</tr>
<tr>
<td>KRDM420</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDM421</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>KRDM424</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>1 - 100m</td>
</tr>
<tr>
<td>KRDM430</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDM433</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>KRDM6115M</td>
<td>230VAC</td>
<td>Fixed</td>
<td>15m</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

© 2023 Littelfuse, Inc.

Littelfuse.com/krdm
**Accessories**

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Specifications**

**Time Delay**
- Range: 0.1s - 100m in 5 adjustable ranges or fixed
- Repeat Accuracy: ±0.5% or 20ms, whichever is greater
- Tolerance: ≤ ±5%

**Input**
- Voltage Tolerance: 12, 24 or 110VDC; 24, 120 or 230VAC
- AC Line Frequency/DC Ripple: ≤ 150ms
- Power Consumption: AC ≤ 2VA; DC ≤ 2W

**Output**
- Type: Isolated relay contacts
- Form: SPDT
- Rating (at 40°C): 10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
- Max. Switching Voltage: 250VAC
- Life (Operations): Mechanical - 1 x 10⁷; Electrical - 1 x 10⁵

**Protection**
- Circuitry: Encapsulated
- Isolation Voltage: ≥ 1500V RMS input to output
- Insulation Resistance: ≥ 100 MΩ
- Polarity: DC units are reverse polarity protected
- Mechanical: Surface mount with one #10 (M5 x 0.8) screw
- Mounting: H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 30.7 mm (1.21”)
- Dimensions: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- Operating/Storage Temperature: -20° to 60°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≅ 2.6 oz (74 g)

**Function Diagram**

- V = Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- = Undefined Time
KRPS SERIES

Description
The KRPS Series is a factory programmed time delay relay available with 1 of 15 functions and measures only 2 inches square. The KRPS offers a wide range of fixed, onboard, or externally adjustable time delays. The output relay contacts offer a full 10A rating with complete isolation. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRPS Series is a cost effective approach for OEM applications that require small size, isolation, accuracy, and long life. Special time ranges and functions are available.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/ - 0.5%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Isolated, SPDT, 10A output</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16)**
  Female Quick Connect
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

For dimensional drawing see: Appendix, page 512, Figure 16.
**Specifications**

**Time Delay**
- **Type:** Microcontroller circuitry
- **Range:** 0.1s - 1000h in 9 adjustable ranges or fixed
- **Repeat Accuracy:** ±0.5% or 20ms, whichever is greater
- **Tolerance**
  - (Factory Calibration): ≤ ±2%
  - **Reset Time:** ≤ 150ms
  - **Initiate Time:** ≤ 40ms; ≤ 750 operations per minute
  - **Time Delay vs Temp. & Voltage:** ≤ ±2%

**Input**
- **Voltage**
  - 12 to 48VDC; 24 to 240VAC/DC
- **Tolerance**
  - 12 to 48VDC: -15% - 20%
  - 24 to 240VAC/DC: -20% - 10%
- **AC Line Frequency/DC Ripple:** 50/60Hz / ≤ 10%

**Output**
- **Type:** Isolated relay contacts
- **Form:** SPDT
- **Rating (at 40°C):**
  - 10A resistive @ 125VAC
  - 5A resistive @ 230VAC & 28VDC
  - 1/4 hp @ 125VAC
- **Max. Switching Voltage:** 250VAC
- **Life (Operations):** Mechanical - 1 x 10⁷; Electrical - 1 x 10⁵

**Protection**
- **Circuitry:** Encapsulated
- **Isolation Voltage:** ≥ 1500V RMS input to output
- **Insulation Resistance:** ≥ 100 MΩ
- **Polarity:** DC units are reverse polarity protected
- **Mounting:** Surface mt. with one #10 (M5 x 0.8) screw
- **Dimensions:** H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 30.7 mm (1.21”)
- **Termination:** 0.25 in. (6.35 mm) male quick connects
- **Operating/Storage Temperature:** -40° to 60°C / -40° to 85°C
- **Humidity:** 95% relative, non-condensing
- **Weight:** ≈ 2.6 oz (74 g)

**Output Current/Ambient Temperature**

**Timer Functions**

**Operation (Delay-on-Make)**
Upon application of the input voltage, the dime delay begins. The output relay is de-energized before and during the time delay. At the end of the time delay, the put energizes and remains energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and output.

**Operation (Delay-on-Break)**
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Re-closing the initiate switch during timing resets the time delay. Removing input voltage resets the time delay and output.

**Operation (Recycling)**
Upon application of input voltage, the output relay energizes and the ON time begins. At the end of the ON time, the output de-energizes and the OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

**Reset:** Removing input voltage resets the output and time delays, and returns the sequence to the first delay.
Operation (Alternating)
Input voltage must be applied at all times for proper operation. The operation begins with the output relay de-energized. Closing S1 enables the next alternating operation. When S1 opens (trailing edge triggered), the time delay begins. At the end of the time delay, the output energizes and remains energized until S1 is (re-closed and) re-opened. Then the output relay de-energizes and remains until S1 opens again. Each time S1 opens the time delay occurs and the output transfers.
Reset: Removing input voltage resets the output and the time delay.

Operation (Single Shot)
Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output (relay or solid state) energizes and the time delay begins. At the end of the delay, the output de-energizes. Opening or re-closing the initiate switch during timing has no effect on the time delay. Note (for most single shot timers): If the initiate switch is closed when input voltage is applied, the output energizes and the time delay begins.
Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Removing input voltage resets the time delay and output.

Operation (Retriggerable Single Shot, Motion Detector)
Input voltage must be applied prior to and during timing. The output relay is de-energized. When the initiate switch S1 closes momentarily or maintained, the output energizes and the time delay begins. Upon completion of the delay, the output de-energizes. Reset: Re-closing S1 resets the time delay and restarts timing. Removing input voltage resets the time delay and output.

Operation (Trailing Edge Single Shot, Impulse-OFF)
Input voltage must be applied before and during timing. When the initiate switch S1 opens, the output relay energizes. At the end of the time delay, the output de-energizes. Re-closing and opening S1 during timing has no affect on the time delay. The output will not energize if S1 is open when input voltage is applied.
Reset: Reset occurs when the time delay is complete and S1 is closed. Removing input voltage resets the time delay and output.

**Legend**

- **V** = Voltage
- **R** = Reset
- **T1** = ON Time
- **T2** = OFF Time
- **S1** = Initiate Switch
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **t** = Incomplete Time Delay
- **TD, TD1, TD2** = Time Delay
- **C** = Count
- **P** = Pulse Duration
- **—** = Undefined Time
KSD1 SERIES
Delay-on-Make Timer

Description
The KSD1 Series features two-terminal, series-connection with the load. The KSD1 Series is an ideal choice for delay-on-make timing applications. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for popular AC and DC voltages. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%, + / -5% time delay accuracy</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A Steady solid-state output, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16)**
  **Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSD11120S</td>
<td>12VDC</td>
<td>Fixed</td>
<td>20s</td>
</tr>
<tr>
<td>KSD1123</td>
<td>12VDC</td>
<td>External</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>KSD1230</td>
<td>24VAC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KSD1320</td>
<td>24VDC</td>
<td>External</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KSD1412S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>2s</td>
</tr>
<tr>
<td>KSD14130S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>30s</td>
</tr>
<tr>
<td>KSD1420</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KSD16130S</td>
<td>230VAC</td>
<td>Fixed</td>
<td>30s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
KSD1 SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

In Secs. or Mins.

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the time delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm R_T. For 1 to 100 S use a 100 K ohm R_T.

Specifications

Time Delay
- Range: 0.1s - 1000m in 6 adjustable ranges or fixed
- Repeat Accuracy: ±0.5% or 20ms, whichever is greater
- Tolerance: ≤ ±5%
- Recycle Time: ≤ 150ms
- Time Delay vs. Temperature & Voltage: ≤ ±10%

Input
- Voltage: 24, 120, or 230VAC; 12 or 24VDC
- Tolerance: ≤ ±20%
- AC Line Frequency: 50/60 Hz

Output
- Type: Solid state
- Form: NO, open during timing
- Maximum Load Current: 1A steady state, 10A inrush at 60°C
- Minimum Holding Current: ≤ 40mA
- OFF State Leakage Current: ≅ 7mA @ 230VAC
- Voltage Drop: ≅ 2.5V @ 1A

Protection
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ
- Polarity: DC units are reverse polarity protected

Mechanical
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

Environmental
- Operating/Storage Temperature: -40° to 60°C / -40° to 85°C
- Humidity: 95% relative, non-condensing

Weight
- 2.4 oz (68 g)
KSDU SERIES

Time Delay Relays
Dedicated — Delay-on-Make

Description
The KSDU Series are encapsulated solid-state, delay-on-make timers that combine digital timing circuitry with universal voltage operation. The KSDU Series is factory fixed from 0.1s to 10,230s and does not include the DIP switch. These series are excellent choices for process control systems and OEM equipment.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal Voltage</td>
<td>24 to 240VAC/DC in 2 ranges</td>
</tr>
<tr>
<td>Digital Integrated Circuitry</td>
<td>Repeat accuracy + / - 5%</td>
</tr>
<tr>
<td>1A Steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>2 terminal design</td>
<td>Provides series connection for easy installation</td>
</tr>
</tbody>
</table>

Accessories

**P1023-6 Mounting bracket**
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P1015-64 (AWG 14/16) Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

For dimensional drawing see: Appendix, page 512, Figure 16.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSDU8120</td>
<td>24 to 120VAC/DC</td>
<td>Fixed</td>
<td>20s</td>
</tr>
<tr>
<td>KSDU811200</td>
<td>24 to 120VAC/DC</td>
<td>Fixed</td>
<td>1200s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848.
# Specifications

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>Digital integrated circuitry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>Range*</td>
<td>Fixed from 0.1s - 10230s</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±0.5% or 20ms, whichever is greater</td>
</tr>
<tr>
<td>Tolerance (Factory Calibration)</td>
<td>±10%</td>
</tr>
<tr>
<td>Recycle Time</td>
<td>≤150ms</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage</td>
<td>≤5%</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>24 to 120VAC/DC; 100 to 240VAC/DC</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Tolerance</td>
<td>±20%</td>
</tr>
<tr>
<td>Output Type</td>
<td>Solid state</td>
</tr>
<tr>
<td>Form</td>
<td>NO, open during timing</td>
</tr>
<tr>
<td>Maximum Load Current</td>
<td>1A steady state, 10A inrush at 60°C</td>
</tr>
<tr>
<td>Minimum Holding Current</td>
<td>40mA</td>
</tr>
<tr>
<td>Voltage Drop</td>
<td>≅ 2.5V @ 1A</td>
</tr>
<tr>
<td>Protection</td>
<td>Encapsulated</td>
</tr>
<tr>
<td>Circuitry Dielectric Breakdown</td>
<td>≥ 2000V RMS terminals to mounting surface</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>≥100 MΩ</td>
</tr>
<tr>
<td>Mechanical Mounting</td>
<td>Surface mount with one #10 (M5 x 0.8) screw</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 30.7 mm (1.21”)</td>
</tr>
<tr>
<td>Termination</td>
<td>0.25 in. (6.35 mm) male quick connect terminals</td>
</tr>
<tr>
<td>Environmental Operating/Storage Temperature</td>
<td>-40° to 60°C / -40° to 85°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>95% relative, non-condensing</td>
</tr>
<tr>
<td>Weight</td>
<td>≅ 2.4 oz (68 g)</td>
</tr>
</tbody>
</table>

* For CE approved applications, power must be removed from the unit when a switch position is changed.

## Function Diagram

![Function Diagram](image)

- V = Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- = Undefined Time
**KSPS SERIES**

**Description**

The KSPS Series is a factory programmed module available in any 1 of 14 standard functions. The KSPS Series offers a single, fixed, externally or onboard adjustable time delay. The 1A steady, 10A inrush rated solid-state output provides 100 million operations typical. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KSPS Series is a cost effective approach for OEM applications that require small size and solid state reliability.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSPS2180SB</td>
<td>24VAC</td>
<td>Fixed</td>
<td>80s</td>
<td>Delay-on-Break</td>
</tr>
<tr>
<td>KPSA21FT</td>
<td>24 - 240VAC, positive switching</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Recycling, On Time First</td>
</tr>
<tr>
<td>KPSN13MI</td>
<td>12 - 120VDC, negative switching</td>
<td>Fixed</td>
<td>3m</td>
<td>Interval</td>
</tr>
<tr>
<td>KPSN21B</td>
<td>12 - 120VDC, negative switching</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Delay-on-Break</td>
</tr>
<tr>
<td>KSPSP145SM</td>
<td>12 - 120VDC, positive switching</td>
<td>Fixed</td>
<td>45s</td>
<td>Delay-on-Make</td>
</tr>
<tr>
<td>KSPSP22B</td>
<td>12 - 120VDC, positive switching</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>Delay-on-Break</td>
</tr>
<tr>
<td>KSPSP35PSD</td>
<td>12 - 120VDC, positive switching</td>
<td>External</td>
<td>1 - 100m</td>
<td>Retriggerable Single Shot</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
### Accessories

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### Specifications

**Time Delay**

<table>
<thead>
<tr>
<th>Type</th>
<th>Microcontroller circuitry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0.1s - 1000h in 9 adjustable ranges or fixed</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±0.5% or 20ms, whichever is greater</td>
</tr>
<tr>
<td>(Factory Calibration)</td>
<td>≤ ±2%</td>
</tr>
<tr>
<td>Reset Time</td>
<td>≤ 150ms</td>
</tr>
<tr>
<td>Initiate Time</td>
<td>≤ 20ms; ≤ 1500 operations per minute</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage</td>
<td>≤ ±2%</td>
</tr>
</tbody>
</table>

**Input**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>12 to 120VDC; 24 to 240VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>≤ ±15%</td>
</tr>
<tr>
<td>AC Line Frequency/DC Ripple</td>
<td>50/60Hz / ≤ 10%</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>AC ≤ 2VA; DC ≤ 1W</td>
</tr>
</tbody>
</table>

**Output**

<table>
<thead>
<tr>
<th>Type</th>
<th>Solid-state output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating</td>
<td>1A steady, 10A inrush for 16ms</td>
</tr>
<tr>
<td>Voltage Drop</td>
<td>AC = 2.5V @ 1A; DC = 1V @ 1A</td>
</tr>
<tr>
<td>OFF State Leakage Current</td>
<td>AC = 5mA @ 240VAC, DC = 1mA</td>
</tr>
</tbody>
</table>

**Protection**

<table>
<thead>
<tr>
<th>Circuitry</th>
<th>Encapsulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dielectric Breakdown</td>
<td>≥ 2000V RMS terminals to mounting surface</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>≥ 100 MΩ</td>
</tr>
<tr>
<td>Polarity</td>
<td>DC units are reverse polarity protected</td>
</tr>
</tbody>
</table>

**Mechanical**

| Mounting Width        | 50.8 mm (2.0"); Height = 50.8 mm (2.0") |
| Dimensions            | 30.7 mm (1.21") |
| Termination            | 0.25 in. (6.35 mm) male quick connects |

**Operating/Storage**

| Temperature           | -40° to 60°C / -40° to 85°C |
| Humidity              | 95% relative, non-condensing |
| Weight                | 2.4 oz (68 g) |

### Timer Functions

**Operation (Delay-on-Make)**

Upon application of the input voltage, the time delay begins. The output relay is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and output.

**Operation (Delay-on-Break)**

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Re-closing the initiate switch during timing resets the time delay. Removing input voltage resets the time delay and output.

**Operation (Recycling)**

Upon application of input voltage, the output relay energizes and the ON time begins. At the end of the ON time, the output de-energizes and the OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

**Reset:** Removing input voltage resets the output and time delays, and returns the sequence to the first delay.
Operation (Alternating)
Input voltage must be applied at all times for proper operation. The operation begins with the output relay de-energized. Closing S1 enables the next alternating operation. When S1 opens (trailing edge triggered), the time delay begins. At the end of the time delay, the output energizes and remains energized until S1 is (re-closed and) re-opened. Then the output relay de-energizes and remains until S1 opens again. Each time S1 opens the time delay occurs and the output transfers.

Reset: Removing input voltage resets the output and the time delay.

Operation (Single Shot)
Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output (relay or solid state) energizes and the time delay begins. At the end of the delay, the output de-energizes. Opening or re-closing the initiate switch during timing has no effect on the time delay. Note (for most single shot timers): If the initiate switch is closed when input voltage is applied, the output energizes and the time delay begins.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Removing input voltage resets the time delay and output.

Operation (Trailing Edge Single Shot, Impulse-OFF)
Input voltage must be applied before and during timing. When the initiate switch S1 opens, the output relay energizes. At the end of the time delay, the output de-energizes. Re-closing and opening S1 during timing has no affect on the time delay. The output will not energize if S1 is open when input voltage is applied.

Reset: Reset occurs when the time delay is complete and S1 is closed. Removing input voltage resets the time delay and output.

Operation (Inverted Single Shot)
Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch S1, the output relay de-energizes. At the end of the time delay, the output energizes. Opening or re-closing S1 during timing has no affect on the time delay. The output will remain de-energized if S1 is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and S1 is open. Removing input voltage resets the time delay and output.

Operation (Interval)
Upon application of input voltage, the time delay begins. The output (relay or solid state) energizes during the time delay. At the end of time delay the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

LEGEND

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Voltage</td>
</tr>
<tr>
<td>R</td>
<td>Reset</td>
</tr>
<tr>
<td>T1</td>
<td>ON Time</td>
</tr>
<tr>
<td>T2</td>
<td>OFF Time</td>
</tr>
<tr>
<td>S1</td>
<td>Initiate Switch</td>
</tr>
<tr>
<td>NO</td>
<td>Normally Open Contact</td>
</tr>
<tr>
<td>NC</td>
<td>Normally Closed Contact</td>
</tr>
<tr>
<td>C</td>
<td>Count</td>
</tr>
<tr>
<td>P</td>
<td>Pulse Duration</td>
</tr>
<tr>
<td>t</td>
<td>Incomplete Time Delay</td>
</tr>
<tr>
<td>TD</td>
<td>Time Delay</td>
</tr>
<tr>
<td>TD1,TD2</td>
<td>Time Delay</td>
</tr>
<tr>
<td>Undefined Time</td>
<td></td>
</tr>
</tbody>
</table>
### Description

The MSM Series replaces bi-metal type timing with reliable solid-state circuitry. There are no moving parts to arc or wear. It is a cost effective solution for OEM designers. It is available for printed circuit board mounting or surface mounting with a removable bracket and wire leads. The MSM Series offers immediate reset on removal of power.

### Operation (Delay-on-Make)

The time delay begins upon application of input voltage. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

### Reset:

Removing input voltage resets the time delay and output.

### Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry</td>
<td>Repeat Accuracy + / - 5%, Factory calibration + / - 15%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Long life</td>
<td>No moving parts to arc or wear</td>
</tr>
<tr>
<td>PCB or wire harness</td>
<td>Offers design and installation flexibility</td>
</tr>
<tr>
<td>Immediate reset</td>
<td>Occurs on removal of power</td>
</tr>
<tr>
<td>Totally Encapsulated</td>
<td>Protects against shock, vibration and humidity</td>
</tr>
</tbody>
</table>

### Wiring Diagram

- **V**: Voltage
- **L**: Load
- **R**: Red Wire
- **B**: Black Wire

V = Voltage
L = Load
R = Red Wire
B = Black Wire

For dimensional drawing see: Appendix, page 514, Figure 39.

### Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>WIRE TYPE</th>
<th>WIRE LENGTH inches (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSM10.5W6</td>
<td>12VDC</td>
<td>Fixed</td>
<td>0.5s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM10.7W6</td>
<td>12VDC</td>
<td>Fixed</td>
<td>0.7s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM11W6</td>
<td>12VDC</td>
<td>Fixed</td>
<td>1s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM110W6</td>
<td>12VDC</td>
<td>Fixed</td>
<td>10s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM130W9</td>
<td>12VDC</td>
<td>Fixed</td>
<td>30s</td>
<td>Standard Lead</td>
<td>9.0 (228.6)</td>
</tr>
<tr>
<td>MSM190W6</td>
<td>12VDC</td>
<td>Fixed</td>
<td>90s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM20.15W9</td>
<td>24VAC</td>
<td>Fixed</td>
<td>0.15s</td>
<td>Standard Lead</td>
<td>9.0 (228.6)</td>
</tr>
<tr>
<td>MSM210P3</td>
<td>24VAC</td>
<td>Fixed</td>
<td>10s</td>
<td>PC Mount</td>
<td>0.5 (12.7)</td>
</tr>
<tr>
<td>MSM25W9</td>
<td>24VAC</td>
<td>Fixed</td>
<td>5s</td>
<td>Standard Lead</td>
<td>9.0 (228.6)</td>
</tr>
<tr>
<td>MSM30.7W6</td>
<td>24VDC</td>
<td>Fixed</td>
<td>0.7s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM42W6</td>
<td>120VAC</td>
<td>Fixed</td>
<td>2s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM43W6</td>
<td>120VAC</td>
<td>Fixed</td>
<td>3s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM420W6</td>
<td>120VAC</td>
<td>Fixed</td>
<td>20s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
<tr>
<td>MSM450W6</td>
<td>120VAC</td>
<td>Fixed</td>
<td>50s</td>
<td>Standard Lead</td>
<td>6.0 (152.4)</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
**Specifications**

**Time Delay**
- **Type**: Analog Circuitry
- **Range**: 0.05 - 180s fixed
- **Repeat Accuracy**: ±5%
- **Tolerance**:
  - **(Factory Calibration)**: ±15%
  - **Recycle Time**: ≤ 75ms
  - **Time Delay vs Temp. & Voltage**: ±15%

**Input**
- **Voltage**: 12 or 24VDC; 24, 120, or 230VAC
- **Tolerance**: ±10%
- **AC Line Frequency**: 50/60 Hz

**Output**
- **Type**: Solid State
- **Form**: NO, open during timing
- **Maximum Load Current**: 0.5A steady state 25°C; 0.25A steady state 60°C
- **Minimum Holding Current**: 40mA
- **Voltage Drop**: ≅ 2.5V @ 0.5A

**Protection**
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS input to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected

**Mechanical**
- **Mounting**:
  - **A.) PC mount**: 14 AWG (2.087mm²) wires
    - (Can be inserted in AMP Miniature Spring Socket #645980-1)
  - **B.) Stranded**: 18 AWG wire leads (0.933 mm²)
    - with mounting bracket

**Environmental**
- **Operation/Storage**
  - **Temperature**: -20° to 60°C / -30° to 85°C
  - **Humidity**: 95% relative, non-condensing
- **Weight**:
  - **P**: ≅ 1.1 oz (31.2 g)
  - **W**: ≅ 1.2 oz (34 g)
Description
The ORM Series features open PC board construction for reduced cost. It has isolated, 10A, DPDT relay contacts and all connections are 0.25 in (6.35 mm) male quick connect terminals. The time delay may be ordered as factory fixed, onboard knob, or external adjustment. Time delays from 0.05 - 300 seconds.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry with electromechanical relay</td>
<td>Repeat Accuracy +/- 2%</td>
</tr>
<tr>
<td>Isolated 10A, DPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Open PCB construction</td>
<td>Reduces cost for OEM applications</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-12, P1004-12-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16)**
  Female Quick Connect
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORM120A17</td>
<td>120VAC</td>
<td>Fixed</td>
<td>7s</td>
</tr>
<tr>
<td>ORM120A25</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>3 - 300s</td>
</tr>
<tr>
<td>ORMZ30A17</td>
<td>230VAC</td>
<td>Fixed</td>
<td>7s</td>
</tr>
<tr>
<td>ORM24D13.5</td>
<td>24VDC/28VDC</td>
<td>Fixed</td>
<td>3.5s</td>
</tr>
<tr>
<td>ORM24D22</td>
<td>24VDC</td>
<td>Onboard knob</td>
<td>0.5 - 30s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
**Specifications**

**Time Delay**

Type: Analog circuitry

Range: 0.05 - 300s in 5 adjustable ranges or fixed

Repeat Accuracy: ±2% or 20ms, whichever is greater

Tolerance: Adjustable: guaranteed range

Recycle Time: After timing - ≤ 16ms;

During timing - 0.1% of max. time delay or 75ms, whichever is greater

**Time Delay vs Temp. & Voltage**

≤ ±10%

**Input**

Voltage: 24 or 110VDC, 24, 120, or 230VAC

Tolerance: 24VDC/AC -15% - 20%

110 to 230VAC/DC -20% - 10%

AC Line Frequency: 50/60 Hz

Power Consumption: 2.25W

**Output**

Type: Electromechanical relay

Form: DPDT, Isolated

Rating: 10A resistive @ 120/240VAC & 28VDC;

1/3 hp @ 120/240VAC

Mechanical - 1x10⁷; Electrical - 1x10⁸

**Protection**

Polarity: DC units are reverse polarity protected

Isolation Voltage: ≥1500V RMS input to output

**Mechanical**

Mounting: Surface mount with four #6 (M3.5 x 0.6) screws

Dimensions: H 53.8 mm (2.12”); W 93.7 mm (3.69”);

D 47.8 mm (1.88”)

Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**

Operating/Storage Temperature: -20° to 85°C / -30° to 85°C

Weight: 2.7 oz (77 g)

---

**Selection Guide**

<table>
<thead>
<tr>
<th>Desired Time Delay*</th>
<th>$R_T$ Selection Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>0.05</td>
</tr>
<tr>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>1.2</td>
<td>0.6</td>
</tr>
<tr>
<td>1.2</td>
<td>1.0</td>
</tr>
<tr>
<td>1.2</td>
<td>10</td>
</tr>
<tr>
<td>1.2</td>
<td>20</td>
</tr>
<tr>
<td>1.2</td>
<td>40</td>
</tr>
<tr>
<td>1.2</td>
<td>80</td>
</tr>
<tr>
<td>1.2</td>
<td>150</td>
</tr>
<tr>
<td>1.2</td>
<td>200</td>
</tr>
<tr>
<td>1.2</td>
<td>250</td>
</tr>
<tr>
<td>1.2</td>
<td>300</td>
</tr>
</tbody>
</table>

*When selecting an external $R_T$ add at least 20% for tolerance of unit and the $R_T$.

---

**Function Diagram**

![Function Diagram]

- $V =$ Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- = Undefined Time
**Description**

The PRLM series is designed for use in non-critical timing applications. It offers low cost, knob adjustable timing control, full 10 A relay output, and onboard LED indication. The knob adjustment provides a guaranteed time range of up to 10 minutes in 6 ranges. The onboard LED indicates whether or not the unit is timing (flashing LED) as well as the status of the output.

**Operation (Delay-on-Make)**

The time delay is initiated when input voltage is applied. LED flashes during timing. At the end of the delay period, the output contacts energize. LED is on steady after the unit times out.

**Reset:** Reset is accomplished by removal of input voltage. There is no false output when reset during timing.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic circuitry with electromechanical relay</td>
<td>Repeat Accuracy + / - 2 %</td>
</tr>
<tr>
<td>Knob adjustable time delay</td>
<td>Guaranteed time range of up to 10 mins in 6 ranges</td>
</tr>
<tr>
<td>Isolated 10 A, DPDT output contacts</td>
<td>Allows control of loads for ac or dc voltages</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides relay status both during and after timing</td>
</tr>
<tr>
<td>Industry standard octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
</tbody>
</table>

**Accessories**

- **OT08PC 8-pin Octal Socket for UL listing**
  Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac

- **P1011-6 Octal Socket for UL listing**
  8-pin surface mount socket with binder head screw terminals. Rate 10 A @ 600 V ac.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRLM41180</td>
<td>120 V ac</td>
<td>Fixed</td>
<td>180 s</td>
</tr>
<tr>
<td>PRLM423</td>
<td>120 V ac</td>
<td>Adjustable</td>
<td>1–60 s</td>
</tr>
</tbody>
</table>

**For dimensional drawing see:** Appendix B, page 512, Figure 24
## Specifications

**Time Delay**
- Digital circuitry
- See “Ordering Information” table

**Range**
- See “Ordering Information” table

**Repeat Accuracy**
- ±2 %

**Fixed Time Tolerance & Setting Accuracy**
- +/- 5 %

**Reset Time**
- ≤ 50 ms

**Recycle Time**
- After timing: ≤ 20 ms
- During timing: 0.1% of max. time delay or 75 ms, whichever is greater

**Time Delay vs Temp. & Voltage**
- ≤ ± 5 %

**Input**
- **Voltage**
  - 120 V ac
- **Tolerance**
  - 120 V ac -20 % – 10 %
- **AC Line Frequency**
  - 50/60 Hz
- **Power Consumption**
  - ≤ 3.25 W

**Output**
- **Type**
  - Electromechanical relay
- **Form**
  - Isolated, DPDT
- **Rating**
  - 10 A resistive @ 240 V ac;
  - 1/3 hp @ 120/240 V ac
- **Life**
  - Mechanical - 1x10⁷;
  - Electrical - 1x10⁶

**Protection**
- **Surge**
  - IEEE C62.41-1991 Level A
- **Isolation Voltage**
  - ≥ 1500 V RMS input to output
- **Insulation Resistance**
  - ≥ 100 MΩ
- **Polarity**
  - Dc units are reverse polarity protected
- **Indication**
  - **Type**
    - LED
  - **Operation**
    - During timing - flashing
    - Output energized - on steady

**Mechanical**
- **Mounting**
  - Plug-in socket
- **Dimensions**
  - H 44.45 mm (1.75”);
  - W 60.33 mm (2.38”);
  - D (with socket) 104.78 mm (4.13”)
- **Termination**
  - Octal 8-pin plug-in

**Environmental**
- **Operating/Storage Temperature**
  - -20° to 65 °C / -30° to 85 °C
- **Weight**
  - 4 oz (113 g)
- **Safety Marks**
  - UL (socket required)*
  - UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC or RB08-PC manufactured by Custom Connector Corp.

**Note:** Manufacturer’s recommended screw terminal torque for the OT series sockets is 12 in-lbs.

---

### Function Diagram

![Function Diagram](image_url)

- **V** = Voltage
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD** = Time Delay
- **R** = Reset
- **= Undefined Time**
Time Delay Relays  
Dedicated — Delay-on-Make

TDM / TDMH / TDML SERIES

Delay-on-Make Timer

Description
The TDM/TDMH/TDML series is a delay-on-make timer that combines accurate digital circuitry with isolated, DPDT relay contacts in an industry standard 8-pin plug-in package. DIP switch adjustment allows precise selection of the time delay over the full time delay range. The TDM/TDMH/TDML series is the product of choice for custom control panel and OEM designers.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide delay range (0.1 s to 2.8 h)</td>
<td>User selectable via DIP switches for fine tuning to individual applications.</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.1 %</td>
</tr>
<tr>
<td>Dip switch adjustment</td>
<td>Provides first time setting accuracy of +/- 2 %</td>
</tr>
<tr>
<td>Setting accuracy +/- 2 %</td>
<td>Provides flexibility for use in most applications</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides visual indication of time delay status</td>
</tr>
<tr>
<td>Isolated 10 A, DPDT output contacts</td>
<td>Allows control of loads for ac or cc voltages</td>
</tr>
</tbody>
</table>

Accessories

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac

P1011-6 Octal Socket for UL listing*
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>DELAY RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDM120AL</td>
<td>120 V ac</td>
<td>1–1023 s in 1 s increments</td>
</tr>
<tr>
<td>TDM12DL</td>
<td>12 V dc</td>
<td>1–1023 s in 1 s increments</td>
</tr>
<tr>
<td>TDM230AL</td>
<td>230 V ac</td>
<td>1–1023 s in 1 s increments</td>
</tr>
<tr>
<td>TDM24AL</td>
<td>24 V ac</td>
<td>1–1023 s in 1 s increments</td>
</tr>
<tr>
<td>TDM24DL</td>
<td>24 V dc/28 V dc</td>
<td>1–1023 s in 1 s increments</td>
</tr>
<tr>
<td>TDMH120AL</td>
<td>120 V ac</td>
<td>10–10230 s in 10 s increments</td>
</tr>
<tr>
<td>TDMH24AL</td>
<td>24 V ac</td>
<td>10–10230 s in 10 s increments</td>
</tr>
<tr>
<td>TDM110DL</td>
<td>110 V dc</td>
<td>0.1–102.3 s in 0.1 s increments</td>
</tr>
<tr>
<td>TDM120AL</td>
<td>120 V ac</td>
<td>0.1–102.3 s in 0.1 s increments</td>
</tr>
<tr>
<td>TDM12DL</td>
<td>12 V dc</td>
<td>0.1–102.3 s in 0.1 s increments</td>
</tr>
<tr>
<td>TDM24DL</td>
<td>24 V dc/28 V dc</td>
<td>0.1–102.3 s in 0.1 s increments</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 23.
**Specifications**

**Time Delay**
- **Type**: Digital integrated circuitry
- **Range**: 0.1–102.3 s in 0.1 s increments
  - 1–1023 s in 1 s increments
  - 10–10,230 s in 10 s increments
- **Repeat Accuracy**: ±0.1 %
- **Setting Accuracy**: ±2 %
- **Reset Time**: ≤ 150 ms
- **Time Delay vs. Temperature & Voltage**: ±5 %
- **Indicator**: LED glows during timing; relay is de-energized

**Input**
- **Voltage**: 12, 24, or 110 V dc; 24, 120, or 230 V ac
- **Tolerance**:
  - 12 V dc & 24 V dc/ac: -15 %–20 %
  - 110 V ac/dc to 230 V ac: -20 %–10 %
- **Ac Line Frequency**: 50/60 Hz
- **Power Consumption**: ≤ 3.25 W

**Output**
- **Type**: Electromechanical relay
- **Form**: DPDT
- **Rating**: 10 A resistive @ 120/240 V ac;
  - 1/3 hp @ 120/240 V ac
- **Life**:
  - Mechanical: - 1 x 10⁷
  - Electrical: - 1 x 10⁶
- **Protection**:
  - Polarity: Dc units are reverse polarity protected
- **Isolation Voltage**: ≥ 1500 V RMS input to output

**Mechanical**
- **Mounting**: Plug-in socket
- **Dimensions**:
  - **H**: 44.45 mm (1.75”);
  - **W**: 60.33 mm (2.38”);
  - **D** (with socket): 104.78 mm (4.13”)
- **Termination**: Octal 8-pin plug-in

**Environmental**
- **Operating/Storage Temperature**: -20 °C to 65 °C / -30 °C to 85 °C
- **Weight**: 4 oz (113 g)
- **Safety Marks**: UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC or RB08-PC manufactured by Custom Connector Corp.

**Note**: Manufacturer’s recommended screw terminal torque for the OT Series sockets is 12 in-lbs.
Description
The TDU Series are encapsulated solid-state, delay-on-make timers that combine digital timing circuitry with universal voltage operation. The TDU offers DIP switch adjustment allowing accurate selection of the time delay over the full time delay range. This series is an excellent choice for process control systems and OEM equipment.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal input voltage</td>
<td>Meets wide application needs</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5% or 20ms, whichever is greater</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time, and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>3 time ranges available (0.1s to 2.8h)</td>
<td>Makes it versatile for use in many applications</td>
</tr>
<tr>
<td>DIP switch adjustment</td>
<td>Provides first time setting accuracy</td>
</tr>
</tbody>
</table>

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
 Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>TIME RANGE (SEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDUL3000A</td>
<td>24 to 120VAC/DC</td>
<td>0.1-102.3</td>
</tr>
<tr>
<td>TDUL3001A</td>
<td>100 to 240VAC/DC</td>
<td>0.1-102.3</td>
</tr>
<tr>
<td>TDU3000A</td>
<td>24 to 120VAC/DC</td>
<td>1-1023</td>
</tr>
<tr>
<td>TDU3001A</td>
<td>100 to 240VAC/DC</td>
<td>1-1023</td>
</tr>
<tr>
<td>TDU3003A</td>
<td>120 to 277VAC/DC</td>
<td>1-1023</td>
</tr>
<tr>
<td>TDUH3000A</td>
<td>24 to 120VAC/DC</td>
<td>10-10230</td>
</tr>
<tr>
<td>TDUH3001A</td>
<td>100 to 240VAC/DC</td>
<td>10-10230</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848
Specifications

**Time Delay**
- **Type**: Digital integrated circuitry
- **Range**: 0.1 - 10.23s in 0.1s increments
  1 - 1,023s in 1s increments
  10 - 10,230s in 10s increments
- ** ±0.5% or 20ms, whichever is greater**

**Tolerance**
- **(Factory Calibration)**: ±10%

**Recycle Time**
- ≤ 150ms

**Time Delay vs Temp. & Voltage**
- ±5%

**Input**
- **Voltage**
  - 24 to 120VAC/DC; 100 to 240VAC/DC
- **AC Line Frequency**
  - 50/60 Hz
- **Tolerance**: ±20%

**Output**
- **Type**: Solid state
- **Form**: NO, open during timing
- **Maximum Load Current**: 1A steady state, 10A inrush at 60°C
- **Minimum Holding Current**: 40mA
- **Voltage Drop**: ≅ 2.5V @ 1A

**Protection**
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥100 MΩ

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- **Operating/Storage Temperature**: -40° to 60°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 2.4 oz (68 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.*

**Binary Switch Operation**

![Binary Switch Operation Diagram]

**Function Diagram**

- V = Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- = Undefined Time
Description
The TH1 Series is a solid-state relay and timer combined into one compact, easy-to-use control. This highly reliable device eliminates the need for a separate solid-state relay. When mounted to a metal surface, it can switch load currents up to 20A steady state, and 200A inrush.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 2%, Factory calibration + / - 5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and component costs</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct operation of motors, lamps, and heaters directly without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer for high current applications</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in. (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OUTPUT RATING</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH1B633</td>
<td>10A</td>
<td>230VAC</td>
<td>Onboard</td>
<td>2 - 180s</td>
</tr>
<tr>
<td>TH1C415</td>
<td>20A</td>
<td>120VAC</td>
<td>Fixed</td>
<td>5s</td>
</tr>
<tr>
<td>TH1C621</td>
<td>20A</td>
<td>230VAC</td>
<td>External</td>
<td>0.1 - 3s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Specifications

Time Delay
- Range: 0.1 - 600s in 4 adjustable ranges or fixed
- Repeat Accuracy: ±2% or 20ms, whichever is greater
- Tolerance (Factory Calibration): ≤ ± 5%
- Time Delay vs Temp. & Voltage: ≤ ±10%
- Recycle Time: ≤ 150ms
- Input:
  - Voltage: 24, 120, or 230VAC
  - Tolerance: ±15%
  - AC Line Frequency: 50/60 Hz
- Power Consumption: ≤ 2VA

Output
- Type: Solid state
- Form: NO, open during timing
- Maximum Load Currents:
  - Output
  - Steady State
  - Inrush**
    - A: 6A 20A
    - B: 10A 100A
    - C: 20A 200A
- Minimum Load Current: 100mA
- Voltage Drop: ≅ 2.5V at rated current
- OFF State Leakage Current: ≅ 5mA @ 230VAC

Protection
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ

Mechanical
- Mounting **: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions:
  - H 50.8 mm (2.0”);
  - W 50.8 mm (2.0”);
  - D 38.4 mm (1.51”)
- Termination:
  - 0.25 in. (6.35 mm) male quick connect terminals

Environmental
- Operating/Storage Temperature: -20° to 60°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

Selection Guide

<table>
<thead>
<tr>
<th>Desired Time Delay* (Seconds)</th>
<th>R_T (Kohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Function Diagram

- V = Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- = Undefined Time

Delay-on-Make (On-Delay)
Description
The THD1B410.5S combines accurate timing circuitry with high power solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, timers.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%, Factory calibration + / - 1%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and component costs</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct operation of motors, lamps, and heaters directly without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer for high current applications</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16)**
  **Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.
Specifications

Time Delay

Range 0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy ±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration) ≤ ±1%
Recycle Time ≤ 150ms
Time Delay vs Temp. & Voltage ≤ ±2%

Input
Voltage 24, 120, or 230VAC
Tolerance ±20%
Line Frequency 50/60 Hz
Power Consumption ≤ 2VA

Output
Type Solid state
Form NO, open during timing
Maximum Load Current

<table>
<thead>
<tr>
<th>Output</th>
<th>Steady State</th>
<th>Inrush**</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6A</td>
<td>60A</td>
</tr>
<tr>
<td>B</td>
<td>10A</td>
<td>100A</td>
</tr>
<tr>
<td>C</td>
<td>20A</td>
<td>200A</td>
</tr>
</tbody>
</table>

Minimum Load Current 100mA
Voltage Drop = 2.5V @ rated current
OFF State Leakage Current = 5mA @ 230VAC

Protection
Circuitry Encapsulated
Dielectric Breakdown ≥ 2000V RMS terminals to mounting surface
Insulation Resistance ≥ 100 MΩ

Mechanical
Mounting ** Surface mount with one #10 (M5 x 0.8) screw
Dimensions H 50.8 mm (2.0"), W 50.8 mm (2.0"),
D 38.4 mm (1.51")
Termination 0.25 in. (6.35 mm) male quick connect terminals

Environmental
Operating/Storage Temperature -40° to 60°C / -40° to 85°C
Humidity 95% relative, non-condensing
Weight ≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

External Resistance vs. Time Delay

In Secs, or Mins.

<table>
<thead>
<tr>
<th>Time Delay Range</th>
<th>R_T = External Timing Resistor in Kilohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the time delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time
**Description**

The TMV and TSU Series are universal voltage delay-on-make timers. Two models cover all the popular voltages and time delays. Available with knob or external adjust time delay. Its simple two terminals can easily be connected in series with a relay coil, contactor coil, solenoid, lamps, small motor, etc., to delay their energization, prevent short cycling or to sequence on various loads.

**Operation (Delay-on-Make)**

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal AC/DC operating voltage</td>
<td>Provides flexibility for use in all systems</td>
</tr>
<tr>
<td>Totally solid-state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Two terminal series connection with the load</td>
<td>Provides quick and easy installation for new or existing systems</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16)**
  Female Quick Connect
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMV8000</td>
<td>24 to 240VAC/DC</td>
<td>Onboard</td>
<td>0.1 - 8m</td>
</tr>
<tr>
<td>TSU2000</td>
<td>24 to 240VAC/DC</td>
<td>External</td>
<td>5 - 480s</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848

---

For dimensional drawing see: Appendix, page 512, Figure 16.
Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Selection Guide

<table>
<thead>
<tr>
<th>Time Delay* (Seconds)</th>
<th>R T (Megohm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.0</td>
</tr>
<tr>
<td>85</td>
<td>0.5</td>
</tr>
<tr>
<td>163</td>
<td>1.0</td>
</tr>
<tr>
<td>240</td>
<td>1.5</td>
</tr>
<tr>
<td>320</td>
<td>2.0</td>
</tr>
<tr>
<td>400</td>
<td>2.5</td>
</tr>
<tr>
<td>480</td>
<td>3.0</td>
</tr>
</tbody>
</table>

* When selecting an external R T add at least 20% for tolerance of unit and the R T

Function Diagram

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay
Type
Analog circuitry
Range
5 - 480s (TSU2000)
0.1 - 8m (TMV8000)
Repeat Accuracy
±2%
Tolerance
≤ ±10%
Reset Time
≤ 100ms
Input
Voltage
24 to 240VAC/DC ±20%
AC Line Frequency
50/60 Hz
Output
Type
Solid State
Form
NO, open during timing
Maximum Load Current
1A steady state, 10A inrush at 55°C
Minimum Holding Current
≤ 40mA
Voltage Drop
= 2.5V @ 1A
Protection
Circuitry
Encapsulated
Dielectric Breakdown
≥ 2000V RMS terminals to mounting surface
Insulation Resistance
≥ 100 MΩ
Mechanical
Mounting
Surface mount with one #10 (M5 x 0.8) screw
Dimensions
H 50.8 mm (2”); W 50.8 mm (2”);
D 30.7 mm (1.21”)
Termination
0.25 in. (6.35 mm) male quick connect terminals
Environmental
Operating/Storage
Temperature
-20° to 70°C / -30° to 85°C
Humidity
95% relative, non-condensing
Weight
≈ 2.4 oz (68 g)
TRM SERIES

Description
The TRM series is a combination of digital electronic circuitry and electromechanical relay output. It provides input to output isolation with a wide variety of input voltages and time ranges. Standard plug-in base wiring, fast reset, rugged enclosure, and good repeat accuracy make the TRM a select choice in any OEM application.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic circuitry with electromechanical relay</td>
<td>Repeat Accuracy +/- 2 %</td>
</tr>
<tr>
<td>Isolated 10 A, SPDT or DPDT output contacts</td>
<td>Allows control of loads for ac or dc voltages.</td>
</tr>
</tbody>
</table>

Wiring Diagram
8-pin octal DPDT

8-pin octal SPDT

V = Voltage

R_T is used when external adjustment is ordered. Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 24.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>OUTPUT</th>
<th>TIME TOLERANCE</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRM120A2X30</td>
<td>120 V ac</td>
<td>Knob</td>
<td>Octal, DPDT</td>
<td>+/- 20%</td>
<td>1–30 s</td>
</tr>
<tr>
<td>TRM1202Y120</td>
<td>120 V ac</td>
<td>Knob</td>
<td>Octal, DPDT</td>
<td>+/- 10%</td>
<td>2–120 s</td>
</tr>
<tr>
<td>TRM1202Y180</td>
<td>120 V ac</td>
<td>Knob</td>
<td>Octal, DPDT</td>
<td>+/- 10%</td>
<td>2–180 s</td>
</tr>
<tr>
<td>TRM24A8Y5</td>
<td>24 V ac</td>
<td>External</td>
<td>Octal, SPDT without</td>
<td>+/- 10%</td>
<td>0.1–5 s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>potentiometer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRM24D1X10</td>
<td>24 V dc/28 V dc</td>
<td>Fixed</td>
<td>Octal, DPDT</td>
<td>+/- 20%</td>
<td>10 s</td>
</tr>
<tr>
<td>TRM24D1X2</td>
<td>24 V dc/28 V dc</td>
<td>Fixed</td>
<td>Octal, DPDT</td>
<td>+/- 20%</td>
<td>2 s</td>
</tr>
</tbody>
</table>
## Time Delay Relays
### Dedicated — Delay-on-Make

### TRM SERIES

### Accessories

**OT08PC 8-pin Octal Socket for UL listing***
- Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac.

**OT11PC Octal Socket for UL listing***
- 11-pin surface & DIN rail mountable. Rated for 10 A @ 300 V ac.

**P1011-6 Octal Socket for UL listing***
- 8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

**P1004-95, P1004-95-X Versa-Pot**
- Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

**P0700-7 Versa-Knob**
- Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**C103PM (AL) DIN Rail**
- 35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

### Specifications

#### Time Delay

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Digital circuitry</td>
</tr>
<tr>
<td>Range</td>
<td>See “Ordering Information” table</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>± 2 %</td>
</tr>
<tr>
<td>Fixed Time Tolerance &amp; Setting Accuracy</td>
<td>± 5, 10, or 20 %</td>
</tr>
<tr>
<td>Reset Time</td>
<td>≤ 50 ms</td>
</tr>
<tr>
<td>Recycle Time</td>
<td>After timing: ≤ 20 ms During timing: 0.1 % of max. time delay or 75 ms, whichever is greater</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage</td>
<td>≤± 5 %</td>
</tr>
<tr>
<td>Indicator</td>
<td>LED glows after time delay; relay is energized</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>24 V dc; 24, 120 V ac</td>
</tr>
<tr>
<td>Tolerance</td>
<td>24 V dc/ac -15 %–20 %</td>
</tr>
<tr>
<td>120 V ac</td>
<td>-20 %–10 %</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>≤ 3.25W</td>
</tr>
</tbody>
</table>

#### Output

| Type          | Electromechanical relay |
| Form          | Isolated DPDT or SPDT |
| Rating        | 10 A resistive @ 120/240 V ac; 1/3 hp @ 120/240 V ac |
| Life          | Mechanical - 1 x 10⁷; Electrical - 1 x 10⁶ |

#### Protection

- Isolation Voltage ≥ 1500 V RMS between input & output terminals
- Insulation Resistance ≥ 100 MΩ
- Polarity Dc units are reverse polarity protected
- Mechanical Plug-in socket
- Mounting H 44.45 mm (1.75”); W 60.33 mm (2.38”); D (with socket) 104.78 mm (4.13”)
- Termination Octal 8-pin or 11-pin plug-in

#### Environmental

- Operating/Storage -20 °C to 65 °C / -30 °C to 85 °C
- Weight ≅ 4 oz (113 g)

#### Safety Marks

- UL 508 (E57310) *UL Listed when used with Part Number OT08-PC, RB08-PC, OT11-PC, or RB11-PC manufactured by Custom Connector Corp.

### Note:
Manufacturer’s recommended screw terminal torque for the OT series sockets is 12 in-lbs.

### Selection Guides

<table>
<thead>
<tr>
<th>External R, P/N</th>
<th>Selection Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE</td>
<td>PART NUMBER*</td>
</tr>
<tr>
<td>100K ohm</td>
<td>P1004-95</td>
</tr>
<tr>
<td>100K ohm</td>
<td>P1004-95-X</td>
</tr>
</tbody>
</table>

*Externally adjustable potentiometers. Numbers with additional “-X” include two pre-soldered 8” wire leads with 1/4” female quick-connect terminals (for clockwise increase).

### Function Diagram

#### DELAY-ON-MAKE (ON-DELAY)

- V = Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- Time

- DELAY-ON-MAKE (ON-DELAY)
**TS1 SERIES**

Delay-on-Make Timer

**Description**

The TS1 Series offers proven reliability and performance with years of use in OEM equipment and commercial applications. This encapsulated general use timing module is capable of controlling load currents ranging from 5mA to 1A. May be connected in series with contactors, relays, valves, solenoids, small motors, and lamps.

**Operation (Delay-on-Make)**

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry</td>
<td>Repeat Accuracy + / - 2%</td>
</tr>
<tr>
<td>Fixed or external adjustable time delay</td>
<td>External time delay settings are adjustable from 0.05s - 10m in 8 ranges for added flexibility</td>
</tr>
<tr>
<td>5mA to 1A load current range</td>
<td>Minimum holding current of 5mA ensures proper operation with the lightest of loads</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Two terminal series load connections</td>
<td>Allows connection in series with contactors, relays, valves, solenoids, small motors and lamps. Provides quick and easy installation for new or existing systems</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS1211.5</td>
<td>24VAC</td>
<td>Fixed</td>
<td>1.5s</td>
<td>TS1412</td>
<td>120VAC</td>
<td>Fixed</td>
<td>2s</td>
</tr>
<tr>
<td>TS121150</td>
<td>24VAC</td>
<td>Fixed</td>
<td>150s</td>
<td>TS14130</td>
<td>120VAC</td>
<td>Fixed</td>
<td>30s</td>
</tr>
<tr>
<td>TS12130</td>
<td>24VAC</td>
<td>Fixed</td>
<td>30s</td>
<td>TS1415</td>
<td>120VAC</td>
<td>Fixed</td>
<td>5s</td>
</tr>
<tr>
<td>TS1214</td>
<td>24VAC</td>
<td>Fixed</td>
<td>4s</td>
<td>TS1416</td>
<td>120VAC</td>
<td>Fixed</td>
<td>6s</td>
</tr>
<tr>
<td>TS12190</td>
<td>24VAC</td>
<td>Fixed</td>
<td>90s</td>
<td>TS1421</td>
<td>120VAC</td>
<td>External</td>
<td>0.05 - 3s</td>
</tr>
<tr>
<td>TS1221</td>
<td>24VAC</td>
<td>External</td>
<td>0.05 - 3s</td>
<td>TS1422</td>
<td>120VAC</td>
<td>External</td>
<td>0.5 - 60s</td>
</tr>
<tr>
<td>TS1222</td>
<td>24VAC</td>
<td>External</td>
<td>5 - 600s</td>
<td>TS1423</td>
<td>120VAC</td>
<td>External</td>
<td>2 - 180s</td>
</tr>
<tr>
<td>TS1224</td>
<td>24VAC</td>
<td>External</td>
<td>0.05 - 3s</td>
<td>TS1424</td>
<td>120VAC</td>
<td>External</td>
<td>5 - 600s</td>
</tr>
<tr>
<td>TS13115</td>
<td>24VDC</td>
<td>Fixed</td>
<td>15s</td>
<td>TS1612</td>
<td>230VAC</td>
<td>Fixed</td>
<td>2s</td>
</tr>
<tr>
<td>TS1321</td>
<td>24VDC</td>
<td>External</td>
<td>0.05 - 3s</td>
<td>TS1615</td>
<td>230VAC</td>
<td>Fixed</td>
<td>5s</td>
</tr>
<tr>
<td>TS1410.25</td>
<td>120VAC</td>
<td>Fixed</td>
<td>0.25s</td>
<td>TS1621</td>
<td>230VAC</td>
<td>External</td>
<td>0.05 - 3s</td>
</tr>
<tr>
<td>TS14110</td>
<td>120VAC</td>
<td>Fixed</td>
<td>10s</td>
<td>TS1622</td>
<td>230VAC</td>
<td>External</td>
<td>0.5 - 60s</td>
</tr>
<tr>
<td>TS141180</td>
<td>120VAC</td>
<td>Fixed</td>
<td>180s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
Function Diagram

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Duration of Voltage

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>Other Voltages</th>
<th>12VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 0.05-3s</td>
<td>VTP4B</td>
<td>1 - 0.05-1s</td>
</tr>
<tr>
<td>2 - 0.5-60s</td>
<td>VTP4F</td>
<td>2 - 0.5-20s</td>
</tr>
<tr>
<td>3 - 2-180s</td>
<td>VTP4J</td>
<td>3 - 2-60s</td>
</tr>
<tr>
<td>4 - 5-600s</td>
<td>VTP5N</td>
<td>4 - 5-120s</td>
</tr>
</tbody>
</table>

Selection Table for VTP Plug-on Adjustment Accessory

Time Delay Relays
Dedicated — Delay-on-Make

Specifications

Time Delay
- Type: Analog circuitry
- Range: 0.05 - 120s in 4 adjustable ranges or fixed (1 MΩ max. R<sub>T</sub>)
- Other Voltages: 0.05 - 600s in 4 adjustable ranges or fixed
- Repeat Accuracy: ±2% or 20ms, whichever is greater
- Tolerance: ≤ ±10%
- (Factory Calibration) Time Delay vs. Temperature: ±20ms
- Recycle Time:
  - After timing: ≤ 16ms
  - During timing: 0.1% of time delay or 75ms, whichever is greater

Input
- Voltage: 12, 24 or 120VDC; 24, 120, or 230VAC
- Tolerance: ±20%
- AC Line Frequency: 50/60 Hz

Output
- Type: Solid state
- Form: NO, open during timing
- Maximum Load Current: 1A steady state, 10A inrush at 60°C
- Minimum Holding Current: 5mA
- Voltage Drop: ≅ 2.5V @ 1A

Protection
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ
- DC units are reverse polarity protected
- Mechanical
  - Surface mount: with one #10 (M5 x 0.8) screw
  - Dimensions: H 50.8 mm (2”); W 50.8 mm (2”);
  - D 30.7 mm (1.21”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

Environmental
- Operating/Storage Temperature: -40° to 80°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≅ 2.4 oz (68 g)

Selection Chart

R<sub>T</sub> Selection Chart

<table>
<thead>
<tr>
<th>Desired Time Delay*</th>
<th>R&lt;sub&gt;T&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>0.05</td>
<td>0.5</td>
</tr>
<tr>
<td>0.5</td>
<td>10</td>
</tr>
<tr>
<td>1.0</td>
<td>20</td>
</tr>
<tr>
<td>2.0</td>
<td>40</td>
</tr>
<tr>
<td>2.5</td>
<td>50</td>
</tr>
<tr>
<td>3.0</td>
<td>60</td>
</tr>
<tr>
<td>4.0</td>
<td>80</td>
</tr>
<tr>
<td>4.5</td>
<td>100</td>
</tr>
<tr>
<td>5.0</td>
<td>120</td>
</tr>
</tbody>
</table>

* When selecting an external R<sub>T</sub> add at least 20% for tolerance of unit and the R<sub>T</sub>.
† 1 Megohm max for 12 VDC Units.

© 2023 Littelfuse, Inc.
**TSD1 SERIES**

**Delay-on-Make Timer**

**Description**

The TSD1 Series is designed for more demanding commercial and industrial applications where small size and accurate performance is required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.1% of the time delay. The TSD1 Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 100 hours are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

**Operation (Delay-on-Make)**

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.1%, +/-1% time delay accuracy</td>
</tr>
<tr>
<td>Extended temperature range</td>
<td>Rated to 75°C operating temperature to withstand high heat applications.</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A Steady solid-state output, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  - Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  - The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  - Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  - These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  - Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSD1311.2S</td>
<td>24VDC</td>
<td>Fixed</td>
<td>1.2s</td>
</tr>
<tr>
<td>TSD1321</td>
<td>24VDC</td>
<td>External</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>TSD1424</td>
<td>120VAC</td>
<td>External</td>
<td>1 - 100m</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R t terminals, as the resistance increases the time delay increases.

When selecting an external R t, add the tolerances of the timer and the R t for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 60 K ohm R t. For 1 to 100 S use a 100 K ohm R t.

Specifications

Time Delay Range
0.1s - 100h in 7 adjustable ranges or fixed

Repeat Accuracy
±0.1% or 20ms, whichever is greater

Tolerance (Factory Calibration)
≤ ±1%

Recycle Time
≤ 150ms

Time Delay vs. Temperature & Voltage
≤ ±1%

Input Voltage
12, 24, 120VDC; 24, 120, 230VAC

Tolerance
±20%

AC Line Frequency
50/60 Hz

Output Type
Solid state

Form
NO, open during timing

Maximum Load Current
1A steady state, 10A inrush at 60°C

Minimum Holding Current
≤ 40mA

Off State Leakage Current
7mA @ 230VAC

Voltage Drop
2.5V @ 1A

Protection Circuitry
Encapsulated

Dielectric Breakdown
≥ 2000V RMS terminals to mounting surface

Insulation Resistance
≥ 100 MΩ

Polarity
DC units are reverse polarity protected

Mechanical Mounting
Surface mount with one #10 (M5 x 0.8) screw

Dimensions
H 50.8 mm (2”); W 50.8 mm (2”);
D 30.7 mm (1.21”)

Termination
0.25 in. (6.35 mm) male quick connect terminals

Environmental Operating/Storage
Temperature
-40°C to 75°C / -40°C to 85°C

Humidity
95% relative, non-condensing

Weight
≅ 2.4 oz (68 g)

This diagram shows the DELAY-ON-MAKE (ON-DELAY) function: V = Voltage, NO = Normally Open Contact, NC = Normally Closed Contact, TD = Time Delay, R = Reset, = Undefined Time.
Description
The TS441165 is an analog delay-on-make timer with a normally closed solid-state output. Unlike an interval timer, the load is energized prior to and during the time delay period. It can be used as a faster starting interval time delay when S1 is closed upon application of input voltage.

Operation (Delay-on-Make NC)
Upon application of input voltage, the load is energized immediately. When the initiate switch is closed, the time delay begins. At the end of the time delay, the load de-energizes.

Reset: When the initiate switch is reopened, the load again energizes and the time delay is reset. Removing input voltage resets the time delay and output.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry</td>
<td>Repeat Accuracy + / - 2%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Load energized prior to and during time delay</td>
<td>Faster operation</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Normally closed output</td>
<td>Can be used as a faster starting interval time delay</td>
</tr>
</tbody>
</table>

Accessories
- **P1004-XX, P1004-XX-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.
- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.
- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.
- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.
- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.
Time Delay Relays
Dedicated — Delay-on-Make, Normally Closed

Accessories

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VTP(X)(X) Plug-on Adjustment Module
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

Selection Table for VTP Plug-on Adjustment Accessory

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>VTP P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 0.05-3s</td>
<td>VTP4B</td>
</tr>
<tr>
<td>2 - 0.5-60s</td>
<td>VTP4F</td>
</tr>
<tr>
<td>3 - 2-180s</td>
<td>VTP4J</td>
</tr>
<tr>
<td>4 - 5-600s</td>
<td>VTP5N</td>
</tr>
</tbody>
</table>

Selection Guide

<table>
<thead>
<tr>
<th>Desired Time Delay*</th>
<th>$R_T$</th>
<th>$R_T$ Selection Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>0.05</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>0.5</td>
<td>1.0</td>
<td>2</td>
</tr>
<tr>
<td>1.0</td>
<td>3.0</td>
<td>2</td>
</tr>
<tr>
<td>2.0</td>
<td>4.0</td>
<td>2</td>
</tr>
<tr>
<td>2.5</td>
<td>5.0</td>
<td>2</td>
</tr>
<tr>
<td>3.0</td>
<td>6.0</td>
<td>2</td>
</tr>
<tr>
<td>4.0</td>
<td>7.0</td>
<td>2</td>
</tr>
<tr>
<td>5.0</td>
<td>8.0</td>
<td>2</td>
</tr>
</tbody>
</table>

*When selecting an external $R_T$ add at least 20% for tolerance of unit and the $R_T$.

Specifications

**Time Delay**
- **Type**: Analog circuitry
- **Range**: 165s
- **Adjustment**: Fixed
- **Repeat Accuracy**: ±2% or 20ms, whichever is greater; under fixed conditions
- **Tolerance (Factory Calibration)**: ≤ ±10%
- **Time Delay vs Temp. & Voltage**: ≤ ±10%
- **Recycle Time**: ≤ 150ms

**Input**
- **Voltage**: 120VAC
- **Tolerance**: ±20%
- **AC Line Frequency**: 50/60 Hz

**Output**
- **Type**: Solid state
- **Form**: NC, closed during timing
- **Maximum Load Current**: 1A steady state, 10A inrush at 60°C
- **Voltage Drop**: ≅ 2.5V @ 1A

**Protection**
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 50.8 mm (2.0”), W 50.8 mm (2.0”); D 30.7 mm (1.21”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- **Operating/Storage Temperature**: -40° to 75°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 2.4 oz (68 g)

Function Diagram

V = Voltage
S1 = Initiate Switch
L = Load
TD = Time Delay
R = Reset
- Undefined Time
**HRDB SERIES**

**Delay-on-Break Timer**

**Description**

The HRDB Series combines an electromechanical, relay output with microcontroller timing circuitry. The HRDB offers 12 to 230V operation in five options and factory fixed, external, or onboard adjustable time delays with a repeat accuracy of ±0.5%. The isolated output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blower motors, heaters, etc. The HRDB is ideal for OEM applications where cost is a factor.

**Operation (Delay-on-Break)**

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Isolated, 30A, SPDT, NO output contacts</td>
<td>Allows direct operation of heavy loads: compressors, pumps, blower motors, heaters.</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME TOLERANCE</th>
<th>TIME DELAY</th>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME TOLERANCE</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRDB1110M</td>
<td>12VDC</td>
<td>Fixed</td>
<td>+ / -5%</td>
<td>10m</td>
<td>HRDB223</td>
<td>24VAC</td>
<td>Onboard</td>
<td>+ / -5%</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>HRDB117S</td>
<td>12VDC</td>
<td>Fixed</td>
<td>+ / -5%</td>
<td>7s</td>
<td>HRDB321</td>
<td>24VDC</td>
<td>Onboard</td>
<td>+ / -5%</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>HRDB120</td>
<td>12VDC</td>
<td>Onboard</td>
<td>+ / -5%</td>
<td>0.1 - 10s</td>
<td>HRDB324</td>
<td>24VDC</td>
<td>Onboard</td>
<td>+ / -5%</td>
<td>1 - 100m</td>
</tr>
<tr>
<td>HRDB121</td>
<td>12VDC</td>
<td>Onboard</td>
<td>+ / -5%</td>
<td>1 - 100s</td>
<td>HRDB423</td>
<td>120VAC</td>
<td>Onboard</td>
<td>+ / -5%</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>HRDB124</td>
<td>12VDC</td>
<td>Onboard</td>
<td>+ / -5%</td>
<td>1 - 100m</td>
<td>HRDB623</td>
<td>230VAC</td>
<td>Onboard</td>
<td>+ / -5%</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>HRDB21A65M</td>
<td>24VAC</td>
<td>Fixed</td>
<td>+ / -1%</td>
<td>65m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848
**HRDB SERIES**

**Time Delay Relays**
Dedicated — Delay-on-Break

---

**Specifications**

**Time Delay**
- **Type**: Microcontroller circuitry
- **Range**: 0.1s - 100m in 5 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5 % or 20ms, whichever is greater
- **Tolerance**: ±1%, ±5%
- **Reset Time**: ≤ 150ms
- **Initiate Time**: ≤ 20ms
- **Time Delay vs Temp. & Voltage**: ±2%

**Input**
- **Voltage**: 12 or 24VDC; 24, 120, or 230VAC
- **Tolerance**: 12VDC & 24VDC -15% - 20%
- 24 to 230VAC -20% - 10%

**AC Line Frequency**: 50/60 Hz

**Power Consumption**
- **AC**: ≤ 4VA
- **DC**: ≤ 2W

**Output**
- **Type**: Electromechanical relay
- **Form**: Isolated, SPDT

**Ratings**
- **General Purpose**
  - SPDT-NO: 125/240VAC 30A 15A
  - SPDT-NC: 125/240VAC 30A 15A
- **Resistive**
  - 28VDC: 20A 10A
  - 125VAC: 1 hp* 1/4 hp**
  - 240VAC: 2 hp** 1 hp**

**Motor Load**
- **125VAC**: 1 hp*
- **240VAC**: 2 hp**

**Life**
- **Mechanical**: - 1 x 10⁶;
- **Electrical**: - 1 x 10⁶; **3 x 10⁶; **6,000

**Protection**
- **Surge**: IEEE C62.41-1991 Level A
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected

**Environmental**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: 50.8 mm (2”); 50.8 mm (2”);
- **D**: 38.1 mm (1.51”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals
- **Operating/Storage**
  - Temperature: -40° to 60°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
- **Weight**: 3.9 oz (111 g)

---

**Function Diagram**

**External Resistance vs. Time Delay**

---

**Accessories**

**P1015-13** (AWG 10/12), **P1015-64** (AWG 14/16)

**Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

---

**Littelfuse.com/hrdb**

© 2023 Littelfuse, Inc.
**Description**

The HRPS/HRIS Series combines an electromechanical relay output with microcontroller timing circuitry. It is a factory programmed module available in any 1 of 13 standard functions. It offers 12 to 240V operation in two universal ranges and factory fixed, onboard, or external adjustable time delays with a repeat accuracy of ±0.5%. The output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blowers, motors, heaters, etc. This series is ideal for OEM applications where cost is a factor. The HRPS has non-isolated SPDT relay contacts, and the HRIS has isolated SPDT relay contacts. Both offer the most popular timer functions in the industry.

**Operation (Interval)**

Upon application of input voltage, the time delay begins. The output (relay or solid state) energizes during the time delay. At the end of time delay the output de-energizes and remains de-energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%, factory calibration +/- 2%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>30A, SPDT, Normally Open output contacts</td>
<td>Allows for direct operation of heavy loads</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUST.</th>
<th>TIME DELAY</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRISW21FT</td>
<td>24 - 240VAC/24 - 110VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Alternating</td>
</tr>
<tr>
<td>HRISW27I</td>
<td>24 - 240VAC/24 - 110VDC</td>
<td>Onboard</td>
<td>0.1 - 10h</td>
<td>Interval</td>
</tr>
<tr>
<td>HRPSD12HI</td>
<td>12 - 48VDC</td>
<td>Fixed</td>
<td>2h</td>
<td>Interval</td>
</tr>
<tr>
<td>HRISW25B</td>
<td>24 - 240VAC/24 - 110VDC</td>
<td>Onboard</td>
<td>1 - 100m</td>
<td>Delay on break</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848.

For dimensional drawing see: Appendix, page 512, Figure 17.
**HRPS / HRIS SERIES**

### Accessories

**P1004-95, P1004-95-X Versa-Pot**
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

**P1023-6 Mounting bracket**
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P0700-7 Versa-Knob**
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**P1015-64 (AWG 14/16), P1015-13 (AWG 10/12) Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### Specifications

**Time Delay**
- **Type**: Microcontroller circuitry
- **Range**: 0.1s - 1000h in 9 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5% or 20ms, whichever is greater
- **Tolerance (Factory Calibration)**: ±2%
- **Reset Time**: ≤ 150ms
- **Initiate Time**: ≤ 20ms
- **Time Delay vs Temp. & Voltage**: ±2%
- **Input Voltage**
  - 12 to 48VDC: 12 to 240VAC/24 to 110VDC
  - -15% - 20%
  - -20% - 10%
- **AC Line Frequency**: 50/60Hz
- **Power Consumption**
  - AC ≤ 4VA
  - DC ≤ 2W

**Output Type**: Electromechanical relay
- **Form**: SPDT
- **Ratings**
  - **General Purpose**
    - 125/240VAC: 30A, 15A
    - 28VDC: 30A, 15A
  - **Resistive**
    - 125/240VAC: 30A, 15A
    - 28VDC: 20A, 10A
  - **Motor Load**
    - 125VAC: 1 hp*, 1/4 hp**
    - 240VAC: 2 hp**, 1 hp**
- **Life**
  - Mechanical: 1 x 10^6
  - Electrical: 1 x 10^6, *3 x 10^6, **6,000

**Protection**
- **Surge**: IEEE C62.41-1991 Level A
- **Circuitry**: Encapsulated
- **Isolation Voltage**: ≥ 1500V RMS input to output; isolated units
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected
- **Mechanical**
  - **Mounting**: Surface mt. with one #10 (M5 x 0.8) screw
  - **Dimensions**: H 76.2 mm (3.0"), W 50.8 mm (2.0"), D 38.1 mm (1.5"
- **Termination**: 0.25 in. (6.35 mm) male quick connects
- **Environmental**
  - **Operating/Storage Temperature**: -40° to 60°C / -40° to 85°C
  - **Humidity**: 95% relative, non-condensing
- **Weight**: 3.9 oz (111 g)

### Function Diagrams

- **INTERVAL (IMPULSE-ON)**
  - **V**: Voltage
  - **S1**: Initiate Switch
  - **NO**: Normally Open Contact
  - **NC**: Normally Closed Contact
  - **TD**: Time Delay
  - **R**: Reset
  - **Time Delay Relays**
- **ALTERNATING RELAY (TRAILING EDGE FLIP-FLOP)**
  - **V**: Voltage
  - **S1**: Initiate Switch
  - **NO**: Normally Open Contact
  - **NC**: Normally Closed Contact
  - **TD**: Time Delay
  - **R**: Reset
  - **Undefined Time**
Description
The KRDB Series is a compact time delay relay measuring only 2 in. (50.8 mm) square. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDB Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Delay-on-Break)
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat accuracy + / - 0.5%, Factory calibration + / - 5%</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>To protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Compact, low cost design measuring 2 in.</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>(50.8mm) square</td>
<td></td>
</tr>
</tbody>
</table>

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRDB110.1S</td>
<td>12VDC</td>
<td>Fixed</td>
<td>0.1s</td>
<td>KRDB31120S</td>
<td>24VDC</td>
<td>Fixed</td>
<td>20s</td>
</tr>
<tr>
<td>KRDB112.5S</td>
<td>12VDC</td>
<td>Fixed</td>
<td>2.5s</td>
<td>KRDB415S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>5s</td>
</tr>
<tr>
<td>KRDB1120M</td>
<td>12VDC</td>
<td>Fixed</td>
<td>20m</td>
<td>KRDB4160S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>60s</td>
</tr>
<tr>
<td>KRDB115M</td>
<td>12VDC</td>
<td>Fixed</td>
<td>5m</td>
<td>KRDB420</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDB120</td>
<td>12VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>KRDB421</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>KRDB8124</td>
<td>12VDC</td>
<td>Onboard</td>
<td>1 - 100m</td>
<td>KRDB422</td>
<td>120VAC</td>
<td>Onboard</td>
<td>10 - 1000s</td>
</tr>
<tr>
<td>KRDB21180S</td>
<td>24VAC/DC</td>
<td>Fixed</td>
<td>180s</td>
<td>KRDB423</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>KRDB217S</td>
<td>24VAC/DC</td>
<td>Fixed</td>
<td>7s</td>
<td>KRDB424</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100m</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 16.

If you don’t find the part you need, call us for a custom product 800-843-8848
## Accessories

**P1015-64 (AWG 14/16)**
**Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

## Specifications

**External Resistance vs. Time Delay**

<table>
<thead>
<tr>
<th>Time Delay in Secs.</th>
<th>0.1s</th>
<th>0.5s</th>
<th>1.0s</th>
<th>2.5s</th>
<th>5.0s</th>
<th>10s</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the full time range by varying the resistance across the \( R_T \) terminals, as the resistance increases the time delay increases.

### Function Diagram

- **V** = Voltage
- **S1** = Initiate Switch
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD** = Time Delay
- **t** = Incomplete Time Delay
- **R** = Reset
- **= Undefined Time**

### Output Current/Ambient Temperature

<table>
<thead>
<tr>
<th>Current (A)</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>9</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>

### Time Delay vs Temp. & Voltage

≤ ±5%

### Input

- **Voltage**: 12, 24, 110VDC, 24, 120 or 230VAC
- **Tolerance**: -15% - 20% for 12VDC & 24VDC/AC, -20% - 10% for 110VDC, 120 or 230VAC
- **Line Frequency/DC Ripple**: 50/60 Hz ≤ 10%
- **Max. Switching Voltage**: 250VAC
- **Power Consumption**: AC ≤ 2VA; DC ≤ 2W
- **Rating (at 40°C)**: 10A resistive @ 125VAC, 5A resistive @ 230VAC & 28VDC, 1/4 hp @ 125VAC
- **Protection**: Encapsulated
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 50.8 mm (2.0"), W 50.8 mm (2.0"), D 30.7 mm (1.21")
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

### Environmental

- **Temperature**: -40° to 60°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: 2.6 oz (74 g)
**Description**

The KSDB Series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for popular AC and DC voltages. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

**Operation (Delay-on-Break)**

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output energizes if the initiate switch is closed when input voltage is applied.

**Reset:** Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat accuracy + / - 0.5%, Factory calibration + / - 5%</td>
</tr>
<tr>
<td>1A Steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>SWITCHING MODE</th>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>SWITCHING MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSDB1110MP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>10m</td>
<td>Positive</td>
<td>KSDB1115MP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>15s</td>
<td>Positive</td>
</tr>
<tr>
<td>KSDB1111SP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>15s</td>
<td>Positive</td>
<td>KSDB1120SP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>20s</td>
<td>Positive</td>
</tr>
<tr>
<td>KSDB1120SP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>20s</td>
<td>Positive</td>
<td>KSDB113MP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>3s</td>
<td>Positive</td>
</tr>
<tr>
<td>KSDB113MP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>3s</td>
<td>Positive</td>
<td>KSDB113SP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>3s</td>
<td>Positive</td>
</tr>
<tr>
<td>KSDB120P</td>
<td>12VDC</td>
<td>External</td>
<td>0.1 - 10s</td>
<td>Positive</td>
<td>KSDB120P</td>
<td>12VDC</td>
<td>Onboard</td>
<td>1 - 100m</td>
<td>Positive</td>
</tr>
<tr>
<td>KSDB2111S</td>
<td>24VAC</td>
<td>Fixed</td>
<td>15s</td>
<td>n/a</td>
<td>KSDB2111S</td>
<td>24VAC</td>
<td>Fixed</td>
<td>15s</td>
<td>n/a</td>
</tr>
<tr>
<td>KSDB220</td>
<td>24VAC</td>
<td>External</td>
<td>0.1 - 10s</td>
<td>n/a</td>
<td>KSDB220</td>
<td>24VAC</td>
<td>Onboard</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>KSDB231</td>
<td>24VAC</td>
<td>Onboard</td>
<td>1 - 100m</td>
<td>n/a</td>
<td>KSDB231</td>
<td>24VAC</td>
<td>Onboard</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>KSDB3114SP</td>
<td>24VDC</td>
<td>Fixed</td>
<td>4s</td>
<td>Positive</td>
<td>KSDB315SP</td>
<td>24VDC</td>
<td>Fixed</td>
<td>5s</td>
<td>Positive</td>
</tr>
<tr>
<td>KSDB31SP</td>
<td>24VDC</td>
<td>Fixed</td>
<td>5s</td>
<td>Positive</td>
<td>KSDB324N</td>
<td>24VDC</td>
<td>External</td>
<td>1 - 100m</td>
<td>Negative</td>
</tr>
<tr>
<td>KSDB324N</td>
<td>24VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Negative</td>
<td>KSDB4120M</td>
<td>120VAC</td>
<td>Fixed</td>
<td>20m</td>
<td>n/a</td>
</tr>
<tr>
<td>KSDB4160S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>60s</td>
<td>n/a</td>
<td>KSDB4190M</td>
<td>120VAC</td>
<td>Fixed</td>
<td>90m</td>
<td>n/a</td>
</tr>
<tr>
<td>KSDB431</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>n/a</td>
<td>KSDB61150S</td>
<td>230VAC</td>
<td>Fixed</td>
<td>150s</td>
<td>n/a</td>
</tr>
<tr>
<td>KSDB631</td>
<td>230VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>n/a</td>
<td>KSDB631</td>
<td>230VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>n/a</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16), P1015-14 (AWG 18/22)**
  **Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### External Resistance vs. Time Delay

This chart applies to externally adjustable part numbers.

The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals, as the resistance increases the time delay increases.

When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT; For 1 to 100 S use a 100 K ohm RT.

### Specifications

- **Time Delay**
  - Range: 0.1s - 1000m in 6 adjustable ranges or fixed
  - Repeat Accuracy: ±0.5 % or 20ms, whichever is greater
  - Tolerance: ±5%
  - Reset Time: ≤ 150ms
  - Initiate Time: ≤ 20ms
  - Time Delay vs Temp. & Voltage: ≤ ±10%

- **Input**
  - Voltage: 12, 24, or 120VDC; 24, 120, or 230VAC
  - Tolerance: ±20%

- **Output**
  - Type: Solid state
  - Form: NO, closed before & during timing
  - Maximum Load Current: 1A steady state, 10A inrush at 60°C
  - OFF State Leakage Current: AC ≅ 5mA @ 230VAC; DC ≅ 1mA
  - Voltage Drop: AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
  - DC Operation: Positive or negative switching
  - Protection: Encapsulated
  - Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
  - Insulation Resistance: ≥ 100 MΩ

- **Environmental**
  - Operating/Storage Temperature: -40° to 60°C / -40° to 80°C
  - Humidity: 95% relative, non-condensing
  - Weight: ≅ 2.4 oz (68 g)

### Function Diagram

- **V** = Voltage
- **S1** = Initiate Switch
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD** = Time Delay
- **R** = Reset
- **t** = Incomplete Time Delay

---

© 2023 Littelfuse, Inc.
Description
The ORB Series’ open PCB construction offers the user good economy without sacrificing performance and reliability. The output relay is available in isolated, 10A, DPDT or SPDT forms. The time delay may be ordered as factory fixed, onboard knob, or external adjustment. All connections are 0.25 in. (6.35 mm) male quick connect terminals.

Operation (Delay-on-Break)
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened (trailing edge triggered). The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open PCB construction</td>
<td>Reduces cost for OEM applications</td>
</tr>
<tr>
<td>Analog circuitry</td>
<td>Repeat accuracy +/- 2%, Factory calibration +/- 10%</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT or DPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Line voltage initiation</td>
<td>Separate control voltage is not required for operation</td>
</tr>
</tbody>
</table>

Accessories

P1004-12, P1004-12-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>OUTPUT FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORB120A160</td>
<td>120VAC</td>
<td>Fixed</td>
<td>60s</td>
<td>SPDT</td>
</tr>
<tr>
<td>ORB120A25</td>
<td>120VAC</td>
<td>Onboard</td>
<td>3 - 300s</td>
<td>SPDT</td>
</tr>
<tr>
<td>ORB24A11D</td>
<td>24VAC</td>
<td>Fixed</td>
<td>1s</td>
<td>DPDT</td>
</tr>
<tr>
<td>ORB24A21D</td>
<td>24VAC</td>
<td>Onboard</td>
<td>0.05 - 3s</td>
<td>DPDT</td>
</tr>
<tr>
<td>ORB24A25</td>
<td>24VAC</td>
<td>Onboard</td>
<td>3 - 300s</td>
<td>SPDT</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Time Delay Relays
Dedicated — Delay-on-Break

Specifications

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>Type</th>
<th>Analog circuitry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0.05 - 300s in 5 adjustable ranges or fixed</td>
<td></td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±2% or 20ms, whichever is greater</td>
<td></td>
</tr>
</tbody>
</table>

| Tolerance (Factory Calibration) | Adjustable: guaranteed range |

<table>
<thead>
<tr>
<th>Reset Time</th>
<th>Fixed: ±10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 50ms</td>
<td>≤ 70ms</td>
</tr>
</tbody>
</table>

| Time Delay vs Temp. & Voltage | ≤ ±10% |

<table>
<thead>
<tr>
<th>Input Voltage</th>
<th>24, 120, or 230VAC</th>
</tr>
</thead>
</table>

| Power Consumption | 2.25W |

| Output Type | Electromechanical relay |

| Form | Isolated, SPDT or DPDT |

| Rating | 10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC |

| Mechanical Life | 1x10^7; Electrical - 1x10^6 |

<table>
<thead>
<tr>
<th>Protection</th>
<th>Isolation Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1500V RMS input to output</td>
<td></td>
</tr>
</tbody>
</table>

| Mounting | Surface mount with four #6 (M3.5 x 0.6) screws |

| Dimensions | H 53.8 mm (2.12”), W 93.7 mm (3.69”); D 47.8 mm (1.88”) |

| Termination | 0.25 in. (6.35 mm) male quick connect terminals |

| Environmental Operating/Storage Temperature | -20° to 65°C / -30° to 85°C |

| Weight | 2.7 oz (77 g) |

Selection Guides

<table>
<thead>
<tr>
<th>Desired Time Delay* (Seconds)</th>
<th>R_T (Megohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>0.5</td>
</tr>
<tr>
<td>0.5</td>
<td>5.0</td>
</tr>
<tr>
<td>1.0</td>
<td>10</td>
</tr>
<tr>
<td>1.5</td>
<td>15</td>
</tr>
<tr>
<td>2.0</td>
<td>20</td>
</tr>
<tr>
<td>2.5</td>
<td>25</td>
</tr>
<tr>
<td>3.0</td>
<td>30</td>
</tr>
</tbody>
</table>

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram

V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

12
Description
The TDB series combines accurate digital circuitry with isolated, 10 A, DPDT or SPDT contacts in an 8-pin or 11-pin plug-in package. The TDB series features DIP switch selectable time delays ranging from 0.1–10,230 seconds in three ranges. The TDB series is the product of choice for custom control panel and OEM designers.

Operation (Delay-on-Break)
Input voltage must be applied to the input before and during timing. Upon closure of the initiate switch, the output relay is energized. The time delay begins when the initiate switch is opened (trailing edge triggered). The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 time ranges available</td>
<td>Makes it versatile for use in many applications</td>
</tr>
<tr>
<td>(0.1 s to 2.8 h)</td>
<td></td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.1 % or 20 ms, whichever is greater, Setting Accuracy + / - 2 % or 50 ms, whichever is greater</td>
</tr>
<tr>
<td>LED indication (select models)</td>
<td>Provides visual indication of relay status</td>
</tr>
<tr>
<td>DIP switch adjustment</td>
<td>Provides first time setting accuracy</td>
</tr>
<tr>
<td>Isolated output contacts</td>
<td>Allows control of loads for ac or dc voltages</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>DELAY RANGE (SEC)</th>
<th>LED</th>
<th>TYPE PLUG/OUTPUT FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDB120AL</td>
<td>120 V ac</td>
<td>1–1023 in 1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDB120ALD</td>
<td>120 V ac</td>
<td>1–1023 in 1 s increments</td>
<td>X</td>
<td>11-pin plug, DPDT</td>
</tr>
<tr>
<td>TDB12D</td>
<td>12 V dc</td>
<td>1–1023 in 1 s increments</td>
<td></td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDB230AL</td>
<td>230 V ac</td>
<td>1–1023 in 1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDB24AL</td>
<td>24 V ac</td>
<td>1–1023 in 1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDB24DL</td>
<td>24 V dc/ 28 V dc</td>
<td>1–1023 in 1s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDBH120AL</td>
<td>120 V ac</td>
<td>10–10230 in 10 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDBH120ALD</td>
<td>120 V ac</td>
<td>10–10230 in 10 s increments</td>
<td>X</td>
<td>11-pin plug, DPDT</td>
</tr>
<tr>
<td>TDBL120AL</td>
<td>120 V ac</td>
<td>0.1–102.3 in 0.1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDBL120ALD</td>
<td>120 V ac</td>
<td>0.1–102.3 in 0.1 s increments</td>
<td>X</td>
<td>11-pin plug, DPDT</td>
</tr>
<tr>
<td>TDBL24DL</td>
<td>24 V dc/ 28 V dc</td>
<td>0.1–102.3 in 0.1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
</tbody>
</table>
**Time Delay Relays**

**Dedicated — Delay-on-Break**

**TDB / TDBH / TDBL SERIES**

---

### Accessories

**OT08PC 8-pin Octal Socket for UL listing**
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac.

**OT11PC Octal Socket for UL listing**
11-pin surface & DIN-rail mountable. Rated for 10 A @ 300 V ac.

**P1011-6 Octal Socket for UL listing**
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

---

### Specifications

#### Time Delay

**Type**
Digital integrated circuitry

**Range**
- 0.1–102.3 s in 0.1 s increments
- 1–1023 s in 1 s increments
- 10–10,230 s in 10 s increments

**Repeat Accuracy**
±0.1 %

**Setting Accuracy**
±2 %

**Reset Time**
≤ 150 ms

**Time Delay vs Temp. & Voltage**
±5 %

**Indicator**
LED indicates relay is energized

**Initiate Time**
≤ 60 ms

**Input**

- **Voltage**
  - 12, 24/28 V dc; 24, 120, or 230 V ac

**Tolerance**
- 12 V dc & 24 V dc/ac: -15 %–+20 %
- 120 to 230 V ac/dc: -20 %–+10 %

**AC Line Frequency**
50/60 Hz

**Power Consumption**
≤ 3.25W

#### Output

**Type**
Electromechanical relay

**Form**
SPDT or DPDT

**Rating**
- 10 A resistive @ 120/240 V ac;
  - 1/3 hp @ 120/240 V ac

**Life**
Mechanical - 1 x 10⁷; Electrical - 1 x 10⁶

**Protection**

- **Isolation Voltage**
  ≥ 1500 V RMS input to output
- Dc units reverse polarity protected

**Mechanical**
Plug-in socket

**Mounting**

- **Dimensions**
  - H: 44.45 mm (1.75”); W: 60.33 mm (2.38”)
  - D (with socket): 104.78 mm (4.13”)

**Termination**
Octal 8-pin plug-in or 11-pin plug-in

**Environmental**

- **Operating/Storage Temperature**
  -20 °C to 65 °C / -30 °C to 85 °C

**Weight**
4 oz (113 g)

**Safety Marks**
UL (socket required)*

**UL (socket required)**
UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC or RB08-PC manufactured by Custom Connector Corp.

**Note:** Manufacturer’s recommended screw terminal torque for the OT series sockets is 12 in-lbs.

---

### Digi-Set Binary Switch Operation

<table>
<thead>
<tr>
<th>Setting</th>
<th>Release</th>
<th>0.1...1023</th>
<th>1...1023</th>
<th>10...1023</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
<td>0.8</td>
<td>1.6</td>
</tr>
<tr>
<td>64 S</td>
<td>128 S</td>
<td>256 S</td>
<td>512 S</td>
<td>1024 S</td>
</tr>
</tbody>
</table>

---

### Function Diagram

- **V = Voltage**
- **S1 = Initiate Switch**
- **NO = Normally Open Contact**
- **NC = Normally Closed Contact**
- **TD = Time Delay**
- **t = Incomplete Time Delay**
- **R = Reset**
- **= Undefined Time**

---

© 2023 Littelfuse, Inc.
**Description**

The TDUB Series combines digital timing circuitry with universal voltage operation. Voltages of 24 to 240VAC and 12 to 24VDC are available in three ranges. The TDUB Series offers DIP switch selectable time delays ranging from 0.1 seconds to 102.3 minutes in three ranges. Its 1A rated output, ability to operate on multiple voltages, and wide range of switch selectable time delays make the TDUB Series an excellent choice for process control systems and OEM equipment.

**Operation (Delay-on-Break)**

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch is opened (trailing edge triggered). The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP switch timing adjustment</td>
<td>Provides setting accuracy of +/-2%</td>
</tr>
<tr>
<td>User selectable time delay</td>
<td>Timing settings are switch selectable 0.1s - 102.3m in three ranges for added flexibility</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity.</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1015-13** (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE RANGE</th>
<th>TIME RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDUB3000A</td>
<td>24 to 120VAC</td>
<td>1-1023s</td>
</tr>
<tr>
<td>TDUB3002A</td>
<td>12 to 24VDC</td>
<td>1-1023s</td>
</tr>
<tr>
<td>TDUBH3002A</td>
<td>12 to 24VDC</td>
<td>0.1-102.3m</td>
</tr>
<tr>
<td>TDUBH3001A</td>
<td>100 to 240VAC</td>
<td>0.1-102.3m</td>
</tr>
<tr>
<td>TDUBL3002A</td>
<td>12 to 24VDC</td>
<td>0.1-102.3s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Specifications

Time Delay

Range*

0.1 - 102.3s in 0.1s increments
1 - 1023s in 1s increments
0.1 - 102.3m in 0.1m increments

Repeat Accuracy

≤ 0.5% or 20ms, whichever is greater

Setting Accuracy

≤ ±2% or 20ms, whichever is greater

Reset Time

≤ 150ms

Initiate Time

≤ 20ms

Time Delay vs. Temperature & Voltage

≤ ±5%

Input

Voltage/Tolerance

24 to 240VAC, 12 to 24VDC ±20%

AC Line Frequency/DC Ripple

50/60 Hz / ± 10%

Power Consumption

AC ≤ 2VA; DC ≤ 1W

Output

Type

Solid state

Form

NO, closed before and during timing

Rating

1A steady state, 10A inrush at 60°C

Voltage Drop

AC ≈ 2.5V @ 1A; DC ≈ 1V @ 1A

Off State Leakage Current

AC ≈ 5mA @ 230VAC; DC ≈ 1mA

Protection

Circuitry

Encapsulated

Dielectric Breakdown

≥ 2000V RMS terminals to mounting surface

Insulation Resistance

≥ 100 MΩ

Polarity

DC units are reverse polarity protected

Mechanical

Mounting

Surface mount with one #10 (M5 x 0.8) screw

Dimensions

H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)

Termination

0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature

-40° to 60°C / -40° to 85°C

Humidity

95% relative, non-condensing

Weight

≈ 2.4 oz (68 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.

Adjustment Switch Operation

<table>
<thead>
<tr>
<th>0.1...102.3</th>
<th>1...1023</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF ON</td>
<td>OFF ON</td>
</tr>
<tr>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>0.2</td>
<td>2</td>
</tr>
<tr>
<td>0.4</td>
<td>4</td>
</tr>
<tr>
<td>0.8</td>
<td>8</td>
</tr>
<tr>
<td>1.6</td>
<td>16</td>
</tr>
<tr>
<td>3.2</td>
<td>32</td>
</tr>
<tr>
<td>6.4</td>
<td>64</td>
</tr>
<tr>
<td>12.8</td>
<td>128</td>
</tr>
<tr>
<td>25.6</td>
<td>256</td>
</tr>
<tr>
<td>51.2</td>
<td>512</td>
</tr>
</tbody>
</table>

Add the value of switches in the ON position for the total time delay.

Function Diagram

V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
t = Incomplete Time Delay

DELAY-ON-BREAK (OFF-DELAY)

Littelfuse.com/tdub
Time Delay Relays
Dedicated — Delay-on-Break

THDB SERIES

Description
The THDB Series combines accurate timing circuitry with high power, solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, timers.

Operation (Delay-on-Break)
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output energizes if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat accuracy +/- 0.5%, Factory calibration +/- 1%</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct operation of motors, lamps and heaters without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and components costs</td>
</tr>
</tbody>
</table>

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>OUTPUT RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>THDB421A</td>
<td>120VAC</td>
<td>External</td>
<td>1 - 100s</td>
<td>6A</td>
</tr>
<tr>
<td>THDB434C</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100m</td>
<td>20A</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 19.
### Specifications

**Time Delay**
- Range: 0.1s - 1000m in 6 adjustable ranges or fixed
- Repeat Accuracy: ±0.5% or 20ms, whichever is greater
- Tolerance: ±1%
- Reset Time: ≤ 150ms
- Initialize Time: ≤ 20ms
- Time Delay vs Temp. & Voltage: ≤ ±2%

**Input**
- Voltage: 24, 120, or 230VAC
- Tolerance: ±20%
- AC Line Frequency: 50/60 Hz
- Power Consumption: ≤ 2VA

**Output**
- Type: Solid state
- Form: NO, closed before & during timing
- Maximum Load Current: A 6A; B 10A; C 20A
- Voltage Drop: ≅ 2.5V @ rated current
- Off State Leakage Current: ≅ 5mA @ 230VAC
- Minimum Load Current: 100mA

**Protection**
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions:
  - H: 50.8 mm (2.0”)
  - W: 50.8 mm (2.0”)
  - D: 38.4 mm (1.51”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals
- Environmental:
  - Operating/Storage:
    - Temperature: -40° to 60°C / -40° to 85°C
    - Humidity: 95% relative, non-condensing
  - Weight: 3.9 oz (111 g)

**Function Diagram**

- V = Voltage
- S1 = Initiate Switch
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- t = Incomplete TimeDelay
- R = Reset

**External Resistance vs. Time Delay**

This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the tie delay increases.

When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.

**Examples:**
- 1 to 50 s adjustable time delay, select time delay range 1 and a 50 K ohm RT.
- For 1 to 100 s use a 100 K ohm RT.

**Notes:**
- Must be bolted to a metal surface using the included heat sink compound. The maximum surface temperature is 90°C. Inrush: Non-repetitive for 16ms.
Description
The TRB series combines an isolated, 10 A electromechanical relay output with digital timing circuitry. False trigger of the TRB by a transient is unlikely because of the complete isolation of the circuit from the line prior to initiation. The initiate contact is common to one side of the line and may be utilized to operate other loads. Installation is easy due to the TRB’s industry standard 8- or 11-pin plug-in base wiring.

Operation (Delay-on-Break)
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened (trailing edge triggered). The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete isolation of circuit from line</td>
<td>No false trip due to transients</td>
</tr>
<tr>
<td>Industry standard 8 or 11-pin connection</td>
<td>Provides easy installation and field replacement</td>
</tr>
<tr>
<td>Isolated, 10 A, SPDT or DPDT output contacts</td>
<td>Allows control of loads for ac or dc voltages</td>
</tr>
<tr>
<td>Digital circuitry</td>
<td>Repeat accuracy +/- 2 %</td>
</tr>
</tbody>
</table>

Wiring Diagram

For dimensional drawing see: Appendix, page 512, Figure 24.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>OUTPUT FORM</th>
<th>TIME TOLERANCE</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRB120A2Y30</td>
<td>120 V ac</td>
<td>Onboard</td>
<td>Octal, SPDT</td>
<td>+/- 10 %</td>
<td>1–30 s</td>
</tr>
<tr>
<td>TRB120A3X600</td>
<td>120 V ac</td>
<td>Lock shaft</td>
<td>Octal, SPDT</td>
<td>+/- 20 %</td>
<td>7–600 s</td>
</tr>
<tr>
<td>TRB120A4Y120</td>
<td>120 V ac</td>
<td>Onboard</td>
<td>11-pin, DPDT</td>
<td>+/- 10 %</td>
<td>2–120 s</td>
</tr>
<tr>
<td>TRB24D10Y10</td>
<td>24 V dc/28 V dc</td>
<td>Fixed</td>
<td>11-pin, DPDT</td>
<td>+/- 10 %</td>
<td>10 s</td>
</tr>
</tbody>
</table>
### Time Delay Relays

#### Dedicated — Delay-on-Break

**Accessories**

- **OT08PC 8-pin Octal Socket for UL listing**
  Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10 A @ 600 V ac.

- **OT11PC Octal Socket for UL listing**
  11-pin surface & DIN rail mountable. Rated for 10 A @ 300 V ac.

- **P1011-6 Octal Socket for UL listing**
  8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

### Function Diagram

- **DELAY-ON-BREAK (OFF-DELAY)**
  - V = Voltage
  - S1 = Initiate Switch
  - NO = Normally Open Contact
  - NC = Normally Closed Contact
  - TD = Time Delay
  - t = Incomplete Time Delay
  - R = Reset
  - = Undefined Time

### Specifications

<table>
<thead>
<tr>
<th>Time Delay</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Digital circuitry</td>
</tr>
<tr>
<td>Range</td>
<td>See &quot;Ordering Information&quot; table</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±2 %</td>
</tr>
<tr>
<td>Fixed Time Tolerance &amp; Setting Accuracy</td>
<td>±5, 10, or 20 %</td>
</tr>
<tr>
<td>Initiate Time</td>
<td>≤ 70 ms</td>
</tr>
<tr>
<td>Reset Time</td>
<td>≤ 75 ms</td>
</tr>
<tr>
<td>Recycle Time</td>
<td>≤ 250 ms</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage</td>
<td>≤ ±5 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>24/28 V dc; 120 V ac</td>
</tr>
<tr>
<td>Indicator</td>
<td>LED indicates relay is energized</td>
</tr>
<tr>
<td>Tolerance</td>
<td>24V dc/ac -15 %–20 %</td>
</tr>
<tr>
<td></td>
<td>120 V ac -20 %–10 %</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>≤ 3.25W</td>
</tr>
</tbody>
</table>

### Output

- **Type**
  Electromechanical relay
- **Form**
  Isolated SPDT or DPDT
- **Rating**
  10 A resistive @ 120/240 V ac
  1/3 hp @ 120/240 V ac
  Mechanical - 1 x 10⁷; Electrical - 1 x 10⁶

### Life

- **Protection**
  ≥ 100 MΩ
- **Insulation Resistance**
  ≥ 1500 V RMS between input to output
- **Polarity**
  Dc units are reverse polarity protected
- **Mechanical Mounting**
  Plug-in socket
- **Dimensions**
  H 44.45 mm (1.75”); W 60.33 mm (2.38”); D (with socket) 104.78 mm (4.13”)
- **Termination**
  Octal 8-pin plug-in or 11-pin plug-in

### Environmental

- **Operating/Storage Temperature**
  -20 °C to 85 °C / -30 °C to 85 °C
- **Weight**
  4 oz (113 g)

### Safety Marks

- **UL (socket required)**
  UL 508 (E57310)

---

*UL Listed when used with Part Number OT08-PC, RB08-PC, OT11-PC, or RB11-PC manufactured by Custom Connector Corp.

**Note:** Manufacturer’s recommended screw terminal torque for the OT series sockets is 12 in-lbs.
Time Delay Relays
Dedicated — Delay-on-Break

TSB SERIES

Description
The TSB Series is a totally solid-state, delay-on-break timing module. The TSB Series is available with a fixed, external, or onboard adjustable time delay. Time Delays from 0.05 to 600 seconds, in 4 standard ranges, cover over 90% of all OEM and commercial appliance timing applications. The repeat accuracy is ±2%. Operating voltages of 24, 120, or 230VAC are available. The TSB’s 1A steady state, 10A rated, solid-state output is perfect for direct control of solenoids, contactors, relays, lamps, buzzers, and small heaters. The TSB Series can be surface mounted with a single screw, or snapped on a 35 mm DIN rail using the P1023-20 adaptor.

Operation (Delay-on-Break)
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch opens. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the output and the time delay.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry</td>
<td>Repeat accuracy +/− 2%, Factory calibration +/− 5%</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Wide time delay range</td>
<td>Meets almost all OEM and commercial appliance timing applications</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
</tbody>
</table>

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSB2190</td>
<td>24VAC</td>
<td>Fixed</td>
<td>90s</td>
<td>TSB434</td>
<td>120VAC</td>
<td>Onboard</td>
<td>5 - 600s</td>
</tr>
<tr>
<td>TSB222</td>
<td>24VAC</td>
<td>External</td>
<td>0.5 - 60s</td>
<td>TSB632</td>
<td>230VAC</td>
<td>Onboard</td>
<td>0.5 - 60s</td>
</tr>
<tr>
<td>TSB41300</td>
<td>120VAC</td>
<td>Fixed</td>
<td>300s</td>
<td>TSB634</td>
<td>230VAC</td>
<td>Onboard</td>
<td>5 - 600s</td>
</tr>
<tr>
<td>TSB422</td>
<td>120VAC</td>
<td>External</td>
<td>0.5 - 60s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 16.
**Accessories**

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Selection Guide**

<table>
<thead>
<tr>
<th>Desired Time Delay* (Seconds)</th>
<th>RT Selection Chart</th>
<th>RT (Kohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.3</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>0.6</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>0.9</td>
<td>18</td>
<td>40</td>
</tr>
<tr>
<td>1.2</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td>1.5</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>1.8</td>
<td>36</td>
<td>100</td>
</tr>
<tr>
<td>2.1</td>
<td>42</td>
<td>200</td>
</tr>
<tr>
<td>2.4</td>
<td>48</td>
<td>300</td>
</tr>
<tr>
<td>2.7</td>
<td>54</td>
<td>500</td>
</tr>
<tr>
<td>3.0</td>
<td>60</td>
<td>1000</td>
</tr>
</tbody>
</table>

*When selecting an external RT, add at least 20% for tolerance of unit and the RT.

**Specifications**

- **Time Delay**
  - Range: 0.05s - 600s in 4 adjustable ranges or fixed
  - Repeat Accuracy: ±2% or 20ms, whichever is greater
  - Tolerance: ≤ ±5%
  - Factory Calibration: ≤ ±10%
  - Time Delay vs Temp. & Voltage: ≤ 150ms
  - Reset Time: ≤ 200ms

- **Input**
  - Voltage: 24, 120, or 230VAC
  - Tolerance: ±20%
  - AC Line Frequency: 50/60 Hz
  - Power Consumption: ≤ 2VA

- **Output**
  - Type: Solid state
  - Form: NO, closed before & during timing
  - Maximum Load Current: 1A steady state, 10A inrush at 60°C
  - Off State Leakage Current: 5mA @ 230VAC
  - Voltage Drop: 2.5V @ 1A
  - Protection:
    - Circuitry: Encapsulated
    - Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
    - Insulation Resistance: ≥ 100 MΩ
    - Mechanical:
      - Mounting: Surface mount with one #10 (M5 x 0.8) screw
      - Dimensions: H 50.8 mm (2.0”), W 50.8 mm (2.0”), D 30.7 mm (1.21”)
      - Termination: 0.25 in. (6.35 mm) male quick connect terminals

- **Environmental**
  - Operating/Storage Temperature: -40° to 75°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
  - Weight: 2.4 oz (68 g)

**Function Diagram**

- V = Voltage
- S1 = Initiate Switch
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- t = Incomplete Time Delay
- R = Reset
- = Undefined Time
**TSDB SERIES**

**Description**

The TSDB Series is designed for more demanding commercial and industrial applications where small size, and accurate performance are required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the time delay.

The TSDB Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 1000 minutes are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

**Operation (Delay-on-Break)**

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat accuracy +/- 0.5%, Factory calibration +/- 1%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A Steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Wide temperature range: -40° to 75°C</td>
<td>Reliable in demanding commercial and industrial applications</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-13, P1004-13-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16)**
  Female Quick Connect
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>SWITCHING MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSDB320P</td>
<td>24VDC</td>
<td>External</td>
<td>0.1 - 10s</td>
<td>Positive</td>
</tr>
<tr>
<td>TSDB421</td>
<td>120VAC</td>
<td>External</td>
<td>1 - 100s</td>
<td>n/a</td>
</tr>
<tr>
<td>TSDB431</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>n/a</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
## Accessories

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
 Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

---

### External Resistance vs. Time Delay

<table>
<thead>
<tr>
<th>Time Delay (s)</th>
<th>R&lt;sub&gt;T&lt;/sub&gt; (KΩ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>25</td>
<td>32</td>
</tr>
<tr>
<td>50</td>
<td>64</td>
</tr>
<tr>
<td>75</td>
<td>128</td>
</tr>
<tr>
<td>100</td>
<td>256</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R<sub>T</sub> terminals; as the resistance increases the time delay increases.

When selecting an external R<sub>T</sub> add the tolerances of the timer and the R<sub>T</sub> for the full time range adjustment.

**Examples:**
- 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm R<sub>T</sub>. For 1 to 100 S use a 100 K ohm R<sub>T</sub>.

---

### Specifications

#### Time Delay
- **Range:** 0.1s - 1000m in 6 adjustable ranges or fixed
- **Repeat Accuracy:** ±0.5 % or 20ms, whichever is greater
- **Tolerance:** ≤ ±1%
- **Reset Time:** ≤ 150ms
- **Initiate Time:** ≤ 20ms
- **Time Delay vs Temp. & Voltage:** ≤ ±2%

#### Input
- **Voltage:** 12 or 24VDC; 24, 120, or 230VAC
- **Tolerance:** ±15%
- **Power Consumption:** AC ≤ 2VA; DC ≤ 1W

#### AC Line Frequency/DC Ripple
- 50/60 Hz / ≤ 10 %

#### Output
- **Type:** Solid state
- **Form:** NO, closed before & during timing
- **Maximum Load Current:** 1A steady state, 10A inrush at 60°C
- **Off State Leakage Current:** 5mA @ 230VAC; DC <= 1mA
- **Voltage Drop:** 2.5V @ 1A; DC <= 1V @ 1A
- **DC Operation:** Positive or negative switching
- **Protection:** Encapsulated
- **Dielectric Breakdown:** ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance:** ≥ 100 MΩ
- **Polarity:** DC units are reverse polarity protected
- **Mechanical:** Surface mount with one #10 (M5 x 0.8) screw
- **Mounting:** H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 30.7 mm (1.21”)
- **Termination:** 0.25 in. (6.35 mm) male quick connect terminals

#### Environmental
- **Temperature:** -40° to 75°F / -40° to 85°F
- **Humidity:** 95% relative, non-condensing
- **Weight:** 2.4 oz (68 g)
**Description**

The HRDS Series combines an electromechanical relay output with microcontroller timing circuitry. It offers 12 to 230V operation in five options and factory fixed, onboard or external adjustable time delays with a repeat accuracy of ±0.5%. The output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blower motors, heaters, etc. This series is ideal for OEM applications where cost is a factor.

**Operation (Single Shot)**

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output relay energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Isolated, 30A, SPDT, NO output contacts</td>
<td>Allows direct operation of heavy loads: compressors, pumps, blower motors, heaters.</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16)**
  Female Quick Connect
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRDS120</td>
<td>12VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>HRDS313M</td>
<td>24VDC</td>
<td>Fixed</td>
<td>3m</td>
</tr>
<tr>
<td>HRDS321</td>
<td>24VDC</td>
<td>Onboard</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>HRDS421</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>HRDS430</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 10s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
**Accessories**

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**External Resistance vs. Time Delay**

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R termial, as the resistance increases the time delay increases.

Examples: To 50 s adjustable time delay, select time delay range 1 and a 50 K ohm R. For 1 to 100 s use a 100 K ohm R.

**Specifications**

**Time Delay**

- **Type**: Microcontroller circuitry
- **Range**: 0.1s - 100m in 5 adjustable ranges or fixed
- **Reset Accuracy**: ±0.5% or 20 ms, whichever is greater
- **Tolerance**: ±1%, ±5%
- **Reset Time**: ≤ 150ms
- **Initiate Time**: ≤ 20ms
- **Time Delay vs Temp. & Voltage**
- **Input**
  - **Voltage**: 12 or 24VDC; 24, 120, or 230VAC
  - **Tolerance**: ±2%
- **Output**
  - **Type**: Electromechanical relay
  - **Form**: SPDT, non-isolated
- **Ratings**
  - **General Purpose**: 125/240VAC
    - SPDT-NO: 30A, 15A
    - SPDT-NC: 30A, 15A
  - **Resistive**: 125/240VAC
    - 28VDC: 20A, 10A
  - **Motor Load**: 125VAC
    - 2 hp**: 1/4 hp**
    - 240VAC: 2 hp**, 1 hp**
- **Life**
  - **Mechanical**: 1 x 10^6
  - **Electrical**: -1 x 10^9
- **Protection**
  - **Surge**: IEEE C62.41-1991 Level A
  - **Circuitry**: Encapsulated
  - **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
  - **Insulation Resistance**: ≥ 100 MΩ
  - **Polarity**: DC units are reverse polarity protected
- **Mechanical**
  - **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
  - **Dimensions**: H 76.7 mm (3"), W 51.3 mm (2""); D 38.1 mm (1.5")
  - **Termination**: 0.25 in. (6.35 mm) male quick connect terminals
- **Environmental**
  - **Operating/Storage Temperature**: -40° to 60°C/-40° to 85°C
  - **Humidity**: 95% relative, non-condensing
  - **Weight**: 3.9 oz (111 g)
Description
The HSPZA22SL is a factory programmed module available in any 1 of 13 standard functions. The HSPZA22SL offers dual switch adjustable timer or counter functions. Switch adjustment allows accurate selection of the time delay or number of counts the first time and every time. The 1A steady, 10A inrush rated solid-state output provides 100 million operations, typical. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The HSPZA22SL is a cost effective approach for OEM applications that require small size, solid state reliability, and accurate switch adjustment.

Operation (Single Shot Lockout)
Upon application of input voltage and momentary or maintained closure of S1, the output relay energizes and TD1 single shot time delay begins. The output relay de-energizes at the end of TD1 and the TD2 lockout time delay begins. During TD2 (and TD1) closing switch S1 has no effect on the operation. After TD2 is complete, closing S1 starts another operation. If S1 is closed when input voltage is applied, the output energizes and the TD1 time delay begins.

Reset: Removing input voltage resets the time delays and the output and returns the cycle to the first delay.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.1%</td>
</tr>
<tr>
<td>User selectable time delay</td>
<td>Timing settings are switch selectable 0.1s - 1023h in a dual switch timer function for added flexibility</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid-state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.
### Switch Adjustment

<table>
<thead>
<tr>
<th>Adjustment Switch Operation</th>
<th>Time Delay</th>
<th>Time Delay and Counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
</tr>
<tr>
<td>1.9</td>
<td>2.0</td>
<td>2.1</td>
</tr>
<tr>
<td>2.5</td>
<td>2.6</td>
<td>2.7</td>
</tr>
<tr>
<td>3.1</td>
<td>3.2</td>
<td>3.3</td>
</tr>
<tr>
<td>3.7</td>
<td>3.8</td>
<td>3.9</td>
</tr>
<tr>
<td>4.3</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>4.9</td>
<td>5.0</td>
<td>5.1</td>
</tr>
<tr>
<td>5.5</td>
<td>5.6</td>
<td>5.7</td>
</tr>
<tr>
<td>6.1</td>
<td>6.2</td>
<td>6.3</td>
</tr>
<tr>
<td>6.7</td>
<td>6.8</td>
<td>6.9</td>
</tr>
<tr>
<td>7.3</td>
<td>7.4</td>
<td>7.5</td>
</tr>
<tr>
<td>7.9</td>
<td>8.0</td>
<td>8.1</td>
</tr>
<tr>
<td>8.5</td>
<td>8.6</td>
<td>8.7</td>
</tr>
<tr>
<td>9.1</td>
<td>9.2</td>
<td>9.3</td>
</tr>
<tr>
<td>9.7</td>
<td>9.8</td>
<td>9.9</td>
</tr>
<tr>
<td>10.3</td>
<td>10.4</td>
<td>10.5</td>
</tr>
<tr>
<td>10.9</td>
<td>11.0</td>
<td>11.1</td>
</tr>
<tr>
<td>11.5</td>
<td>11.6</td>
<td>11.7</td>
</tr>
<tr>
<td>12.1</td>
<td>12.2</td>
<td>12.3</td>
</tr>
<tr>
<td>12.7</td>
<td>12.8</td>
<td>12.9</td>
</tr>
<tr>
<td>13.3</td>
<td>13.4</td>
<td>13.5</td>
</tr>
<tr>
<td>13.9</td>
<td>14.0</td>
<td>14.1</td>
</tr>
<tr>
<td>14.5</td>
<td>14.6</td>
<td>14.7</td>
</tr>
<tr>
<td>15.1</td>
<td>15.2</td>
<td>15.3</td>
</tr>
<tr>
<td>15.7</td>
<td>15.8</td>
<td>15.9</td>
</tr>
</tbody>
</table>

### Function Diagrams

- **V** = Voltage
- **S1** = Initiate Switch
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD1, TD2** = Time Delay
- **R** = Reset

#### Specifications

**Time Delay**
- **Type**: Microcontroller circuitry
- **Range**: 1-1023s, m or h in 1s, m or h increments
- **Repeat Accuracy**: ±0.1% or 20ms, whichever is greater
- **Setting Accuracy**: ≤ ±1% or 20ms, whichever is greater
- **Reset Time**: ≤ 150ms
- **Initiate Time**: ≤ 20ms
- **Time Delay vs Temp. & Voltage**: ≤ ±2%
- **Count Range**: 1 - 1023 in 2 ranges
- **Count Rate**: ≤ 25 counts per second

**Input**
- **Voltage**: 24 to 240VAC
- **Tolerance**: ≤ ±15%
- **AC Line Frequency/DC Ripple**: 50/60Hz / ≤ 10%

**Output**
- **Type**: Solid-state output
- **Rating**: 1A steady, 10A inrush for 16ms
- **Voltage Drop**: AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
- **OFF State Leakage Current**: AC ≅ 5mA @ 240VAC; DC ≅ 1mA
- **Counter Output**: Output pulse width: 300ms ±20%

**Protection**
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 76.2 mm (3.0”); W 50.8 mm (2.0”); D 38.1 mm (1.5”)
- **Termination**: 0.25 in. (6.35 mm) male quick connects

**Environmental**
- **Operating/Storage Temperature**: -40° to 60°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 3.9 oz (111 g)
Description
The KRDS Series is a compact time delay relay measuring only 2 in. (50.8 mm) square. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDS Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Single Shot)
Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output relay energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact, low cost design measuring 2 in. (50.8mm) square</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / -0.5%, Factory calibration + / -5%</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>To protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.
KRDS SERIES

Time Delay Relays
Dedicated — Single Shot

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals, as the resistance increases the time delay increases.

When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.

Examples: 1 to 50 s adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Output Current/Ambient Temperature

Specifications

Time Delay
Type
Microcontroller with watchdog circuitry
Range
0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy
±0.5% or 20ms, whichever is greater
Tolerance
≤ ±5%
Reset Time
≤ 150ms
Initiate Time
≤ 40ms
Time Delay vs Temp.
& Voltage
≤ ±5%
Output
Type
Isolated relay contacts
Form
SPDT
Rating (at 40°C)
10A resistive @ 125VAC;
5A resistive @ 230VAC & 28VDC;
1/4 hp @ 125VAC
Mechanical - 1 x 10⁷; Electrical - 1 x 10⁴
Life (Operations)
Protection
Circuitry
Encapsulated
Isolation Voltage
≥ 1500V RMS input to output
Insulation Resistance
≥ 100 MΩ
Polarity
DC units are reverse polarity protected
Mechanical
Mounting
Surface mount with one #10 (M5 x 0.8) screw
Dimensions
H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 30.7 mm (1.21”)
Termination
Environmental
Operating/Storage
Temperature
-40° to 60°C/-40° to 85°C
Humidity
95% relative, non-condensing
Weight
≈ 2.6 oz (74 g)

Function Diagram

V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
Description
The KSDS Series is ideal for applications that require momentary start interval timing including dispensing, exposure timing, or pulse shaping. This series is available for both AC and DC voltages. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Single Shot)
Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will not energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%, Factory calibration +/- 5%</td>
</tr>
<tr>
<td>1A Steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
</tbody>
</table>

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
### Accessories

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### External Resistance vs. Time Delay

#### In Socs. or Mins.

<table>
<thead>
<tr>
<th>Time Delay Ranges</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>10</td>
<td>7.5</td>
<td>5.0</td>
<td>2.5</td>
<td>1.0</td>
<td>0.5</td>
<td>0.25</td>
<td>0.1</td>
<td>0.05</td>
<td>0.01</td>
<td>0.005</td>
<td>0.0025</td>
<td>0.00125</td>
<td>0.000625</td>
<td>0.0003125</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the \( R_T \) terminals, as the resistance increases the tie delay increases.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm \( R_T \). For 1 to 100 S use a 100 K ohm \( R_T \).

### Function Diagram

**SINGLE SHOT (PULSE FORMER)**

- **V** = Voltage
- **S1** = Initiate Switch
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD** = Time Delay
- **R** = Reset

### Specifications

**Time Delay**
- Range: 0.1s - 1000m in 6 adjustable ranges or fixed
- Repeat Accuracy: ±0.5 % or 20ms, whichever is greater
- Tolerance (Factory Calibration): ≤ ±5%
- Reset Time: ≤ 150ms
- Initiate Time: ≤ 20ms
- Time Delay vs Temp. & Voltage: ≤ ±10%

**Input**
- Voltage: 12 or 24VDC; 24, 120, or 230VAC
- Tolerance: ±20%
- AC Line Frequency/DC Ripple: 50/60 Hz / ≤ 10 %
- Power Consumption:
  - AC ≤ 2VA
  - DC ≤ 1W

**Output**
- Type: Solid state
- Form: NO, closed during timing
- Maximum Load Current: 1A steady state, 10A inrush at 60°C
- OFF State Leakage Current: AC ≈ 5mA @ 230VAC; DC ≈ 1mA
- Voltage Drop: AC ≈ 2.5V @ 1A; DC ≈ 1V @ 1A
- DC Operation: Positive or negative switching

**Protection**
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ
- Polarity: DC units are reverse polarity protected

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions:
  - H: 50.8 mm (2.0”)
  - W: 50.8 mm (2.0”)
  - D: 30.7 mm (1.21”)
- Termination:
  - Environmental Operating/Storage:
    - Temperature: -40° to 60°C / -40° to 85°C
    - Humidity: 95% relative, non-condensing
- Weight: ≈ 2.4 oz (68 g)
Description
The ORS Series’ open PCB construction offers the user good economy without sacrificing performance and reliability. The output relay is available in isolated, 10A, DPDT or SPDT forms. The time delay may be ordered as factory fixed, onboard knob, or external adjustment. All connections are 0.25 in. (6.35 mm) male quick connect terminals.

Operation (Single Shot)
Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output relay energizes for a measured interval of time. At the end of the time delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open PCB construction</td>
<td>Reduces cost without sacrificing performance and reliability</td>
</tr>
<tr>
<td>Analog circuitry</td>
<td>Repeat accuracy +/- 2%, Factory calibration +/- 10%</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT or DPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Line voltage initiation</td>
<td>Separate control voltage is not required for operation</td>
</tr>
</tbody>
</table>

Accessories

**P1004-12, P1004-12-X Versa-Pot**
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

**P0700-7 Versa-Knob**
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**P1015-64 (AWG 14/16)**
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>OUTPUT FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORS120A150SD</td>
<td>120VAC</td>
<td>Fixed</td>
<td>50s</td>
<td>DPDT</td>
</tr>
<tr>
<td>ORS230A150SD</td>
<td>230VAC</td>
<td>Fixed</td>
<td>50s</td>
<td>DPDT</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 26.
Selection Guide

<table>
<thead>
<tr>
<th>Desired Time Delay*</th>
<th>Rₜ Selection Chart</th>
<th>Rₜ</th>
<th>Time Delay vs Temp. &amp; Voltage</th>
<th>Time Delay vs Temp. &amp; Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.05 0.5 1.0 2.0 3.0 6.0</td>
<td>0.0 1.0 2.0 4.0 10 30</td>
<td>100 150 200 300</td>
<td>±10%</td>
</tr>
<tr>
<td>2</td>
<td>0.05 0.5 1.0 2.0 3.0 6.0</td>
<td>0.0 1.0 2.0 4.0 10 30</td>
<td>100 150 200 300</td>
<td>±10%</td>
</tr>
<tr>
<td>3</td>
<td>0.05 0.5 1.0 2.0 3.0 6.0</td>
<td>0.0 1.0 2.0 4.0 10 30</td>
<td>100 150 200 300</td>
<td>±10%</td>
</tr>
<tr>
<td>4</td>
<td>0.05 0.5 1.0 2.0 3.0 6.0</td>
<td>0.0 1.0 2.0 4.0 10 30</td>
<td>100 150 200 300</td>
<td>±10%</td>
</tr>
<tr>
<td>5</td>
<td>0.05 0.5 1.0 2.0 3.0 6.0</td>
<td>0.0 1.0 2.0 4.0 10 30</td>
<td>100 150 200 300</td>
<td>±10%</td>
</tr>
</tbody>
</table>

* When selecting an external Rₜ, add at least 20% for tolerance of unit and the Rₜ.

Specifications

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>Analog circuitry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>0.05 - 300s in 5 adjustable ranges or fixed</td>
</tr>
<tr>
<td>Range</td>
<td>±2% or 20ms, whichever is greater</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±2% or 20ms, whichever is greater</td>
</tr>
<tr>
<td>Tolerance</td>
<td>Adjustable: guaranteed range</td>
</tr>
<tr>
<td>Factory Calibration</td>
<td>Fixed: ±10%</td>
</tr>
<tr>
<td>Reset Time</td>
<td>≤ 50ms</td>
</tr>
<tr>
<td>Initiate Time</td>
<td>≤ 70ms</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage</td>
<td>≤ ±10%</td>
</tr>
</tbody>
</table>

Input

<table>
<thead>
<tr>
<th>Voltage</th>
<th>24, 120, or 230VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>24VAC: -15% - 20%</td>
</tr>
<tr>
<td></td>
<td>120 &amp; 230VAC: -20% - 10%</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>2.25W</td>
</tr>
</tbody>
</table>

Output

<table>
<thead>
<tr>
<th>Type</th>
<th>Electromechanical relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Isolated, SPDT or DPDT</td>
</tr>
<tr>
<td>Rating</td>
<td>10A resistive @ 120/240VAC &amp; 28VDC; 1/3 hp @ 120/240VAC</td>
</tr>
<tr>
<td>Life</td>
<td>Mechanical - 1x10⁷; Electrical - 1x10⁶</td>
</tr>
</tbody>
</table>

Protection

<table>
<thead>
<tr>
<th>Isolation Voltage</th>
<th>≥1500V RMS input to output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical</td>
<td>Surface mount with four #6 (M3.5 x 0.6) screws</td>
</tr>
<tr>
<td>Mounting</td>
<td>H 53.8 mm (2.12’’); W 93.7 mm (3.69’’); D 47.8 mm (1.88’’);</td>
</tr>
<tr>
<td>Dimensions</td>
<td>0.25 in. (6.35 mm) male quick connect terminals</td>
</tr>
</tbody>
</table>

Environmental

<table>
<thead>
<tr>
<th>Operating/Storage</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating/Storage</td>
<td>-20° to 65°C / -30° to 85°C</td>
</tr>
<tr>
<td>Weight</td>
<td>2.7 oz (77 g)</td>
</tr>
</tbody>
</table>
Description
The PRS65 is a single shot time delay relay for use on non-critical timing applications. The knob adjustable time delay carries a guaranteed time range of up to 8 minutes.

Operation
Power must be applied to the input at all times prior to and during timing. Upon closure of the initiate switch (momentary or maintained) the output contacts transfer and the time delay is initiated. At the end of the delay interval, the output contacts revert to their original position. If the initiate switch is reclosed during timing, the time delay will not be affected.

Features & Benefits
- Electronic Circuit with Electromechanical Relay
- Popular Operating Voltages
- Octal Plug-in
- Hold Down Clamps Available

Accessories
- **BZ1 Front Panel Mount Kit**
  Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.
- **NDS-8 Octal 8-pin Socket**
  8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

Specifications

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time Delay</strong></td>
<td>Analog circuitry</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>7 to 480 seconds</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>±2% under fixed conditions</td>
</tr>
<tr>
<td><strong>Repeat Accuracy</strong></td>
<td>Knob adjustable: guaranteed range</td>
</tr>
<tr>
<td><strong>Tolerance</strong></td>
<td>80ms max.</td>
</tr>
<tr>
<td><strong>Reset Time</strong></td>
<td>16ms max.</td>
</tr>
<tr>
<td><strong>Recycle Time</strong></td>
<td>0.1% of max. time delay or 75ms, whichever is greater</td>
</tr>
<tr>
<td><strong>After Timing</strong></td>
<td>15% max.</td>
</tr>
<tr>
<td><strong>During Timing</strong></td>
<td>1% of nominal</td>
</tr>
<tr>
<td><strong>Input Voltage</strong></td>
<td>230VAC, nominal</td>
</tr>
<tr>
<td><strong>Tolerance</strong></td>
<td>±15% of nominal</td>
</tr>
<tr>
<td><strong>AC Line Frequency</strong></td>
<td>50/60 Hz</td>
</tr>
<tr>
<td><strong>Output Type</strong></td>
<td>Relay</td>
</tr>
<tr>
<td><strong>Form</strong></td>
<td>Single Pole, Double Throw</td>
</tr>
<tr>
<td><strong>Rating</strong></td>
<td>10 amperes resistive at 240VAC</td>
</tr>
<tr>
<td><strong>Protection Transient</strong></td>
<td>±1500 volts for 150 microseconds</td>
</tr>
<tr>
<td><strong>Dielectric Breakdown</strong></td>
<td>≥1500 V rms min. at 60 Hz between input and output terminals</td>
</tr>
<tr>
<td><strong>Mechanical Mounting</strong></td>
<td>Plug in (hold-down clips for panel mounting also available)</td>
</tr>
<tr>
<td><strong>Termination Standard Octal Plug-in</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>H 92.2 mm (3.63”), W 60.45 mm (2.38”), D 44.45 mm (1.75&quot;)</td>
</tr>
<tr>
<td><strong>Environmental Operating/Storage Temperature</strong></td>
<td>-20°C to 65°C / -30°C to 85°C</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>95% relative, non-condensing</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>Approx. 6 oz (170 g)</td>
</tr>
</tbody>
</table>
### Description

The TDS series combines accurate digital circuitry with isolated, 10 A rated, DPDT or SPDT relay contacts in an 8-pin or 11-pin plug-in package. The TDS series features DIP switch selectable time delays ranging from 0.1 s to 10,230 s in three ranges. The TDS series is the product of choice for custom control panel and OEM designers.

### Operation (Single Shot)

Input voltage must be applied to the input before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output relay energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

### Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 time ranges available (0.1 s to 2.8 h)</td>
<td>Makes it versatile for use in many applications</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.1 % or 20 ms, whichever is greater; Setting Accuracy +/- 2 % or 50 ms, whichever is greater</td>
</tr>
<tr>
<td>LED indication (select models)</td>
<td>Provides visual indication of relay status</td>
</tr>
<tr>
<td>DIP switch adjustment</td>
<td>Provides first time setting accuracy</td>
</tr>
<tr>
<td>Isolated output contacts</td>
<td>Allows control of loads for ac or dc voltages</td>
</tr>
</tbody>
</table>

### Wiring Diagram

8-PIN OCTAL SPDT

11-PIN DPDT

S1 = Initiate Switch

Relay contacts are isolated.

**For dimensional drawing see: Appendix, page 512, Figure 23.**

### Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>DELAY RANGE (SEC)</th>
<th>LED</th>
<th>PLUG TYPE/OUTPUT FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDS120AL</td>
<td>120 V ac</td>
<td>1–1023 in 1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDS120ALD</td>
<td>120 V ac</td>
<td>1–1023 in 1 s increments</td>
<td>X</td>
<td>11-pin plug, DPDT</td>
</tr>
<tr>
<td>TDS12D</td>
<td>12 V dc</td>
<td>1–1023 in 1 s increments</td>
<td></td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDS230AL</td>
<td>230 V ac</td>
<td>1–1023 in 1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDS24AL</td>
<td>24 V ac</td>
<td>1–1023 in 1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDSH120AL</td>
<td>120 V ac</td>
<td>10–10230 in 10 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
<tr>
<td>TDSL120AL</td>
<td>120 V ac</td>
<td>0.1–102.3 in 0.1 s increments</td>
<td>X</td>
<td>Octal (8-pin) plug, SPDT</td>
</tr>
</tbody>
</table>
Accessories

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10 A @ 600 V ac.

OT11PC Octal Socket for UL listing*
11-pin surface & DIN rail mountable. Rated for 10 A @ 300 V ac

P1011-6 Octal Socket for UL listing*
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

Digi-Set Binary Switch Operation

Specifications

Time Delay
Type: Digital integrated circuitry
Range:
- 0.1–102.3 s in 0.1 s increments
- 1–1023 s in 1 s increments
- 10–10,230 s in 10 s increments
Repeat Accuracy: ± 0.1 %
Setting Accuracy: ± 2 %
Reset Time: ≤ 150 ms
Time Delay vs Temp. & Voltage: ± 5 %
Indicator: LED glows during timing; relay is energized
Initiate Time: ≤ 60 ms
Input
Voltage Tolerance:
- 12 V dc; 24, 120, or 230 V ac
- 12 V dc & 24 V dc/ac: -15 %–20 %
- 110 to 230 V dc/ac: -20 %–10 %
AC Line Frequency: 50/60 Hz
Power Consumption: ≤ 3.25W
Output
Type: Electromechanical relay
Form: SPDT or DPDT
Rating:
- 10 A resistive @ 120/240 V ac
- 1/3 hp @ 120/240 V ac
Life:
- Mechanical - 1 x 10⁷
- Electrical - 1 x 10⁴
Protection
Isolation Voltage: ≥ 1500 V RMS input to output
Polarity: Dc units are reverse polarity protected
Mechanical
Mounting: Plug-in socket
Termination: Octal 8-pin plug-in or 11-pin plug-in
Dimensions:
- H 44.45 mm (1.75”); W 60.33 mm (2.38”); D (with socket) 104.78 mm (4.13”)
Environmental
Operating/Storage Temperature: -20 °C to 65 °C/-30 °C to 85 °C
Weight: ≤ 4 oz (113 g)
Safety Marks
UL (socket required)*: UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC, RB08-PC, OT11-PC, or RB11-PC manufactured by Custom Connector Corp.

Note: Manufacturer’s recommended screw terminal torque for the OT Series sockets is 12 in-lbs.
**Description**

The TDUS Series combines digital timing circuitry with universal voltage operation. Voltages of 24 to 240VAC and 12 to 24VDC are available in three ranges. The TDUS Series offers DIP switch selectable time delays ranging from 0.1 seconds to 102.3 minutes in three ranges. Its 1A rated output, ability to operate on multiple voltages, and wide range of switch selectable time delays make the TDUS Series an excellent choice for process control systems and OEM equipment.

**Operation (Single Shot)**

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.1%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>TIME RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDUS3000A</td>
<td>24 to 120VAC</td>
<td>1 - 1023s</td>
</tr>
<tr>
<td>TDUS3001A</td>
<td>100 to 240VAC</td>
<td>1 - 1023s</td>
</tr>
<tr>
<td>TDUS3002A</td>
<td>12 to 24VDC</td>
<td>1 - 1023s</td>
</tr>
<tr>
<td>TDUSH3001A</td>
<td>100 to 240VAC</td>
<td>0.1 - 102.3m</td>
</tr>
<tr>
<td>TDUSL3000A</td>
<td>24 to 120VAC</td>
<td>0.1 - 102.3s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
Specifications

Time Delay
Range* 0.1 - 102.3s in 0.1s increments
1 - 1023s in 1s increments
0.1 - 102.3ms in 0.1ms increments
Repeat Accuracy ±0.5% or 20 ms, whichever is greater
Setting Accuracy ≤ ±2% or 20 ms, whichever is greater
Reset Time ≤ 150ms
Initiate Time ≤ 20ms
Time Delay vs. Temperature & Voltage ≤ ±5%

Input
Voltage/Tolerance 24 to 240VAC, 12 to 24VDC /±20%
AC Line Frequency/DC Ripple 50/60 Hz / ≤ 10%
Power Consumption AC ≤ 2VA; DC ≤ 1W

Output
Type Solid state
Form NO, closed during timing
Rating 1A steady state, 10A inrush at 60°C
Voltage Drop AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
Off State Leakage Current AC ≅ 5mA @ 230VAC; DC ≅ 1mA

Protection
Circuitry Encapsulated
Dielectric Breakdown ≥ 2000V RMS terminals to mounting surface
Insulation Resistance ≥ 100 MΩ
Polarity DC units are reverse polarity protected

Mechanical
Mounting Surface mount with one #10 (M5 x 0.8) screw
Dimensions H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
Termination 0.25 in. (6.35 mm) male quick connect terminals

Environmental
Operating/Storage Temperature -40° to 60°C / -40° to 85°C
Humidity 95% relative, non-condensing
Weight ≅ 2.4 oz (68 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.

Adjustment Switch Operation

Function Diagram
**Description**

The THC/THS Series is a solid-state relay and timer combined into one compact, easy-to-use control. When mounted to a metal surface, the THC/THS Series may be used to directly control lamp or heater loads of up to 20A steady, 200A inrush. Its single shot function can perform dispensing and pulse shaping operations. The initiate switch can be a momentary or maintained type of switch. Time delays can be selected from 0.1 - 600 seconds in 4 ranges. The THC/THS Series is used for coin vending applications where fast initiate response is required.

**Operation (Single Shot)**

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Reset occurs when the time delay is complete and the initiate switch opens. Loss of input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry</td>
<td>Repeat accuracy +/- 2%, Factory calibration +/- 5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and component costs</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct operation of motors, lamps, and heaters directly without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

---

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>OUTPUT RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>THC421C</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 3s</td>
<td>20A</td>
</tr>
<tr>
<td>THS422B</td>
<td>120VAC</td>
<td>External</td>
<td>0.5 - 60s</td>
<td>10A</td>
</tr>
<tr>
<td>THS422C</td>
<td>120VAC</td>
<td>External</td>
<td>0.5 - 60s</td>
<td>20A</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 19.
**Selection Guide**

<table>
<thead>
<tr>
<th>Desired Time Delay (Seconds)</th>
<th>$R_T$ (Kohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.5</td>
</tr>
<tr>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>0.6</td>
<td>12</td>
</tr>
<tr>
<td>0.9</td>
<td>18</td>
</tr>
<tr>
<td>1.2</td>
<td>24</td>
</tr>
<tr>
<td>1.5</td>
<td>30</td>
</tr>
<tr>
<td>1.8</td>
<td>36</td>
</tr>
<tr>
<td>2.1</td>
<td>42</td>
</tr>
<tr>
<td>2.4</td>
<td>48</td>
</tr>
<tr>
<td>2.7</td>
<td>54</td>
</tr>
<tr>
<td>3.0</td>
<td>60</td>
</tr>
</tbody>
</table>

*When selecting an external $R_T$ add at least 20% for tolerance of unit and the $R_T$."

**Specifications**

- **Time Delay**
  - Range: 0.1 - 600s in 4 adjustable ranges or fixed
  - Repeat Accuracy: $\pm 2\%$ or 20ms, whichever is greater
  - Tolerance (Factory Calibration): $\leq \pm 5\%$
  - Reset Time: $\leq 150$ms
  - Initiate Time: $\leq 20$ms
  - Time Delay vs Temp. & Voltage: $\leq \pm 10\%$

- **Input**
  - Voltage: 24, 120, or 230VAC
  - Tolerance: $\pm 15\%$
  - AC Line Frequency: 50/60 Hz

- **Power Consumption**
  - $\leq 2$VA

- **Output**
  - Type: Solid state
  - Form: NO, closed during timing
  - Maximum Load Currents: Solid state
    - A: 6A, 60A
    - B: 10A, 100A
    - C: 20A, 200A

- **Minimum Load Current Voltage Drop**
  - $\leq 2.5$V at rated current

- **OFF State Leakage Current**
  - $\leq 5$mA @ 230VAC

- **Protection**
  - Circuitry: Encapsulated
  - Dielectric Breakdown: $\geq 2000$V RMS terminals to mounting surface
  - Insulation Resistance: $\geq 100$ MΩ

- **Mechanical**
  - Mounting:** Surface mount with one #10 (M5 x 0.8) screw
  - Dimensions:** H 50.8 mm (2.0”); W 50.8 mm (2.0’’);
  - D 38.4 mm (1.51’’)

- **Termination**
  - 0.25 in. (6.35 mm) male quick connect terminals

- **Environmental**
  - Operating/Storage Temperature: -20° to 60°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
  - Weight:** $\leq 3.9$ oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms."
Description
The THDS Series combines accurate timing circuitry with high power solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, timers.

Operation (Single Shot)
Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no effect on the time delay. The output energizes if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%, Factory calibration +/- 1%</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct operation of motors, lamps and heaters without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and component costs</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>OUTPUT RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>THDS410.25SA</td>
<td>120VAC</td>
<td>Fixed</td>
<td>0.25s</td>
<td>6A</td>
</tr>
<tr>
<td>THDS431C</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>20A</td>
</tr>
<tr>
<td>THDS610.25SA</td>
<td>230VAC</td>
<td>Fixed</td>
<td>0.25s</td>
<td>6A</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 19.
External Resistance vs. Time Delay

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the \( R_T \) terminals; as the resistance increases the time delay increases.

When selecting an external \( R_T \), add the tolerances of the timer and the \( R_T \) for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 k\( \Omega \) \( R_T \). For 1 to 100 S use a 100 k\( \Omega \) \( R_T \).

Function Diagram

- \( V \) = Voltage
- \( S1 \) = Initiate Switch
- \( NO \) = Normally Open Contact
- \( NC \) = Normally Closed Contact
- \( TD \) = Time Delay
- \( R \) = Reset

Specifications

- **Time Delay Range**: 0.1s - 1000m in 6 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5% or 20ms, whichever is greater
- **Tolerance**:
  - (Factory Calibration): ≤ ±1%
  - Reset Time: ≤ 150ms
  - Initiate Time: ≤ 20ms
  - Time Delay vs Temp. & Voltage: ≤ ±2%
- **Input**
  - Voltage: 24, 120, or 230VAC
  - Tolerance: ±20%
  - AC Line Frequency: 50/60 Hz
  - Power Consumption: ≤ 2VA
- **Output**
  - Type: Solid state
  - Form: NO, closed during timing
  - Maximum Load Current: See table below
- **Voltage Drop**: 2.5V @ rated current
- **Off State Leakage Current**: 5mA @ 230VAC
  - Minimum Load Current: 100mA
- **Protection**
  - Circuitry: Encapsulated
  - Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
  - Insulation Resistance: ≥ 100 MΩ
- **Mechanical**
  - Mounting**: Surface mount with one #10 (M5 x 0.8) screw
  - Dimensions: H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 38.4 mm (1.51”)
  - Termination: 0.25 in. (6.35 mm) male quick connect terminals
- **Environmental**
  - Operating/Storage Temperature: -40° to 60°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
  - Weight: 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.**
Time Delay Relays
Dedicated — Single Shot

TRS SERIES

Description
The TRS series combines an isolated, 10 A electromechanical, relay output with digital timing circuitry. False trigger of the TRS series by a transient is unlikely because of the complete isolation of the circuit from the line prior to initiation. The initiate contact is common to one side of the line and may be utilized to operate other loads. Installation is easy due to the TRS’s industry standard 8 or 11-pin plug-in base wiring.

Operation (Single Shot)
Input voltage must be applied to the input before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. Applying input voltage with the initiate switch closed will energize the load and begin the time delay.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete isolation of circuit from line</td>
<td>No false trip due to transients</td>
</tr>
<tr>
<td>Industry standard octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
<tr>
<td>Isolated, 10 A, SPDT or DPDT output contacts</td>
<td>Allows control of loads for ac or dc voltages</td>
</tr>
<tr>
<td>Digital circuitry</td>
<td>Repeat accuracy +/- 2 %</td>
</tr>
</tbody>
</table>

Wiring Diagram

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>OUTPUT FORM</th>
<th>TIME TOLERANCE</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRS120A2X300</td>
<td>120 V ac</td>
<td>Knob</td>
<td>8-Pin, Octal, SPDT</td>
<td>+/- 20 %</td>
<td>7–300s</td>
</tr>
<tr>
<td>TRS120A2Y10</td>
<td>120 V ac</td>
<td>Knob</td>
<td>8-Pin, Octal, SPDT</td>
<td>+/- 10 %</td>
<td>0.1–10s</td>
</tr>
<tr>
<td>TRS24D7Z10</td>
<td>24 V dc/28 V dc</td>
<td>External</td>
<td>11-Pin, SPDT no potentiometer</td>
<td>+/- 5 %</td>
<td>0.1–10s</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 24.
Time Delay Relays
Dedicated — Single Shot

TRS SERIES

Accessories

**P1011-6 Octal Socket for UL listing**
8-pin surface mount socket with header screw terminals. Rated 10 A @ 600 V ac.

**P0700-7 Versa-Knob**
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**OT08PC 8-pin Octal Socket for UL listing**
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac.

**OT11PC Octal Socket for UL listing**
11-pin surface & DIN rail mountable. Rated for 10 A @ 300 V ac.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Selection Guides

<table>
<thead>
<tr>
<th>External R, P/N Selection Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE</td>
</tr>
<tr>
<td>100K ohm</td>
</tr>
<tr>
<td>100K ohm</td>
</tr>
</tbody>
</table>

* Externally adjustable potentiometers. Numbers with additional “-X” include two pre-soldered 8” wire leads with ¼” female quick-connect terminals (for clockwise increase).

Specifications

**Time Delay**

- **Type:** Digital circuitry
- **Range:** See “Ordering Information” table
- **Repeat Accuracy:** ± 2 %
- **Fixed Time Tolerance & Setting Accuracy:** ± 5, 10, or 20 %
- **Initiate Time:** ≤ 70 ms
- **Reset Time:** ≤ 75 ms
- **Recycle Time:** ≤ 250 ms
- **Time Delay vs Temp. & Voltage:** ≤± 5 %

**Input**

- **Voltage:** 24/28 V dc, 24, 120 V ac
- **Tolerance:**
  - 24 V dc/ac: -15 %–20 %
  - 120 V ac: -20 %–10 %
- **AC Line Frequency:** 50/60 Hz
- **Power Consumption:** ≤ 3.25W

**Output**

- **Type:** Electromechanical relay
- **Form:** Isolated SPDT or DPDT
- **Rating:** 10 A resistive @ 120/240 V ac & 28 V dc; 1/3 hp @ 120/240 V ac
- **Mechanical Life:** 1 x 10⁷; Electrical - 1 x 10⁴
- **Protection:**
  - Insulation Resistance: ≥ 100 MΩ
  - Isolation Voltage: ≥ 1500 V RMS between input & output terminals
- **DC units are reverse polarity protected**

**Mounting**

- **Plug-in socket**
- **Termination:** Octal 8-pin plug-in or 11-pin plug-in
- **Dimensions:**
  - **H:** 44.45 mm (1.75”)
  - **W:** 60.33 mm (2.38”)
  - **D:** (with socket) 104.78 mm (4.13”)

**Environmental**

- **Operating/Storage Temperature:** -20 °C to 65 °C/-30 °C to 85 °C
- **Weight:** ≅ 4 oz (113 g)
- **Safety Marks:** UL (socket required)*
- **UL Listed when used with Part Number OT08-PC, RB08-PC, OT11-PC, or RB11-PC manufactured by Custom Connector Corp.**

**Function Diagram**

*S: Initiate Switch
NO: Normally Open Contact
NC: Normally Closed Contact
TD: Time Delay
V = Voltage
R = Reset

Note: Manufacturer’s recommended screw terminal torque for the OT series sockets is 12 in-lbs.
Description
The TSDS Series is designed for more demanding commercial and industrial applications where small size and accurate performance are required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the time delay. The TSDS Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 1000 minutes are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry. This product is suitable for many applications, including dispensing, welding, and exposure timing.

Operation (Single Shot)
Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will not energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact, low cost design measuring 2 in. (50.8mm) square</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%, Factory calibration + / - 1%</td>
</tr>
<tr>
<td>1A Steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Wide temperature range: -40° to 75°C</td>
<td>Reliable in demanding commercial and industrial applications</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>SWITCHING MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSDS2110S</td>
<td>24VAC</td>
<td>Fixed</td>
<td>10s</td>
<td>n/a</td>
</tr>
<tr>
<td>TSDS320N</td>
<td>24VDC</td>
<td>External</td>
<td>0.1 - 10s</td>
<td>Negative</td>
</tr>
<tr>
<td>TSDS321P</td>
<td>24VDC</td>
<td>External</td>
<td>1 - 100s</td>
<td>Positive</td>
</tr>
<tr>
<td>TSDS421</td>
<td>120VAC</td>
<td>External</td>
<td>1 - 100s</td>
<td>n/a</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.
Accessories

**P1015-64 (AWG 14/16)**
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### External Resistance vs. Time Delay

**In Secs. or Mins.**

<table>
<thead>
<tr>
<th>Time Delay Ranges</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000+</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>750+</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td>500+</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>250+</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**$R_T = \text{External Timing Resistor in Kilohms}$**

This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the $R_T$ terminals, as the resistance increases, the time delay increases.

When selecting an external $R_T$, add the tolerances of the timer and the $R_T$ for the full time range adjustment.

**Examples:** 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm $R_T$. For 1 to 100 S use a 100 K ohm $R_T$.

### Function Diagram

**SINGLE SHOT (PULSE FORMER)**

- **V** = Voltage
- **S1** = Initiate Switch
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD** = Time Delay
- **R** = Reset

**Specifications**

**Time Delay**
- Range: 0.1s - 1000m in 6 adjustable ranges or fixed
- Repeat Accuracy: ±0.5% or 20ms, whichever is greater
- Tolerance (Factory Calibration): ±1%
- Reset Time: ≤ 200ms
- Time Delay vs Temp. & Voltage: ≤ ±2%

**Input**
- Voltage: 12 or 24VDC; 24, 120, or 230VAC
- Tolerance: ±15%

**Output**
- Power Consumption:
  - AC: ≤ 2VA
  - DC: ≤ 1W
- AC Line Frequency/DC Ripple: 50/60 Hz / ≤ 10%

**Protection**
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ
- Polarity: DC units are reverse polarity protected

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 30.7 mm (1.21”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- Operating/Storage Temperature: -40° to 75°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≅ 2.4 oz (68 g)
**Description**

The TSS Series is a totally solid-state timing module. Its 1A rated, solid-state output provides an excellent method of time control for exposures, dispensing, or for increasing or decreasing a switch closure. Time delays from 0.05 to 600 seconds, in 4 ranges, cover 90% of all OEM applications. Factory calibration of fixed delays is ±5% and the repeat accuracy is ±2%. The TSS Series can be surface mounted with a single screw, or snapped on a 35mm DIN rail using the P1023-20 accessory adaptor.

**Operation (Single Shot)**

Voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

**Reset:** Reset occurs when the time delay is complete and the initiate switch opens. Loss of input voltage resets the time delay and output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry</td>
<td>Repeat accuracy +/− 2%, Factory calibration +/− 5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Surface or DIN rail mounting</td>
<td>Provides flexibility for installation</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSS410.5</td>
<td>120VAC</td>
<td>Fixed</td>
<td>0.5s</td>
</tr>
<tr>
<td>TSS421</td>
<td>120VAC</td>
<td>External</td>
<td>0.05 - 3s</td>
</tr>
<tr>
<td>TSS422</td>
<td>120VAC</td>
<td>External</td>
<td>0.5 - 60s</td>
</tr>
<tr>
<td>TSS424</td>
<td>120VAC</td>
<td>External</td>
<td>5 - 600s</td>
</tr>
<tr>
<td>TSS622</td>
<td>230VAC</td>
<td>External</td>
<td>0.5 - 60s</td>
</tr>
<tr>
<td>TSS624</td>
<td>230VAC</td>
<td>External</td>
<td>5 - 600s</td>
</tr>
</tbody>
</table>

If desired part number is not listed, please call us to see if it is technically possible to build.

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
Accessories

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Selection Guide

<table>
<thead>
<tr>
<th>Desired Time Delay* (Seconds)</th>
<th>R&lt;sub&gt;T&lt;/sub&gt; (Kohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>0</td>
</tr>
<tr>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>0.6</td>
<td>12</td>
</tr>
<tr>
<td>0.9</td>
<td>18</td>
</tr>
<tr>
<td>1.2</td>
<td>24</td>
</tr>
<tr>
<td>1.5</td>
<td>30</td>
</tr>
<tr>
<td>1.8</td>
<td>36</td>
</tr>
<tr>
<td>2.1</td>
<td>42</td>
</tr>
<tr>
<td>2.4</td>
<td>48</td>
</tr>
<tr>
<td>2.7</td>
<td>54</td>
</tr>
<tr>
<td>3.0</td>
<td>60</td>
</tr>
</tbody>
</table>

*When selecting an external R<sub>T</sub> add at least 20% for tolerance of unit and the R<sub>T</sub>.

Function Diagram

- V = Voltage
- S1 = Initiate Switch
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset

Specifications

**Time Delay**
- Range: 0.05s - 600s in 4 adjustable ranges or fixed
- Repeat Accuracy: ±2% or 20ms, whichever is greater
- Tolerance: (Factory Calibration) ≤ ±5%
- Reset Time: ≤ 150ms
- Initiate Time: ≤ 20ms
- Time Delay vs Temp. & Voltage
- Input Voltage: 24, 120, or 230VAC
- Tolerance: ±20%
- AC Line Frequency: 50/60 Hz
- Power Consumption: ≤ 2VA

**Output**
- Type: Solid state
- Form: NO, closed during timing
- Maximum Load Current: 1A steady state, 10A inrush at 60°C
- Off State Leakage Current: ≈ 5mA @ 230VAC
- Voltage Drop: ≈ 2.5V @ 1A

**Protection**
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2.0”); W 50.8 mm (2.0”);
- D 30.7 mm (1.21”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- Operating/Storage Temperature: - 40° to 75°C / - 40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≈ 2.4 oz (68 g)
**Descripción**
Econo-Timers son una combinación de electrónica digital y un relé electromecánico. La salida DPDT del relé permite circuitos lógicos y aislamiento de la tensión de entrada de la tensión de salida. Para aplicaciones, como intervalo, pulso de corto tiempo, tiempo mínimo de funcionamiento, etc. La serie ERD está encapsulada para proteger el circuito de choque, vibración y humedad.

**Operación (Intervalo)**
Al aplicar tensión de entrada, el retraso de tiempo comienza, y el relé de salida activa. Al final del tiempo de retraso, el relé de salida desactiva hasta que se quita la tensión de entrada.

**Reajuste:** Se resetean la tiempo de retraso y la salida al quitar la tensión de entrada.

**Operación (Single Shot)**
La tensión de entrada debe aplicarse antes y durante el tiempo de retraso. Al cerrar momentáneamente o mantener cierto tiempo el interruptor de iniciación, el relé de salida activa para el tiempo de retraso. Al final del tiempo de retraso, el relé de salida desactiva. Abrir o recerrar el interruptor de iniciación durante el tiempo de retraso no afecta el tiempo de retraso. La salida se activará si se cierra el interruptor de iniciación cuando se aplica la tensión de entrada.

**Reajuste:** El reset se produce cuando el tiempo de retraso es completo e iniciador se abre. La pérdida de tensión de entrada resetea el tiempo de retraso y la salida.

**Características & Beneficios**

**Características**
- Integración digital
- Circuito repetitivo ± 0.5%
- Calibración de fábrica ± 10%
- Salidas aisladas, 10A, DPDT
- Permite el control de cargas para voltajes AC o DC
- Encapsulado
- Protección contra choque, vibración y humedad

**Beneficios**
- Precisión repetitiva ± 0.5%
- Calibración de fábrica ± 10%
- Control de carga para voltajes AC o DC
- Protección contra choques, vibraciones y humedad

**Accesorios**

<table>
<thead>
<tr>
<th>Modelo</th>
<th>Voltaje de Entrada</th>
<th>Ajuste</th>
<th>Tiempo de Retraso</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERD436</td>
<td>120VAC</td>
<td>Externo</td>
<td>0.6 - 60s</td>
</tr>
<tr>
<td>ERD6210</td>
<td>230VAC</td>
<td>Interno</td>
<td>1 - 100m</td>
</tr>
</tbody>
</table>

Si no encuentra el producto que necesita, llame a nuestro producto personalizado 800-843-8848

---

**Planilla de conexionado**

- 2-3 & 7-6 son contactos de entrada Normalmente Abiertos (NO)
- 2-4 & 7-5 son contactos de entrada Normalmente Cerrados (NC)

---

**Información de pedido**

<table>
<thead>
<tr>
<th>Modelo</th>
<th>Voltaje de Entrada</th>
<th>Ajuste</th>
<th>Tiempo de Retraso</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERD436</td>
<td>120VAC</td>
<td>Externo</td>
<td>0.6 - 60s</td>
</tr>
<tr>
<td>ERD6210</td>
<td>230VAC</td>
<td>Interno</td>
<td>1 - 100m</td>
</tr>
</tbody>
</table>

Si no encuentra el producto que necesita, llame a nuestro producto personalizado 800-843-8848
Selection Guides

### Time Delay

**Type**
- Digital integrated circuitry

**Range**
- 0.1s - 500m in 11 adjustable ranges,
- 0.1s - 1000m fixed

**Adjustment**
- External adjust or onboard

**Repeat Accuracy**
- ±0.5%

**Tolerance**
- (Factory Calibration) ≤ ±10%
- Reset Time ≤ 150ms
- Time Delay vs Temp. & Voltage ≤ ±2%

**Input**
- **Voltage**
  - 120VAC or 230VAC
  - Tolerance: 12VDC & 24VDC/AC -15% - 20%
  - 120VDC/AC & 230VAC -20% - 10%
- **AC Line Frequency**
  - 50/60 Hz

**Output**
- **Type**
  - Isolated relay contacts
- **Form**
  - DPDT
- **Rating**
  - 10A resistive @ 120/240VAC & 28VDC;
  - 1/3 hp @ 120/240VAC
- **Life**
  - Mechanical - 1 x 10^7;
  - Electrical - 1 x 10^6

**Protection**
- Isolation Voltage ≥ 1500V RMS input to output
- Insulation Resistance ≥ 100 MΩ
- DC units are reverse polarity protected

**Mechanical**
- Surface mount with two #6 (M3.5 x 0.6) screws

**Dimensions**
- **H** 88.9 mm (3.5”);
- **W** 63.5 mm (2.5”);
- **D** 43.2 mm (1.7”)

**Termination terminals**
- 0.25 in. (6.35 mm) male quick connect

**Environmental**
- Operating/Storage: -40° to 65°C / -40° to 85°C
- Weight: ≅ 5.7 oz (162 g)

### Function Diagrams

**INTERVAL (IMPULSE-ON)**
- V = Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- = Undefined Time

**SINGLE SHOT (PULSE FORMER)**
- V = Voltage
- S1 = Initiate Switch
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
HRDI SERIES

Interval Timer

Description
The HRDI Series combines an electromechanical relay output with microcontroller timing circuitry. It offers 12 to 230V operation in five ranges and factory fixed, external, or onboard adjustable time delays with a repeat accuracy of ±0.5%. The output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blowers, motors, heaters, etc. This series is ideal for OEM applications where cost is a factor.

Operation (Interval)
Upon application of input voltage, the time delay begins. The output relay is energized during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Isolated, 30A, SPDT, NO output contacts</td>
<td>Allows direct operation of heavy loads: compressors, pumps, blowers, heaters.</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity.</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**: Panel mountable, industrial potentiometer recommended for remote time delay adjustment.
- **P1023-6 Mounting bracket**: The 90° orientation of mounting slots makes installation/removal of modules quick and easy.
- **P0700-7 Versa-Knob**: Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.
- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**: These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
- **P1015-18 Quick Connect to Screw Adapter**: Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.
- **C103PM (AL) DIN Rail**: 35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.
- **P1023-20 DIN Rail Adapter**: Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRDI117S</td>
<td>12VDC</td>
<td>Fixed</td>
<td>7s</td>
</tr>
<tr>
<td>HRDI421</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>HRDI422</td>
<td>120VAC</td>
<td>Onboard</td>
<td>10 - 1000s</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 17.
### External Resistance vs. Time Delay

<table>
<thead>
<tr>
<th>R (kΩ)</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>750</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>16</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R1 terminals; as the resistance increases, the time delay increases. When selecting an external R1, add the tolerances of the timer and the R1 for the full time range adjustment.

Examples: 1 to 50 are adjustable time delay, select time delay range 1 and a 50 kΩ R1. For 1 to 100 S use a 100 kΩ R1.

### Specifications

#### Time Delay

- **Type**: Microcontroller circuitry
- **Range**: 0.1s - 100m in 5 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5 % or 20ms, whichever is greater
- **Tolerance**: ±1%, ±5%
- **Recycle Time**: ≤ 150ms
- **Time Delay vs Temp. & Voltage**: ±2%

#### Input

- **Voltage**: 12 or 24VDC, 24, 120, or 230VAC
- **Tolerance**: 12VDC & 24VDC -15% - 20%
  -20% - 10%
- **AC Line Frequency**: 50/60 Hz
- **Power Consumption**: AC ≤ 4VA; DC ≤ 2W

#### Output

- **Type**: Electromechanical relay
- **Form**: SPDT, non-isolated
- **Ratings**:
  - **General Purpose**: 125/240VAC - 30A / 15A
  - **Resistive**:
    - 125/240VAC - 30A / 15A
    - 28VDC - 20A / 10A
  - **Motor Load**:
    - 125VAC - 1 hp* / 1/4 hp**
    - 240VAC - 2 hp** / 1 hp**
- **Life**
  - Mechanical - 1 x 10⁶
  - Electrical - 1 x 10⁵, **3 x 10⁴, **6,000

#### Protection

- **Surge**: IEEE C62.41-1991 Level A
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected
- **Mechanical**
  - Surface mount with one #10 (M5 x 0.8) screw
  - **Dimensions**:
    - H 76.7 mm (3”), W 51.3 mm (2”)
    - D 38.1 mm (1.5”)
- **Termination**
  - 0.25 in. (6.35 mm) male quick connect terminals
- **Operating/Storage**
  - Temperature: -40° to 60°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
- **Weight**: 3.9 oz (111 g)
KRDI SERIES

Description
The KRDI Series is a compact time-delay relay measuring only 2 in. (50.8 mm) square. Its solid-state timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDI Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Interval)
Upon application of input voltage, the time delay begins. The output relay energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact, low cost design measuring 2 in. (50.8 mm) square</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%, Factory calibration +/- 5%</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRDI120</td>
<td>12VDC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDI121</td>
<td>12VDC</td>
<td>Onboard knob</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>KRDI122</td>
<td>12VDC</td>
<td>Onboard knob</td>
<td>10 - 1000s</td>
</tr>
<tr>
<td>KRDI2110S</td>
<td>24VAC/VDC</td>
<td>Fixed</td>
<td>10s</td>
</tr>
<tr>
<td>KRDI2160S</td>
<td>24VAC/VDC</td>
<td>Fixed</td>
<td>60s</td>
</tr>
<tr>
<td>KRDI220</td>
<td>24VAC/VDC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDI320</td>
<td>24VDC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDI420</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDI424</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>1 - 100m</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
**Accessories**

**C103PM (AL) DIN Rail**  
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**  
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Specifications**

**Time Delay**
- **Range**: 0.1s - 100m in 5 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5% or 20ms, whichever is greater
- **Tolerance** (Factory Calibration): ≤ ± 5%
- **Reset Time**: ≤ 150ms
- **Time Delay vs Temp. & Voltage**: ≤ ±5%

**Input**
- **Voltage**: 12, 24 or 110VDC; 24, 120 or 230VAC
- **Tolerance**
  - 12VDC & 24VDC/AC: -15% - 20%
  - 110VDC, 120VAC or 230VAC: -20% - 10%
- **AC Line Frequency/DC Ripple**: 50/60 Hz / ≤ 10%
- **Power Consumption**: AC ≤ 2VA; DC ≤ 2W

**Output**
- **Type**: Isolated relay contacts
- **Form**: SPDT
- **Rating (at 40°C)**
  - 10A resistive @ 125VAC,
  - 5A resistive @ 230VAC & 28VDC,
  - 1/4 hp @ 125VAC
- **Max. Switching Voltage**: 250VAC
- **Life (Operations)**
  - Mechanical: -1 x 10^7
  - Electrical: -1 x 10^5

**Protection**
- **Circuitry**: Encapsulated
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**
  - H: 50.8 mm (2”);
  - W: 50.8 mm (2”);
  - D: 30.7 mm (1.21”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- **Operating/Storage Temperature**: -20° to 60°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≈ 2.6 oz (74 g)

**External Resistance vs. Time Delay**

<table>
<thead>
<tr>
<th>Time Delay Ranges</th>
<th>In Secs. or Mins.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1s</td>
<td>1000</td>
</tr>
<tr>
<td>1s</td>
<td>100</td>
</tr>
<tr>
<td>10s</td>
<td>10</td>
</tr>
<tr>
<td>100s</td>
<td>1</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R_t terminals; as the resistance increases the time delay increases.

**Examples**:
- For a 1 to 20 s adjustable time delay, select time delay range 1 and a 60 k ohm R_t. For 1 to 100 s use a 100 k ohm R_t.

**Output Current/Ambient Temperature**

**Function Diagram**

- V = Voltage
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD = Time Delay
- R = Reset
- Undefined Time
The KSD2 Series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable, solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for input voltages of 24, 120 or 230VAC. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry. An excellent choice for most OEM pulse shaping, maximum run time, and other process control applications.

**Operation (Interval)**

Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and the output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%, + / - 5% time delay accuracy</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A Steady solid-state output, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

**P1004-95, P1004-95-X Versa-Pot**

Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

**P1023-6 Mounting bracket**

The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P0700-7 Versa-Knob**

Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**P1015-64 (AWG 14/16)**

Female Quick Connect

These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

If you don't find the part you need, call us for a custom product 800-843-8848.

For dimensional drawing see: Appendix, page 512, Figure 16.
**Time Delay Relays**

**Dedicated — Interval**

**KSD2 SERIES**

**Accessories**

**P1015-18 Quick Connect to Screw Adapter**

Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**

35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**

Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**External Resistance vs. Time Delay**

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the $R_T$ terminals; as the resistance increases the time delay increases.

When selecting an external $R_T$, add the tolerances of the timer and the $R_T$ for the full time range adjustment.

**Examples:** 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm $R_T$. For 1 to 100 S use a 100 K ohm $R_T$.

**Specifications**

| Time Delay | Range | 0.1s - 1000m in 6 adjustable ranges or fixed |
| Repeat Accuracy | ±0.5% or 20ms, whichever is greater |
| Tolerance (Factory Calibration) | ≤ ±5% |
| Reset Time | ≤ 150ms |
| Time Delay vs. Temperature & Voltage | ≤ ±10% |

**Input**

- **Voltage:** 24, 120, or 230VAC
- **Tolerance:** ±20%
- **AC Line Frequency:** 50/60 Hz
- **Power Consumption:** ≤ 2VA

**Output**

- **Type:** Solid state
- **Form:** NO, closed during timing
- **Maximum Load Current:** 1A steady state, 10A inrush at 60°C
- **OFF State Leakage Current:** ≅ 5mA @ 230VAC
- **Voltage Drop:** ≅ 2.5V @ 1A

**Protection**

- **Circuitry:** Encapsulated
- **Dielectric Breakdown:** ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance:** ≥ 100 MΩ

**Mechanical**

- **Mounting:** Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions:** H 50.8 mm (2”), W 50.8 mm (2”), D 30.7 mm (1.21”)
- **Termination:** 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**

- **Operating/Storage Temperature:** -40°C to 60°C / -40°C to 85°C
- **Humidity:** 95% relative, non-condensing
- **Weight:** ≅ 2.4 oz (68 g)

---

© 2023 Littelfuse, Inc.
Description
The KSPU Series is a factory programmed module available in any 1 of 14 standard functions. The KSPU offers a single adjustable timer or counter function. Switch adjustment allows accurate selection of the time delay or number of counts the first time and every time. The 1A steady, 10A inrush rated solid-state output provides 100 million operations, typical. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KSPU Series is a cost effective approach for OEM applications that require small size, solid state reliability, and accurate switch adjustment.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.1%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

- **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) Female Quick Connect
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18** Quick Connect to Screw Adapter
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>TIME DELAY/COUNTS</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSPUA2I</td>
<td>24 to 240VAC</td>
<td>1 - 1023s</td>
<td>Interval</td>
</tr>
<tr>
<td>KSPUA8C</td>
<td>24 to 240VAC</td>
<td>1 - 1023 counts (binary) with pulsed output</td>
<td>Counter with pulsed output</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
Specifications

Time Delay
Range* 0.1 - 102.3s, m or h in 0.1s, m or h increments
1 - 1023s, m or h in 1s, m or h increments
1 - 63s or m in 1s or m increments
Repeat Accuracy ±0.1% or 20 ms, whichever is greater
Setting Accuracy ≤ ±1% or 20 ms, whichever is greater
Reset Time ≤ 150ms
Initiate Time ≤ 20ms
Time Delay vs. Temperature & Voltage ≤ ±2%

Input
Voltage/Tolerance 24 to 240VAC, 12 to 120VDC/≤ ±15%
AC Line Frequency/DC Ripple 50/60 Hz/≤ 10%
Power Consumption AC ≤ 2VA; DC ≤ 1W

Output
Type Solid state
Form NO, SPST-NO
Rating 1A steady state, 10A inrush for 16ms
Voltage Drop AC = 2.5V @ 1A; DC = 1V @ 1A
Off State Leakage Current AC = 5mA @ 240VAC; DC = 1 mA
Counter Output Output pulse width: 300ms ± 20%
Time Delay/Counts Variable 7 & 8

Protection
Circuitry Encapsulated
Dielectric Breakdown ≥ 2000V RMS terminals to mounting surface
Insulation Resistance ≥ 100 MΩ
Polarity DC units are reverse polarity protected
Mechanical Surface mount with one #10 (M5 x 0.8) screw
Mounting H 50.8 mm (2”), W 50.8 mm (2”);
Dimensions D 30.7 mm (1.21”)
Termination 0.25 in. (6.35 mm) male quick connect terminals

Environmental
Operating/Storage Temperature -40° to 60°C / -40° to 85°C
Humidity 95% relative, non-condensing
Weight 2.4 oz (68 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.

Adjustment Switch Operation

**Adjustment Switch Operation**

<table>
<thead>
<tr>
<th>TIME DELAY</th>
<th>COUNTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1…102.3</td>
<td>1…1023</td>
</tr>
<tr>
<td>1…165</td>
<td>1…63</td>
</tr>
</tbody>
</table>

```
OFF ▶ ON     OFF ▶ ON     OFF ▶ ON     OFF ▶ ON
0.1          1              1.1         1
0.2          2              2.1         2
0.4          4              4.1         4
0.8          8              8.1         8
1.6          16             16.1        16
3.2          32             32.1        32
6.4          64             64.1        64
12.8         128            128.1       128
25.6         256            256.1       256
51.2         512            512.1       512
```

* for selecting time in minutes or seconds

Function Diagrams

**DELAY-ON-MAKE (ON-DELAY)**

```
V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time
```

**INTERVAL (IMPULSE-ON)**

```
V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time
```
**Description**

The TDI series is an interval timer that combines accurate digital circuitry with isolated, 10 A rated, DPDT relay contacts in an 8-pin plug-in package. The TDI series features DIP switch selectable time delays ranging from 0.1 to 10,230 seconds in three ranges. The TDI series is the product of choice for custom control panel and OEM designers.

**Operation (Interval)**

Upon application of input voltage, the time delay begins. The output relay is energized during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

**Reset**: Removing input voltage resets the time delay and the output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital circuitry</td>
<td>Repeat Accuracy + / - 0.1 %, Setting accuracy + / - 2 %</td>
</tr>
<tr>
<td>Isolated, 10 A, DPDT output contacts</td>
<td>Allows control of loads for ac or dc voltages</td>
</tr>
<tr>
<td>DIP switch adjustment</td>
<td>Provides first time setting accuracy</td>
</tr>
<tr>
<td>Industry standard octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
<tr>
<td>LED indication (select models)</td>
<td>Provides visual indication of timing and output status</td>
</tr>
</tbody>
</table>

**Accessories**

**OT08PC 8-pin Octal Socket for UL listing**

Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac.

**C103PM (AL) DIN Rail**

35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.
## Specifications

**Time Delay**  
Type: Digital integrated circuitry  
Range:  
- 0.1–102.3 s in 0.1 s increments  
- 1–1023 s in 1 s increments  
- 10 – 10,230 s in 10 s increments  

Repeat Accuracy: ±0.1 %  
Setting Accuracy: ±2 %  
Reset Time: ≤ 150 ms  
Time Delay vs Temp. & Voltage: ±5 %  
Indicator: LED glows during timing; relay is energized  

**Input**  
Voltage: 12, 24 V dc; 24, 120 V ac  
Tolerance:  
- 12 V dc & 24 V dc/ac: -15 % to +20 %  
- 120 V ac: -20 % to +10 %  

**AC Line Frequency**  
50/60 Hz  

**Power Consumption**  
≤ 3.25W  

**Output**  
Type: Electromechanical relay  
Form: DPDT  
Rating: 10 A resistive @ 120/240 V ac; 1/3 hp @ 120/240 V ac  
Life: Mechanical - 1 x 10^7; Electrical - 1 x 10^6  
Protection: Dc units are reverse polarity protected  
Isolation Voltage: ≥ 1500 V RMS input to output  

**Mechanical**  
Mounting: Plug-in socket  
Dimensions:  
- H 44.45 mm (1.75”);  
- W 60.33 mm (2.38”);  
- D (with socket) 104.78 mm (4.13”)  
Termination: Octal 8-pin plug-in  

**Environmental**  
Operating/Storage Temperature: -20 °C to 65 °C / -30 °C to 85 °C  
Weight: ≅ 4 oz (113 g)  
Safety Marks:  
- UL (socket required)*  
- UL 508 (E57310)  

*UL Listed when used with Part Number OT08-PC or RB08-PC manufactured by Custom Connector Corp.

**Note:** Manufacturer’s recommended screw terminal torque for the OT Series sockets is 12 in-lbs.

## Digi-Set Binary Switch Operation

**Function Diagram**

- V = Voltage  
- NO = Normally Open Contact  
- NC = Normally Closed Contact  
- TD = Time Delay  
- R = Reset  
- = Undefined Time  

### Time Delay vs Temp.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20 °C to 65 °C</td>
<td>±5 %</td>
</tr>
<tr>
<td>-30 °C to 85 °C</td>
<td>±5 %</td>
</tr>
</tbody>
</table>

---

© 2023 Littelfuse, Inc.  
Littelfuse.com/tdi-tdih-tdil  
389
**TDUI / TDUIH / TDUIL SERIES**

**Description**
The TDUI Series combines digital timing circuitry with universal voltage operation. Voltages of 24 to 240VAC and 12 to 24VDC are available in three ranges. The TDUI Series offers DIP switch selectable time delays ranging from 0.1 seconds to 102.3 minutes in three ranges. Its 1A rated output, ability to operate on multiple voltages, and wide range of switch selectable time delays make the TDUI Series an excellent choice for process control systems and OEM equipment.

**Operation (Interval)**
Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and the output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%, Setting accuracy +/- 2%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Wide voltage ranges</td>
<td>Flexibility to handle multiple voltages found in control systems and OEM applications</td>
</tr>
<tr>
<td>DIP switch Adjustment</td>
<td>Provides first time setting accuracy</td>
</tr>
</tbody>
</table>

**Accessories**

**P1015-13** (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDUI3000A</td>
<td>24 to 120VAC</td>
<td>1 - 1023s</td>
</tr>
<tr>
<td>TDUIH3002A</td>
<td>12 to 24VDC</td>
<td>0.1 - 102.3m</td>
</tr>
<tr>
<td>TDUIL3001A</td>
<td>100 to 240VAC</td>
<td>0.1 - 102.3s</td>
</tr>
<tr>
<td>TDUIL3002A</td>
<td>12 to 24VDC</td>
<td>0.1 - 102.3s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

**Wiring Diagram**

- **V** = Voltage
- **L** = Load

For dimensional drawing see: Appendix, page 512, Figure 16.
Specifications

Time Delay
Range* 0.1 - 102.3s in 0.1s increments
1 - 1023s in 1s increments
0.1 - 102.3m in 0.1m increments
Repeat Accuracy ±0.5% or 20ms, whichever is greater
Setting Accuracy ≤ ±2% or 20ms, whichever is greater
Reset Time ≤ 150ms
Time Delay vs Temp. & Voltage ≤ ±5%

Input
Voltage 24 to 240VAC, 12 to 24VDC ±20%
AC Line Frequency 50/60 Hz
Power Consumption AC ≤ 2VA; DC ≤ 1W
DC Ripple ≤ 10%

Output
Type Solid state
Form NO, closed during timing
Rating 1A steady state, 10A inrush at 60°C
Voltage Drop AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
OFF State Leakage Current AC ≅ 5mA @ 230VAC; DC ≅ 1mA

Protection
Circuitry Encapsulated
Dielectric Breakdown ≥ 2000V RMS terminals to mounting surface
Insulation Resistance ≥ 100 MΩ
Polarity DC units are reverse polarity protected

Mechanical
Mounting Surface mount with one #10 (M5 x 0.8) screw
Dimensions H 50.8 mm (2”); W 50.8 mm (2”);
D 30.7 mm (1.21”)
Termination 0.25 in. (6.35 mm) male quick connect terminals

Environmental
Operating/Storage
Temperature -40° to 60°C / -40° to 85°C
Humidity 95% relative, non-condensing
Weight ≅ 2.4 oz (68 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.

Switch Operation

Function Diagram
Description

The THD2 Series combines accurate timing circuitry with high power solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, Digi-Power timers.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%, Factory calibration +/- 1%</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct control of motors, lamps and heaters without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and components costs</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OUTPUT RATING</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>THD2C420</td>
<td>20A</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>THD2C423</td>
<td>20A</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>THD2C620</td>
<td>20A</td>
<td>230VAC</td>
<td>External</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>THD2C633</td>
<td>20A</td>
<td>230VAC</td>
<td>Onboard</td>
<td>0.1 - 10m</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
External Resistance vs. Time Delay

In Secs. or Mins.

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>R_T = External Timing Resistor in Kiloohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>750</td>
<td>750</td>
</tr>
<tr>
<td>1000</td>
<td>1000</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the time delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm R_T. For 1 to 100 S use a 100 K ohm R_T.

Specifications

- **Time Delay**
  - Range: 0.1s - 1000m in 6 adjustable ranges or fixed
  - Repeat Accuracy: ±0.5% or 20ms, whichever is greater
  - Tolerance (Factory Calibration): ≤ ±1%
  - Reset Time: ≤ 150ms
  - Time Delay vs Temp. & Voltage: ≤ ±2%

- **Input**
  - Voltage: 24, 120, or 230VAC
  - Tolerance: ±20%
  - AC Line Frequency: 50/60 Hz

- **Output**
  - Type: Solid state
  - Form: NO, closed during timing
  - Maximum Load Current: Solid state
    - Output: Steady State, Inrush**
      - A: 6A, 60A
      - B: 10A, 100A
      - C: 20A, 200A
  - Minimum Load Current: 100mA
  - Voltage Drop: ≅ 2.5V at rated current
  - OFF State Leakage Current: ≅ 5mA @ 230VAC

- **Protection**
  - Circuitry: Encapsulated
  - Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
  - Insulation Resistance: ≥ 100 MΩ

- **Mechanical**
  - Mounting **
    - Surface mount with one #10 (M5 x 0.8) screw
  - Dimensions
    - H: 50.8 mm (2’’); W: 50.8 mm (2’’);
    - D: 38.4 mm (1.51’’)
  - Termination: 0.25 in. (6.35 mm) male quick connect terminals

- **Environmental**
  - Operating/Storage Temperature: -40° to 60°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
  - Weight: 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

Function Diagram

```
1 2
V ——— INTERVAL (IMPULSE-ON) ——— R

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

INTERVAL (IMPULSE-ON) = Voltage
```
## THD7 SERIES

### Description
The THD7 Series utilizes only two terminals connected in series with the load. Interval timing mode is achieved by using a small portion of the AC sine wave allowing sufficient voltage for circuit operation. The THD7 Series can be used for interval or delay-on-break timing. It is designed to operate large loads directly, such as motors, heater elements, and motor starters.

#### Operation (Interval)
Upon application of input voltage, the output energizes and the time delay begins. The output remains energized throughout the time delay. At the end of the time delay the output de-energizes and remains de-energized until power is removed.

**Reset:** Removing input voltage resets the time delay and the output.

#### Operation (Delay-on-Break)
Upon closure of SW1, the load energizes and the timer is reset (zero voltage across its input terminals). Opening SW1 re-applies input voltage to the timer, the load remains energized and the time delay begins. At the end of the time delay the output de-energizes. If SW1 is open when power is applied, the load will energize for the time delay then de-energize.

**Reset:** Reclosing SW1 resets the timer.

### Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital integrated circuitry</td>
<td>Repeat Accuracy + / - 0.5%</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct operation of motors, lamps and heaters without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and component costs</td>
</tr>
</tbody>
</table>

### Accessories

- **P1004-13, P1004-13-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
**Accessories**

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**VTP(X)(X) Plug-on Adjustment Module**
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

**Selection Table for VTP Plug-on Adjustment Accessory**

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>VTP P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 1-100s</td>
<td>VTP5G</td>
</tr>
<tr>
<td>2 - 10-1000s</td>
<td>VTP5K</td>
</tr>
<tr>
<td>3 - 0.1-10m</td>
<td>VTP5N</td>
</tr>
<tr>
<td>4 - 1-100m</td>
<td>VTP5P</td>
</tr>
<tr>
<td>5 - 10-1000m</td>
<td>VTP5R</td>
</tr>
</tbody>
</table>

**Specifications**

**Time Delay**

- **Type**: Digital integrated circuitry
- **Range**: 1s - 1000m in 5 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5% or 20ms, whichever is greater
- **Tolerance**
  - (Factory Calibration): ≤ ±10%
  - After timing: ≤150ms; During timing: ≤ 350ms
- **Recycle Time**
  - ≤ ±2%
- **Time Delay vs Temp. & Voltage**
  - ≤ ±2%
- **Input**
  - **Voltage**: 24, 120, or 230VAC
  - **Tolerance**: ±20%
  - **AC Line Frequency**: 50/60 Hz
- **Output**
  - **Type**: Solid state
  - **Form**: NO, closed during timing
  - **Rating**
    - A: 6A
    - B: 10A
    - C: 20A

**Effective Voltage Drop (VLine-VLoad)**

- **Input**
  - 24VAC: ≤ 3V
  - 120VAC: ≤ 3V
  - 230VAC: ≤ 5V
  - 100mA

**Minimum Load Current**

- **Rating**: 20mA

**Protection**

- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ

**Mechanical**

- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**
  - H: 50.8 mm (2”)
  - W: 50.8 mm (2”)
  - D: 38.4 mm (1.51”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**

- **Operating/Storage**
  - **Temperature**: -40° to 60°C / -40° to 85°C
  - **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 3.9 oz (111 g)

**Function Diagrams**

**Selection Guide**

![Selection Chart](chart.png)

*When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.*
The TS2 Series is designed for 24, 120 or 230VAC and the TS6 Series is designed for 12 or 24VDC. These series are capable of controlling load currents of up to 1A steady state, 10A inrush. Encapsulated circuitry and the reliability of a ±2% repeat accuracy make the TS2 and TS6 ideal for cost sensitive applications.

**Operation (Interval)**
Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and the output.

## Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry</td>
<td>Repeat accuracy + / - 2%, Factory calibration + / - 10%</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
<tr>
<td>Rated for operation up to 75°C</td>
<td>Can be used in the harshest environments</td>
</tr>
</tbody>
</table>

## Accessories

- **P1004-XX** (fig. A), **P1004-XX-X** (fig. B) Versa-Pot
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6** Mounting bracket
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7** Versa-Knob
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

If you don’t find the part you need, call us for a custom product 800-843-8848
## Accessories

**P1015-64 (AWG 14/16)**
**Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**VTP(X)(X) Plug-on Adjustment Module**
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

### Selection Table for VTP Plug-on Adjustment Accessory

#### TS6 12VDC

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>VTP P/N</th>
<th>Versa-Pot (potentiometer)</th>
<th>Fig. A P/N</th>
<th>Fig. B P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 0.05-1s</td>
<td>VTP2A</td>
<td>P1004-16</td>
<td>P1004-16-X</td>
<td></td>
</tr>
<tr>
<td>2 - 0.5-20s</td>
<td>VTP2E</td>
<td>P1004-16</td>
<td>P1004-16-X</td>
<td></td>
</tr>
<tr>
<td>3 - 2-60s</td>
<td>VTP2F</td>
<td>P1004-16</td>
<td>P1004-16-X</td>
<td></td>
</tr>
<tr>
<td>4 - 5-120s</td>
<td>VTP2H</td>
<td>P1004-16</td>
<td>P1004-16-X</td>
<td></td>
</tr>
</tbody>
</table>

#### TS2 & TS6 All Other Voltages

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>VTP P/N</th>
<th>Versa-Pot (potentiometer)</th>
<th>Fig. A P/N</th>
<th>Fig. B P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 0.05-3s</td>
<td>VTP4B</td>
<td>P1004-12</td>
<td>P1004-12-X</td>
<td></td>
</tr>
<tr>
<td>2 - 0.5-60s</td>
<td>VTP4F</td>
<td>P1004-12</td>
<td>P1004-12-X</td>
<td></td>
</tr>
<tr>
<td>3 - 2-180s</td>
<td>VTP4J</td>
<td>P1004-12</td>
<td>P1004-12-X</td>
<td></td>
</tr>
<tr>
<td>4 - 5-600s</td>
<td>VTP5N</td>
<td>P1004-13</td>
<td>P1004-13-X</td>
<td></td>
</tr>
</tbody>
</table>

### Specifications

#### Time Delay

- **Type**: Analog circuitry
- **Range**: 0.05 - 120s in 4 adjustable ranges or fixed (1 MΩ max. R<sub>T</sub>)
- **Other Voltages**: 0.05 - 600s in 4 adjustable ranges or fixed
- **Repeat Accuracy**: ±2% or 20ms, whichever is greater
- **Tolerance (Factory Calibration)**: ≤±10%
- **Time Delay vs Temp. & Voltage**: ≤±10%
- **Reset Time**: ≤150ms
- **Input**
  - **Voltage**: 12 or 24VDC; 24 or 20VAC
  - **Tolerance**: ±15%
  - **DC Ripple**: 10%
  - **Power Consumption**: DC ≤ 1W; AC ≤ 2VA

#### Output

- **Type**: Solid state
- **Form**: NO, closed during timing
- **Maximum Load Current**: 1A steady state, 10A inrush at 60°C
- **Voltage Drop**: DC ≤ 1.0V @ 1A; AC ≤ 2.5V @ 1A
- **Protection**
  - **Circuitry**: Encapsulated
  - **Polarity**: T6 is not reverse polarity protected
  - **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
  - **Insulation Resistance**: ≥ 100 MΩ
  - **Mechanical**
    - **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
    - **Dimensions**: H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
    - **Termination**: 0.25 in. (6.35 mm) male quick connect terminals
- **Environmental**
  - **Operating/Storage**
    - Temperature: -40° to 75°C / -40° to 85°C
    - Humidity: 95% relative, non-condensing
  - **Weight**: 2.4 oz (68 g)

© 2023 Littelfuse, Inc.
Description

The TSD2 Series is designed for more demanding commercial and industrial applications where small size and accurate performance are required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.1% of the time delay. The TSD Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 100 hours are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output is energized during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.1%, + / -1% time delay accuracy</td>
</tr>
<tr>
<td>Extended temperature range</td>
<td>Rated to 75°C operating temperature to withstand high heat applications.</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A Steady solid-state output, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSD2411S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>1s</td>
</tr>
<tr>
<td>TSD24145S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>45s</td>
</tr>
<tr>
<td>TSD241600S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>600s</td>
</tr>
<tr>
<td>TSD2434</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100m</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 16.
### Accessories

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### External Resistance vs. Time Delay

| Time Delay (Seconds, Minutes, or Hours) | 0.1 | 1 | 2 | 4 | 6 | 10 | 25 | 50 | 75 | 100
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance (kΩ)</td>
<td>10</td>
<td>7.5</td>
<td>5.0</td>
<td>2.5</td>
<td>1</td>
<td>0.25</td>
<td>0.5</td>
<td>0.75</td>
<td>1.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R† terminals, as the resistance increases the time delay increases. When selecting an external R† add the tolerances of the timer and the R† for the final time range adjustment. Examples: 1 to 60 s adjustable time delay, select time delay range 1 and a 60 kΩ chmn R†. For 1 to 100 s use a 100 KΩ chmn R†.

### Specifications

**Time Delay**
- Range: 0.1 s - 100 h in 7 adjustable ranges or fixed
- Repeat Accuracy: ±0.1% or 20 ms, whichever is greater
- Tolerance (Factory Calibration): ≤ ±1%
- Reset Time: ≤ 150 ms
- Time Delay vs. Temperature & Voltage: ≤ ±1%

**Input**
- Voltage: 24, 120, or 230 VAC
- Tolerance: ±20%
- AC Line Frequency: 50/60 Hz
- Power Consumption: ≤ 2 VA

**Output**
- Type: Solid state
- Form: NO, closed during timing
- Maximum Load Current: 1 A steady state, 10 A inrush at 60°C
- Off State Leakage Current: ≅ 5 mA @ 230 VAC
- Voltage Drop: ≅ 2.5 V @ 1 A

**Protection**
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000 V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- Operating/Storage Temperature: -40° to 75°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≅ 2.4 oz (68 g)

---

**Function Diagram**

```
1  ❋ INTERVAL (IMPULSE-ON)  ❋
V  ❋
NO  ❋
NC  ❋

TD  ❋
R  ❋

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time
```
**TSD6 SERIES**

**Interval Timer**

The TSD6 Series offers total solid-state, interval timing for 12 or 24VDC applications. This series provides either negative or positive switching. The TSD6 Series is designed for more demanding commercial and industrial applications where small size and accurate performance is required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.1% of the time delay. The TSD6 Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 100 hours are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

**Operation (Interval)**

Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

**Reset:** Removing input voltage resets the time delay and the output.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/− 0.1%, +/−1% time delay accuracy</td>
</tr>
<tr>
<td>Extended temperature range</td>
<td>Rated to 75°C operating temperature to withstand high heat applications.</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A Steady solid-state output, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16)**
  Female Quick Connect
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>SWITCHING MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSD6113SP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>3s</td>
<td>Positive</td>
</tr>
<tr>
<td>TSD6111SP</td>
<td>12VDC</td>
<td>Fixed</td>
<td>15s</td>
<td>Positive</td>
</tr>
<tr>
<td>TSD6113SN</td>
<td>12VDC</td>
<td>Fixed</td>
<td>3s</td>
<td>Negative</td>
</tr>
<tr>
<td>TSD6310.8SN</td>
<td>24VDC</td>
<td>Fixed</td>
<td>0.8s</td>
<td>Negative</td>
</tr>
<tr>
<td>TSD631380SP</td>
<td>24VDC</td>
<td>Fixed</td>
<td>380s</td>
<td>Positive</td>
</tr>
<tr>
<td>TSD6320P</td>
<td>24VDC</td>
<td>External</td>
<td>0.1 - 10s</td>
<td>Positive</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

*For dimensional drawing see: Appendix, page 512, Figure 16.*
**TSD6 SERIES**

**Time Delay Relays**

**Dedicated — Interval**

**Accessories**

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**External Resistance vs. Time Delay**

In Secs., Mins., or Hours

<table>
<thead>
<tr>
<th>Time Delay Ranges</th>
<th>1k</th>
<th>2k</th>
<th>4k</th>
<th>8k</th>
<th>16k</th>
</tr>
</thead>
<tbody>
<tr>
<td>100s</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>750k</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>500k</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>250k</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100k</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers.
The time delay’s adjustable over the time delay range selected by varying the resistance across the Rt terminals, as the resistance increases the time delay increases.

When selecting an external Rr add the tolerances of the timer and the Rr for the full time range adjustment.

**Function Diagram**

- **V** = Voltage
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD** = Time Delay
- **R** = Reset

**Specifications**

**Time Delay**

- **Range**: 0.1s - 100h in 7 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.1% or 20ms, whichever is greater
- **Tolerance**
  - **(Factory Calibration)**: ≤ ±1%
  - **Reset Time**: ≤ 150ms
  - **Time Delay vs. Temperature & Voltage**: ≤ ±1%

**Input**

- **Voltage**: 12 or 24VDC
- **Tolerance**: ±15%
- **DC Ripple**: ±10%
- **Power Consumption**: ≤ 1W

**Output**

- **Type**: Solid state, positive or negative switching
- **Form**: NO, closed during timing
- **Maximum Load Current**: 1A steady state, 10A inrush at 60°C
- **Off State Leakage Current**: ≅ 1mA
- **Voltage Drop**: ≅ 1.0V @ 1A

**Circuitry**

- **Encapsulated**
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: Units are reverse polarity protected

**Mechanical**

- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**:
  - **H**: 50.8 mm (2”);
  - **W**: 50.8 mm (2”);
  - **D**: 30.7 mm (1.21”)
- **Termination terminals**: 0.25 in. (6.35 mm) male quick connect

**Environmental**

- **Operating/Storage Temperature**: -40° to 75°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 2.4 oz (68 g)
Description

The TSD7 Series utilizes only two terminals connected in series with the load. Interval timing mode period is achieved by using a small portion of the AC sine wave allowing sufficient voltage for circuit operation. It can be used as an interval timer to control or pulse shape the operation of contactors, solenoids, relays, and lamp loads. The TSD7 Series can be wired to delay on the break of a switch for energy saving fan delays.

Operation (Interval)

Upon application of input voltage, the output energizes and the time delay begins. The output remains energized throughout the time delay. At the end of the time delay, the output de-energizes and remains de-energized until power is removed.

Reset: Removing input voltage resets the time delay and the output.

Operation (Delay-on-Break)

Upon closure of SW1, the load is energized and the timer is reset (zero volts across its input terminals). Opening SW1 reapplies input voltage to the timer, the load remains energized and the time delay begins. At the end of the time delay, the output de-energizes. If SW1 is open when power is applied, the load will energize for the time delay then de-energize.

Reset: Reclosing SW1 resets the timer.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%, +/ -1% time delay accuracy</td>
</tr>
<tr>
<td>Extended temperature range</td>
<td>Rated to 75°C operating temperature to withstand high heat applications</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A steady solid-state output, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Two terminal series load connections</td>
<td>Provides quick and easy installation for new or existing systems</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSD7412S</td>
<td>120VAC</td>
<td>Fixed</td>
<td>2s</td>
<td>TSD76120S</td>
<td>230VAC</td>
<td>Fixed</td>
<td>120s</td>
</tr>
<tr>
<td>TSD7414M</td>
<td>120VAC</td>
<td>Fixed</td>
<td>4m</td>
<td>TSD761180S</td>
<td>230VAC</td>
<td>Fixed</td>
<td>180s</td>
</tr>
<tr>
<td>TSD7421</td>
<td>120VAC</td>
<td>External</td>
<td>1 - 100s</td>
<td>TSD7611S</td>
<td>230VAC</td>
<td>Fixed</td>
<td>1s</td>
</tr>
<tr>
<td>TSD7423</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 10m</td>
<td>TSD7621</td>
<td>230VAC</td>
<td>External</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>TSD7424</td>
<td>120VAC</td>
<td>External</td>
<td>1 - 100m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
Accessories

P1004-13, P1004-13-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting Bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VTP(X)(X) Plug-on Adjustment Module
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

<table>
<thead>
<tr>
<th>Selection Table for VTP Plug-on Adjustment Accessory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Delay</td>
</tr>
<tr>
<td>1 - 1-100s</td>
</tr>
<tr>
<td>2 - 10-1000s</td>
</tr>
<tr>
<td>3 - 0.1-10m</td>
</tr>
</tbody>
</table>

Selection Guide

<table>
<thead>
<tr>
<th>R&lt;sub&gt;T&lt;/sub&gt; Selection Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired Time Delay*</td>
</tr>
<tr>
<td>Seconds</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

* When selecting an external R<sub>T</sub> add at least 20% for tolerance of unit and the R<sub>T</sub>.

Specifications

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>Digital integrated circuitry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>1s - 1000m in 5 adjustable ranges or fixed</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±0.5% or 20ms, whichever is greater</td>
</tr>
<tr>
<td>Tolerance</td>
<td>≤ ±10%</td>
</tr>
<tr>
<td>Recycle Time</td>
<td>≤ 400ms</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage</td>
<td>≤ ±2%</td>
</tr>
</tbody>
</table>

Input

- Voltage: 24, 120, or 230VAC
- Tolerance: ±20%
- AC Line Frequency: 50/60 Hz

Output

- Type: Solid state
- Form: NO, closed during timing
- Maximum Load Current: 1A steady state, 10A inrush at 45°C
- Minimum Load Current: 40mA

Effective Voltage Drop (VLine-VLoad)

<table>
<thead>
<tr>
<th>Input</th>
<th>Effective Drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>24VAC</td>
<td>3V</td>
</tr>
<tr>
<td>120VAC</td>
<td>4V</td>
</tr>
<tr>
<td>230VAC</td>
<td>6V</td>
</tr>
</tbody>
</table>

Protection

- Dielectric Breakdown: Encapsulated
- ≥ 2000V RMS terminals to mounting surface
- ≥ 100 MΩ

Mechanical

- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals
- Operating/Storage Temperature: -40° to 75°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≅ 2.4 oz (68 g)

Function Diagrams

V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
O = Output
L = Load
R = Time Delay
TD = Time Delay
= Undefined Time
**Description**

The KRD9 Series microcontroller timing circuit provides excellent repeat accuracy and stability. Cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

**Operation (Retriggerable Single Shot)**

**Function Type A (Output Initially De-energized):** Input voltage must be applied prior to and during timing. When the initiate switch is closed, (momentary or maintained) the output energizes and the time delay starts. On completion of the delay, the output de-energizes. The unit will time out if S1 remains in the open or closed position for the full time delay. Reclosing the initiate switch resets the time delay and restarts timing; the output remains energized. The output will not energize if the initiate switch is closed when input voltage is applied.

**Function Type B (Output Initially Energized):** Upon application of input voltage, the output energizes and the time delay starts. At the end of the time delay, the load de-energizes. The unit will time out if S1 remains in the open or closed position for the full time delay. Closing (re-closing) the initiate switch resets the time delay and restarts timing; the output remains energized.

**Reset:** The time delay and the output are reset when input voltage is removed.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%, Factory calibration +/- 5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and component costs</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated circuitry</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>FUNCTION TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRD912OB</td>
<td>12VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Energized</td>
</tr>
<tr>
<td>KRD9211SMA</td>
<td>24VAC/DC</td>
<td>Fixed</td>
<td>15m</td>
<td>De-energized</td>
</tr>
<tr>
<td>KRD9211SMB</td>
<td>24VAC/DC</td>
<td>Fixed</td>
<td>15m</td>
<td>Energized</td>
</tr>
<tr>
<td>KRD922OB</td>
<td>24VAC/DC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Energized</td>
</tr>
<tr>
<td>KRD9311SMA</td>
<td>24VDC</td>
<td>Fixed</td>
<td>15m</td>
<td>De-energized</td>
</tr>
<tr>
<td>KRD9423B</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10m</td>
<td>Energized</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
**KRD9 SERIES**

### Accessories

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### External Resistance vs. Time Delay

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the delay increases.

When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

### Output Current/Ambient Temperature

### Specifications

**Time Delay**

- **Type**: Microcontroller based with watchdog circuitry
- **Range**: 0.1s - 1000m in 6 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5% or 20ms, whichever is greater
- **Tolerance**: ±5%
- **Reset Time**: ≤ 150ms
- **Initiate Time**: ≤ 40ms; ≤ 750 operations per minute
- **Time Delay vs Temp. & Voltage**: ≤ ±5%
- **Voltage**: 12, 24 or 110VDC; 24, 120 or 230VAC
- **Tolerance**: -15% - +20% (12VDC & 24VDC/AC); -20% - +10% (110VDC, 120 or 230VAC)
- **AC Line Frequency/DC Ripple**: 50/60 Hz / ≤ 10%
- **Power Consumption**: AC ≤ 2VA; DC ≤ 2W
- **Rating (at 40°C)**: 10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
- **Type**: Isolated relay contacts
- **Form**: SPDT

**Protection**

- **Circuitry**: Encapsulated
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reversed polarity protected

**Mechanical**

- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 50.8 mm (2.0”); W 50.8 mm (2.0”); D 30.7 mm (1.21”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**

- **Operating/Storage**:
  - Temperature: -40° to 60°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing

**Encapsulated**

- **Weight**: 2.6 oz (74 g)

### Function Diagram

**RETRIGGERABLE SINGLE SHOT (MOTION DETECTOR) (PSD)**

- **V** = Voltage
- **S1** = Initiate Switch
- **NO = Normally Open Contact**
- **NC = Normally Closed Contact**
- **t** = Incomplete Time Delay
- **TD** = Time Delay
- **R** = Reset

© 2023 Littelfuse, Inc. Littelfuse.com/krd9
Description
The TSD94110SB retriggerable single-shot timer is designed for a variety of applications. Its digital circuit provides long or short delays with accuracy and stability over a wide voltage and temperature range. It is the ideal timer for pulse-train monitoring of programmable controllers, or any system requiring motion detection.

Operation A Type
Power must be applied to input at all times prior to and during timing. Upon closure of initiate switch (momentary or maintained) the load is energized and the time delay is started. On completion of the delay period the load is de-energized. Should the initiate switch be reclosed during timing, the delay will be reset to zero and restarted.

Operation B Type
Upon application of input power, the load is energized and a time delay is started. At the end of the time delay, the load is de-energized. Should the initiate switch be closed or reclosed during timing, the delay is reset to zero and restarted.

Features & Benefits
- Excellent Pulse Train Monitor
- Totally Solid State and Encapsulated
- Microcontroller Circuitry
- Fast Reset to Zero During Timing
- Excellent Accuracy and Reliability
- DC Units are Reverse Polarity Protected

Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Delay Type</td>
<td>Microcontroller circuitry</td>
</tr>
<tr>
<td>Range</td>
<td>Factory fixed 10s</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±0.5%</td>
</tr>
<tr>
<td>Tolerance</td>
<td>±1%</td>
</tr>
<tr>
<td>Recycle Time</td>
<td>300ms max.</td>
</tr>
<tr>
<td>Time Delay vs. Temp. &amp; Voltage</td>
<td>±2%</td>
</tr>
<tr>
<td>Initiate Timing</td>
<td>16ms max. AC</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>120 volts AC</td>
</tr>
<tr>
<td>Tolerance</td>
<td>±15%</td>
</tr>
<tr>
<td>Output Type</td>
<td>Solid State</td>
</tr>
<tr>
<td>Form</td>
<td>Normally open</td>
</tr>
<tr>
<td>Rating</td>
<td>1 ampere steady state, 10 amperes inrush at 55°C</td>
</tr>
<tr>
<td>Voltage Drop Protection</td>
<td>AC 2.5 volts typical at 1 ampere</td>
</tr>
<tr>
<td>Transient Protection</td>
<td>Protected</td>
</tr>
<tr>
<td>Dielectric Insulation Resistance</td>
<td>1500 volts RMS</td>
</tr>
<tr>
<td></td>
<td>100 megohms minimum 4.4</td>
</tr>
</tbody>
</table>

Environmental
- Operating/Storage Temperature: -40°C to 60°C / -40°C to 85°C
- Humidity: 95% relative, non-condensing
- Weight: Approx. 2.4 oz (68 g)

Function Diagram
- V = Voltage
- S1 = Initiate Switch
- NO = Normally Open Contact
- NC = Normally Closed Contact
- t = Incomplete Time Delay
- R = Reset
- TD = Time Delay

For dimensional drawing see: Appendix, page 512, Figure 16.
Description

Econo-Timers are a combination of digital electronics and a reliable electromechanical relay. DPDT relay output for relay logic circuits, and isolation of input to output voltages. Cost effective for OEM applications, such as duty cycling, drying, washing, signaling, and flashing.

Operation (Recycling - ON Time First)

Upon application of input voltage, the output relay energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output relay energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital integrated circuitry</td>
<td>Repeat Accuracy +/- 0.5%, Factory calibration +/- 10%</td>
</tr>
<tr>
<td>Isolated, 10A, DPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-16, P1004-16-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16)**
  Female Quick Connect
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

For dimensional drawing see: Appendix, page 512, Figure 25.
**Selection Guides**

**Specifications**

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>Digital integrated circuitry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>0.1s - 500m in 11 adjustable ranges</td>
</tr>
<tr>
<td>Range</td>
<td>0.1s - 1000m fixed</td>
</tr>
<tr>
<td>Adjustment</td>
<td>Knob, external adjust, or fixed</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±0.5%</td>
</tr>
<tr>
<td>Tolerance</td>
<td>(Factory Calibration)</td>
</tr>
<tr>
<td>Reset Time</td>
<td>≤ ±10%</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage</td>
<td>≤ 150ms</td>
</tr>
<tr>
<td>≤ ±2%</td>
<td></td>
</tr>
</tbody>
</table>

**Input**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>12, 24, or 120VDC; 24, 120, or 230VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>12VDC &amp; 24VDC/AC</td>
</tr>
<tr>
<td>120VAC/DC &amp; 230VAC</td>
<td>-15% - 20%</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>-20% - 10%</td>
</tr>
<tr>
<td>50/60 Hz</td>
<td></td>
</tr>
</tbody>
</table>

**Output**

<table>
<thead>
<tr>
<th>Type</th>
<th>Isolated relay contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>DPDT</td>
</tr>
<tr>
<td>Rating</td>
<td>10A resistive @ 120/240VAC &amp; 28VDC; 1/3 hp @ 120/240VAC</td>
</tr>
<tr>
<td>Life</td>
<td>Mechanical - 1 x 10⁷; Electrical - 1 x 10⁶</td>
</tr>
<tr>
<td>Protection</td>
<td>≥ 1500V RMS input to output</td>
</tr>
<tr>
<td>Isolation Voltage</td>
<td>≥ 100 MO</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>DC units are reverse polarity protected</td>
</tr>
<tr>
<td>Polarity</td>
<td>Surface mount with two #6 (M3.5 x 0.6) screws</td>
</tr>
<tr>
<td>Mechanical</td>
<td>H 88.9 mm (3.5&quot;), W 63.5 mm (2.5&quot;); D 43.2 mm (1.7&quot;)</td>
</tr>
<tr>
<td>Mounting</td>
<td>0.25 in. (6.35 mm) male quick connect terminals</td>
</tr>
<tr>
<td>Dimensions</td>
<td>-40°C to 65°C / -40°F to 85°F</td>
</tr>
<tr>
<td>Weight</td>
<td>5.7 oz (162 g)</td>
</tr>
</tbody>
</table>

**Function Diagram**

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

Littelfuse.com/erd3425A
**Description**

The ESDR Series offers independent time adjustment of both delay periods. Adjustment options include fixed, onboard or external adjust. The ESDR is recommended for air drying, automatic oiling, life testing, chemical metering and automatic duty cycling. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable, solid-state timer is required. The factory calibration for fixed time delays is ±5%. The repeat accuracy, under stable conditions, is 0.1% of the selected time delay. This series is designed for input voltages of 12VDC to 230VAC in five ranges. Time delays of 0.1 seconds to 1000 minutes are available in six ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

**Operation (Recycling - ON Time First)**

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2, OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

**Reset:** Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

**Operation (Recycling - OFF Time First)**

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the cycle repeats as long as input voltage is applied.

**Reset:** Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy ± 0.1%</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity.</td>
</tr>
<tr>
<td>ON/OFF recycling with independent adjustment of both time periods</td>
<td>Separate on and off timing settings are knob adjustable for added flexibility.</td>
</tr>
<tr>
<td>Compact, low cost design measuring 2 in. (50.8mm) square</td>
<td>Allows flexibility for OEM applications</td>
</tr>
</tbody>
</table>

**Ordering Information**

See next page.

---

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in. (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

---

**Wiring Diagram**

[Diagram showing wiring connections]

For dimensional drawing see: Appendix, page 512, Figure 16.
Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>T1 ON TIME</th>
<th>FIRST DELAY</th>
<th>T2 OFF TIME</th>
<th>SWITCHING MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESDR120A0P</td>
<td>12VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>On time</td>
<td>0.1 - 10s</td>
<td>Positive</td>
</tr>
<tr>
<td>ESDR120B3P</td>
<td>12VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Off time</td>
<td>0.1 - 10m</td>
<td>Positive</td>
</tr>
<tr>
<td>ESDR123B4P</td>
<td>12VDC</td>
<td>Onboard</td>
<td>0.1 - 10m</td>
<td>Off time</td>
<td>1 - 100m</td>
<td>Positive</td>
</tr>
<tr>
<td>ESDR125A5P</td>
<td>12VDC</td>
<td>Onboard</td>
<td>10 - 1000m</td>
<td>On time</td>
<td>10 - 1000m</td>
<td>Positive</td>
</tr>
<tr>
<td>ESDR221A2</td>
<td>24VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>On time</td>
<td>10 - 1000s</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR320A0P</td>
<td>24VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>On time</td>
<td>0.1 - 10m</td>
<td>Positive</td>
</tr>
<tr>
<td>ESDR320A3P</td>
<td>24VDC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Off time</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR420A0</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>On time</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR420A1</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>On time</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR420A4</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>On time</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR420B1</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Off time</td>
<td>1 - 100s</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR420B4</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Off time</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR421A1</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>On time</td>
<td>1 - 100s</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR421A4</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100s</td>
<td>On time</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR423A3</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10m</td>
<td>On time</td>
<td>0.1 - 10m</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR423A4</td>
<td>120VAC</td>
<td>Onboard</td>
<td>0.1 - 10m</td>
<td>On time</td>
<td>1 - 100m</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR424A1</td>
<td>120VAC</td>
<td>Onboard</td>
<td>1 - 100m</td>
<td>On time</td>
<td>1 - 100s</td>
<td>n/a</td>
</tr>
<tr>
<td>ESDR450A1</td>
<td>120VAC</td>
<td>External</td>
<td>0.1 - 10s</td>
<td>On time</td>
<td>1 - 100s</td>
<td>n/a</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

External Resistance vs. Time Delay

This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals, as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 s adjustable time delay, select time delay range 1 and a 50 k ohm RT. For 1 to 100 s use a 100 k ohm RT.
## Specifications

| Time Delay | Range | 0.1s - 1000m in 6 adjustable ranges or fixed  
| Repeate Accuracy | ±0.1% or 20ms, whichever is greater  
| Tolerance | ≤ ±5%  
| Time Delay vs Temp. & Voltage | ≤ ±2%  
| Reset Time | ≤ 150ms  
| Input Voltage | 12 or 24VDC; 24, 120, or 230VAC  
| Tolerance | ±20%  
| Power Consumption | AC ≤ 2VA; DC ≤ 1W  
| AC Line Frequency/DC Ripple | 50/60 Hz / ≤ 10%  
| Output Type | Solid state  
| Maximum Load Current | 1A steady state, 10A inrush at 60°C  
| OFF State Leakage Current | AC ≅ 5mA @ 230VAC; DC ≅ 1mA  
| Voltage Drop | AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A  

## Protection

| Circuitry | Encapsulated  
| Dielectric Breakdown | ≥ 2000V RMS terminals to mounting surface  
| Insulation Resistance | ≥ 100 MΩ  
| Polarity | DC units are reverse polarity protected  
| Mechanical | Surface mount with one #10 (M5 x 0.8) screw  
| Mounting Dimensions | H 50.8 mm (2"), W 50.8 mm (2"), D 30.7 mm (1.21")  
| AC Line Frequency/DC Ripple | 0.25 in. (6.35 mm) male quick connect terminals  
| Operating/Storage Temperature | -40° to 75°C / -40° to 85°C  
| Humidity | 95% relative, non-condensing  
| Weight | ≅ 2.4 oz (68 g)  

© 2023 Littelfuse, Inc.  
Littelfuse.com/esdr
**Description**

The HRDR Series combines an electromechanical relay and microcontroller timing circuitry. It offers 12 to 230V operation in five ranges and factory fixed, onboard or externally adjustable time delays with a repeat accuracy of ±0.5%. The high switching capacity of the output contacts allow for direct control of heavy loads like compressors, pumps, motors, heaters and lighting. A bypass/reset switch option allows operator to interrupt normal recycling sequence and energize output relay. An excellent choice for OEM applications.

**Operation (Recycling with Reset Switch)**

Upon application of input voltage, the ON time T1 begins and output relay energizes. At the end of the ON time, the output relay de-energizes and the OFF time T2 begins. At the end of the OFF time, the output relay energizes and the cycle repeats as long as input voltage is applied. Some recycling timers have the OFF time as the first delay.

**Reset:**

Removing input voltage resets output and time delays, and returns sequence to the first delay.

**Bypass/Reset Switch:**

Closing the normally open bypass/reset switch energizes the output relay and resets the time delays. Opening the switch restarts recycling operation with the first delay.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.5%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Isolated, 30A, SPDT, NO output contacts</td>
<td>Allows direct operation of heavy loads: compressors, pumps, blowers, motors, heaters.</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Independent adjustment of On and Off delays</td>
<td>Provides greater flexibility of timing options</td>
</tr>
<tr>
<td>Bypass/Reset switch option</td>
<td>Allows operator to interrupt the timing sequence and energize the output relay</td>
</tr>
</tbody>
</table>

**Wiring Diagram**

NO = Normally Open  
S1 = Reset Switch  
C = Common, Transfer Contact  
L = Load

Terminals 4 & 5 and/or 7 & 8 are only included on externally adjustable units. Relay contacts are non-isolated.  
Rt is included when external adjustment is ordered.  
Terminal 6 is included when Bypass/Reset is selected.

For dimensional drawing see: Appendix, page 512, Figure 17.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>EXTERNAL ADJUSTMENT</th>
<th>T1 ON TIME</th>
<th>OPERATING SEQUENCE</th>
<th>T2 OFF TIME</th>
<th>BYPASS / RESET OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRDR121A4R</td>
<td>12VDC</td>
<td>Both time onboard adj</td>
<td>1 - 100s</td>
<td>On time first</td>
<td>1 - 100ms</td>
<td>Yes</td>
</tr>
<tr>
<td>HRDR321A4R</td>
<td>24VDC</td>
<td>Both time onboard adj</td>
<td>1 - 100s</td>
<td>On time first</td>
<td>1 - 100ms</td>
<td>Yes</td>
</tr>
<tr>
<td>HRDR32B2R</td>
<td>24VDC</td>
<td>Both time onboard adj</td>
<td>10 - 1000s</td>
<td>Off time first</td>
<td>10 - 1000s</td>
<td>Yes</td>
</tr>
<tr>
<td>HRDR330A0R</td>
<td>24VDC</td>
<td>Both time external adj</td>
<td>0.1 - 10s</td>
<td>On time first</td>
<td>0.1 - 10s</td>
<td>Yes</td>
</tr>
<tr>
<td>HRDR431A1</td>
<td>24VDC</td>
<td>Both time external adj</td>
<td>1 - 100s</td>
<td>On time first</td>
<td>1 - 100s</td>
<td>No</td>
</tr>
<tr>
<td>HRDR411SB30MR</td>
<td>120VAC</td>
<td>Both times fixed</td>
<td>1s</td>
<td>Off time first</td>
<td>30m</td>
<td>Yes</td>
</tr>
<tr>
<td>HRDR431A1R</td>
<td>120VAC</td>
<td>Both times external adj</td>
<td>0.1 - 100s</td>
<td>On time first</td>
<td>0.1 - 100s</td>
<td>Yes</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848
**Accessories**

**P1004-95, P1004-95-X Versa-Pot**
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

**P1023-6 Mounting bracket**
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P0700-7 Versa-Knob**
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**P1015-13 (AVG 10/12), P1015-64 (AVG 14/16) Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Specifications**

**Time Delay**
- Range: 100ms - 1000m in 6 adjustable ranges or fixed
- Repeat Accuracy: ±0.5% or 20ms, whichever is greater
- Tolerance (Factory Calibration): ±5%
- Reset Time: ≤ 150ms
- Time Delay vs Temp. & Voltage: ≤ ±2%

**Input**
- Voltage: 12 or 24VDC, 24, 120, or 230VAC
- Tolerance: 12VDC & 24VDC -15% - 20%
- 24 to 230VAC -20% - 10%
- AC Line Frequency: 50/60 Hz
- Power Consumption: AC ≤ 4VA; DC ≤ 2W

**Output**
- Type: Electromechanical relay
- Form: SPDT, non-isolated

**Ratings**
- General Purpose: 125/240VAC 30A, 15A
- Resistive: 28VDC 20A, 10A
- Motor Load: 125VAC 1 hp*, 1/4 hp**; 240VAC 2 hp**, 1 hp**

**Life**
- Mechanical: 1 x 10⁶
- Electrical: 1 x 10⁵, **3 x 10⁴, **6,000

**Protection**
- Surge: IEEE C62.41-1991 Level A
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MO
- Polarity: DC units are reverse polarity protected

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 76.7 mm (3"), W 51.3 mm (2"), D 38.1 mm (1.5"
- Termination: 0.25 in. (6.35 mm) male quick connect terminals
- Operating/Storage: -40° to 60°C / -40° to 85°C
- Humidity: 95% relative non-condensing
- Weight: ≅ 3.9 oz (111 g)

**External Resistance vs. Time Delay**

**Function Diagram**

This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the Rₜ terminals; as the resistance increases the time delay increases.

When selecting an external Rₜ and the tolerances of the timer and the Rₜ for the full time range adjustment.

Examples: 1 to 500 adjustable time delay, select time delay range 1 and a 50 K ohm Rₜ. For 1 to 100 use a 10 K ohm Rₜ.
**Description**

The KRD3 Series measures only 2 in. (50.8 mm) square. Its solid-state timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRD3 Series is a cost-effective approach for OEM applications that require small size, isolation, reliability, and long life.

**Operation (Recycling Flasher - ON Time First)**

Upon application of input voltage, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

**Reset:** Removing input voltage resets the output and time delays, and returns the sequence to T1 ON time.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact, low cost design measuring 2 in. (50.8mm) square</td>
<td>Provides greater flexibility for OEM applications and reduces component and labor costs</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/-0.5%, Factory calibration +/-5%</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>OPERATING SEQUENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRD3420A</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>0.1 - 10s</td>
<td>On time first</td>
</tr>
<tr>
<td>KRD3421A</td>
<td>120VAC</td>
<td>Onboard knob</td>
<td>1 - 100s</td>
<td>On time first</td>
</tr>
<tr>
<td>KRD3434A</td>
<td>120VAC</td>
<td>External</td>
<td>1 - 100m</td>
<td>On time first</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
**KRD3 SERIES**

---

**External Resistance vs. Time Delay**

![Graph showing external resistance vs. time delay]

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R1 terminals; as the resistance increases the time delay increases.

Examples: 1 to 60 S adjustable time delay, select time delay range 1 and a 50 k ohm R1. For 1 to 100 S use a 100 k ohm R1.

---

**Output Current/Ambient Temperature**

![Graph showing output current vs. ambient temperature]

---

**Function Diagram**

![Diagram showing relay connections]

**Specifications**

**Time Delay**
- Range: 0.1s - 100m in 5 adjustable ranges or fixed
- Repeat Accuracy: ±0.5% or 20ms, whichever is greater
- Tolerance: ± 5%
- Reset Time: ≤ 150ms
- Time Delay vs Temp. & Voltage: ±5%

**Input**
- Voltage: 12, 24 or 110VDC; 24, 120, or 230VAC
- Tolerance: 12VDC & 24VDC/AC -15% - 20%
  - 110VDC, 120 or 230VAC -20% - 10%
- AC Line Frequency/DC Ripple: 50/60 Hz / ≤ 10%
- Power Consumption: AC ≤ 2VA; DC ≤ 2W

**Output**
- Type: Isolated relay contacts
- Form: SPDT
- Rating (at 40°C): 10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC;
- 1/4 hp @ 125VAC 250VAC
- Max. Switching Voltage: Mechanical - 1 x 10⁷; Electrical - 1 x 10⁵

**Protection**
- Circuitry: Encapsulated
- Isolation Voltage: ≥ 1500V RMS input to output
- Insulation Resistance: ≥ 100 MO
- Polarity: DC units are reverse polarity protected
- Mechanical:
  - Mounting: Surface mount with one #10 (M5 x 0.8) screw
  - Dimensions: H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
  - Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- Operating/Storage Temperature: -20° to 60°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≈ 2.6 oz (74 g)

---

© 2023 Littelfuse, Inc.
Littelfuse.com/krd3
KRDR SERIES

Description
The KRDR Series is a compact time-delay relay measuring only 2 in. (50.8 mm) square. Its solid-state timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDR Series is a cost effective recycling timer for OEM applications that require small size, isolation, reliability, and long life.

Operation (Recycling - ON Time First)
Upon application of input voltage, the output relay energizes and the T2 ON time begins. At the end of the ON time, the output de-energizes and the T1 OFF time begins. At the end of the OFF time, the output relay energizes and the cycle repeats as long as input voltage is applied.
Reset: Removing input voltage resets the output and the time delays, and returns the sequence to the ON time.

Operation (Recycling - OFF Time First)
Upon application of input voltage, the T1 OFF time begins. At the end of the OFF time, the T2 ON time begins and the load energizes. At the end of the ON time the load de-energizes, and the cycle repeats until input voltage is removed.
Reset: Removing input voltage resets the output and the sequence to the OFF time.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact design and independent adjustment of ON and OFF times</td>
<td>Provides greater flexibility for OEM applications and reduces component and labor costs</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%, Factory calibration +/- 5%</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLT.</th>
<th>ADJUST.</th>
<th>T2 ON TIME</th>
<th>FIRST DELAY</th>
<th>T1 OFF TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRDR115MB25M</td>
<td>12VDC</td>
<td>Fixed</td>
<td>5m</td>
<td>Off time</td>
<td>25m</td>
</tr>
<tr>
<td>KRDR120A0</td>
<td>12VDC</td>
<td>Adjustable</td>
<td>0.1 - 10s</td>
<td>On time</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDR121A1</td>
<td>12VDC</td>
<td>Adjustable</td>
<td>1 - 100s</td>
<td>On time</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>KRDR320B0</td>
<td>24VDC</td>
<td>Adjustable</td>
<td>0.1 - 10s</td>
<td>Off time</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDR321A4</td>
<td>24VDC</td>
<td>Adjustable</td>
<td>1 - 100s</td>
<td>Off time</td>
<td>1 - 100m</td>
</tr>
<tr>
<td>KRDR321B4</td>
<td>24VDC</td>
<td>Adjustable</td>
<td>1 - 100s</td>
<td>Off time</td>
<td>1 - 100m</td>
</tr>
<tr>
<td>KRDR420A3</td>
<td>120VAC</td>
<td>Adjustable</td>
<td>0.1 - 10s</td>
<td>Off time</td>
<td>0.1 - 10m</td>
</tr>
<tr>
<td>KRDR421A4</td>
<td>120VAC</td>
<td>Adjustable</td>
<td>1 - 100s</td>
<td>On time</td>
<td>1 - 100m</td>
</tr>
<tr>
<td>KRDR424A0</td>
<td>120VAC</td>
<td>Adjustable</td>
<td>1 - 100m</td>
<td>On time</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KRDR424A4</td>
<td>120VAC</td>
<td>Adjustable</td>
<td>1 - 100m</td>
<td>On time</td>
<td>1 - 100m</td>
</tr>
<tr>
<td>KRDR440.5S40</td>
<td>120VAC</td>
<td>On time fixed</td>
<td>0.5s</td>
<td>On time</td>
<td>0.1 - 10s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
KRDR SERIES

Specifications

Time Delay
Range 0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy ±0.5 % or 20ms, whichever is greater
Tolerance (Factory Calibration) ≤ ±5%
Reset Time ≤ 150ms
Time Delay vs Temp. & Voltage ≤ ±5%

Input
Voltage
12VDC & 24VDC/AC -15% - 20%
110VDC & 120 or 230VAC -20% - 10%

AC Line Frequency/DC Ripple
50/60 Hz / ≤ 10%

Power Consumption
AC ≤ 2VA; DC ≤ 2W

Output
Type Isolated relay contacts
Form SPDT
Rating (at 40°C) 10A resistive @ 125VAC;
5A resistive @ 230VAC & 28VDC;
1/4 hp @ 125VAC

Max. Switching Voltage
250VAC

Life (Operations)
Mechanical - 1 x 10^7; Electrical - 1 x 10^4

Protection
Encapsulated
Isolation Voltage ≥ 1500V RMS input to output
Insulation Resistance ≥ 100 MΩ

Polarity
DC units are reverse polarity protected

Mechanical
Surface mount with one #10 (M5 x 0.8) screw
Dimensions
H 50.8 mm (2”); W 50.8 mm (2”);
D 30.7 mm (1.21”)

Termination
0.25 in. (6.35 mm) male quick connect terminals

Environmental
Operating/Storage
Temperature -20° to 60°C / -40° to 85°C
Humidity
95% relative, non-condensing
Weight
≈ 2.6 oz (74 g)

Output Current/Ambient Temperature

Function Diagrams

RECYCLING (ON FIRST)

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
T1 = OFF Time
T2 = ON Time
R = Reset

RECYCLE (OFF TIME FIRST)

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
T1, TD1, TD2 = Time Delay
T2 = ON Time
R = Reset

RECYCLING (OFF TIME FIRST)

V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
T1 = OFF Time
T2 = ON Time
R = Reset
The KSD3 Series Digi-Timer is a cost effective approach for ON/OFF recycling applications. The on time is equal to the off time. An adjustment of the $R_T$ will change the time delays of both on and off times. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable, solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for popular AC and DC voltages. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

**Operation (Recycling Flasher - ON Time First)**
Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the ON time.

**Operation (Recycling Flasher - OFF Time First)**
Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of the ON time the load de-energizes, and the cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and time delays and the sequence to the OFF time.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy $\pm$ 0.5%, $\pm$ 5% time delay accuracy</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A Steady solid-state output, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
<th>OPERATING SEQUENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSD3120A</td>
<td>12VDC</td>
<td>External</td>
<td>0.1 - 10s</td>
<td>ON time first</td>
</tr>
<tr>
<td>KSD3310.1SA</td>
<td>24VDC</td>
<td>Fixed</td>
<td>0.1s</td>
<td>ON time first</td>
</tr>
<tr>
<td>KSD3415MA</td>
<td>120VAC</td>
<td>Fixed</td>
<td>5m</td>
<td>ON time first</td>
</tr>
<tr>
<td>KSD3432A</td>
<td>120VAC</td>
<td>Onboard</td>
<td>10 - 1000s</td>
<td>ON time first</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 880-843-8848

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.
## Accessories

**P1015-64 (AWG 14/16)**  
**Female Quick Connect**  
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**  
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**  
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**  
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

## Specifications

### Time Delay
- **Range**: 0.1s - 1000m in 6 adjustable ranges or fixed
- **Repeat Accuracy**: ±0.5% or 20ms, whichever is greater
- **Tolerance**:  
  - Factory Calibration: ≤ ± 5%
  - Reset Time: ≤ 150ms
  - Time Delay vs. Temperature & Voltage: ≤10%

### Input
- **Voltage**: 24 or 120VAC; 12 or 24VDC
- **Tolerance**: ±20%
- **AC Line Frequency**: 50/60 Hz
- **Power Consumption**: AC ≤ 2VA; DC ≤ 1W

### Output
- **Type**: Solid state
- **Maximum Load Current**: 1A steady state, 10A inrush at 60°C
- **OFF State Leakage Current**:  
  - AC: ≤ 5mA @ 230VAC
  - DC: ≤ 1mA
- **Voltage Drop**:  
  - AC: ≤ 2.5V @ 1A
  - DC: ≤ 1V @ 1A

### Protection
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected

### Mechanical
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**:  
  - H: 50.8 mm (2”); W: 50.8 mm (2”); D: 30.7 mm (1.21”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

### Environmental
- **Operating/Storage Temperature**: -40° to 60°C / -40° to 85°C
- **Relative Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 2.4 oz (68 g)

### Function Diagrams

**FLASHER (ON FIRST)**  
ON time plus OFF time equals one complete flash.

**FLASHER (OFF FIRST)**  
V = Voltage
L = Load
T1 = ON Time
T2 = OFF Time
R = Reset
**Description**

The KSDR Series offers independent time adjustment of both delay periods. The KSDR Series is recommended for air drying, automatic oiling, life testing, chemical metering, and automatic duty cycling. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable, solid-state timer is required. The factory calibration for fixed time delays is within ± 5% of the target delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for input voltages of 24, 120 or 230VAC. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

**Operation (Recycling - ON Time First)**

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2, OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

**Reset:** Removing input voltage resets the output and time delays, and returns the sequence to T1 ON time.

**Operation (Recycling - OFF Time First)**

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

**Reset:** Removing input voltage resets the output and the sequence to T2 OFF time.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Microcontroller based</strong></td>
<td>Repeat Accuracy ± 0.5%, Factory calibration ± 5%</td>
</tr>
<tr>
<td><strong>1A steady, 10A inrush solid-state output</strong></td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
<tr>
<td><strong>Totally solid state and encapsulated</strong></td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td><strong>Wide operating temperature range: -40° to 75°C</strong></td>
<td>Reliable in demanding commercial and industrial applications</td>
</tr>
<tr>
<td><strong>Compact, low cost design measuring 2 in. (50.8mm) square</strong></td>
<td>Allows flexibility for OEM applications</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>T1 ON TIME</th>
<th>FIRST DELAY</th>
<th>T2 OFF TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSDR40A0</td>
<td>120VAC</td>
<td>0.1 - 10s</td>
<td>On time</td>
<td>0.1 - 10s</td>
</tr>
<tr>
<td>KSDR42A4</td>
<td>120VAC</td>
<td>10 - 1000s</td>
<td>On time</td>
<td>1 - 100m</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848.

For dimensional drawing see: Appendix, page 512, Figure 16.
## Accessories

**P1004-95, P1004-95-X Versa-Pot**  
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

**P1023-6 Mounting bracket**  
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P0700-7 Versa-Knob**  
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

**P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect**  
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**  
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**  
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**  
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

---

## External Resistance vs. Time Delay

This chart applies to externally adjustable part numbers.  
The time delay is adjustable over the time delay range selected by varying the resistance across the \( R_T \) terminals; as the resistance increases the time delay increases.

When selecting an external \( R_T \), add the tolerances of the timer and the \( R_T \) for the full time range adjustment.

**Examples:**  
1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm \( R_T \).  
For 1 to 100 S use a 100 K ohm \( R_T \).

---

## Function Diagrams

### Recycling (on first)

- \( V \) = Voltage
- \( NO \) = Normally Open Contact
- \( NC \) = Normally Closed Contact
- \( TD1, TD2 \) = Time Delay
- \( R \) = Reset

### Recycling (off time first)

- \( V \) = Voltage
- \( NO \) = Normally Open Contact
- \( NC \) = Normally Closed Contact
- \( TD1, TD2 \) = Time Delay
- \( R \) = Reset

---

## Specifications

**Time Delay**
- Range: 0.1s - 1000m in 6 ranges
- Repeat Accuracy: ±0.5% or 20ms, whichever is greater
- Tolerance (Factory Calibration): ≤ ±5%
- Reset Time: ≤ 150ms
- Time Delay vs Temp. & Voltage: ≤ ±10%

**Input**
- Voltage: 24, 120, or 230VAC
- Tolerance: ±20%
- AC Line Frequency: 50/60 Hz
- Power Consumption: ≤ 2VA

**Output**
- Type: Solid state
- Rating: 1A steady state, 10A inrush at 60°C
- Voltage Drop: ≅ 2.5V @ 1A
- OFF State Leakage Current: ≅ 5mA @ 230VAC

**Protection**
- Circuitry: Encapsulated
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions:  
  - H 50.8 mm (2")
  - W 50.8 mm (2")
  - D 30.7 mm (1.21")
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- Operating/Storage Temperature: -40° to 75°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: 2.4 oz (68 g)
**KSPD SERIES**

**Solid State Timer**

**Description**
The KSPD Series is a factory programmed module available with 1 of 12 standard dual functions. The time delays can be factory fixed, externally or onboard adjustable, or a combination of fixed and adjustable. The 1A steady, 10A inrush rated solid-state output provides 100 million operations, typical. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KSPD Series is a cost effective approach for OEM applications that require small size and long life.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/ - 0.5%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**: Panel mountable, industrial potentiometer recommended for remote time delay adjustment.
- **P1023-6 Mounting bracket**: The 90° orientation of mounting slots makes installation/removal of modules quick and easy.
- **P0700-7 Versa-Knob**: Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.
- **P1015-64 (AWG 14/16) Female Quick Connect**: These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
- **C103PM (AL) DIN Rail**: 35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.
- **P1023-20 DIN Rail Adapter**: Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT</th>
<th>ADJUSTMENT 1</th>
<th>TIME DELAY 1</th>
<th>ADJUSTMENT 2</th>
<th>TIME DELAY 2</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSPDA2222RXE</td>
<td>24 to 240VAC</td>
<td>Onboard</td>
<td>1-100s</td>
<td>Onboard</td>
<td>1-100s</td>
<td>Recycling/On Time First</td>
</tr>
<tr>
<td>KSPDP110M18SRXE</td>
<td>12 to 120VDC</td>
<td>Fixed</td>
<td>10 mins</td>
<td>Fixed</td>
<td>8s</td>
<td>Recycling/On Time First</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848
### Specifications

#### Time Delay

**Type**
Microcontroller circuitry

**Range**
0.1s - 1000h in 9 adjustable ranges or fixed (to 999)

**Repeat Accuracy**
±0.5% or 20ms, whichever is greater

**Tolerance**
≤ ±2%

**Reset Time**
≤ 150ms

**Initiate Time**
≤ 20ms; ≤ 1500 operations per minute

**Time Delay vs Temp. & Voltage**
≤ ±2%

#### Input

**Voltage**
12 to 120VDC; 24 to 240VAC

**Tolerance**
≤ ±15%

**AC Line Frequency/DC Ripple**
50/60Hz / ≤ 10%

**Power Consumption**
AC ≤ 2VA; DC ≤ 1W

#### Output

**Type**
Solid-state output

**Rating**
1A steady, 10A inrush for 16ms

**Voltage Drop**
AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A

**OFF State Leakage Current**
AC ≅ 5mA @ 230VAC; DC ≅ 1mA

**Protection**
Encapsulated

**Dielectric Breakdown**
≥ 2000V rms terminals to mounting surface

**Insulation Resistance**
≥ 100 MΩ

**Polarity**
DC units are reverse polarity protected

### Mechanical

**Mounting**
Surface mt. with one #10 (M5 x 0.8) screw

**Dimensions**
H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)

**Termination**
0.25 in. (6.35 mm) male quick connects

### Environmental

**Operating/Storage**
-40° to 60°C / -40° to 85°C

**Humidity**
95% relative, non-condensing

**Weight**
≈ 2.4 oz (68 g)

---

### Function Diagrams

**RECYCLING (ON FIRST)**

- V = Voltage
- S1 = Initiate Switch
- NO = Normally Open Contact
- NC = Normally Closed Contact
- TD1, TD2 = Time Delay
- R = Reset
- ⌣ = Undefined Time

**RECYCLE (OFF TIME FIRST)**

**DELAY-ON-MAKE / SINGLE SHOT**

**DELAY-ON-MAKE / DELAY-ON-BREAK**

**DELAY-ON-MAKE / INTERVAL**
RS SERIES

Description

The RS Series is a solid-state, encapsulated, recycling timer designed for tough industrial environments. It is used by many testing labs as a life cycle tester; by others as a cycle controller. The RS Series has separate DIP switch adjustments for the on delay and the off delay. These make accurate adjustment possible the first time, every time. Time delays of 0.1 seconds to 1023 hours are available in 4 ranges.

Operation (Recycling - ON Time First)

Upon application of input voltage, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the ON time.

Operation (Recycling - OFF Time First)

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the OFF time.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.1%, Setting accuracy +/- 2%</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>ON and OFF time delay settings</td>
<td>Independent adjustment provides greater timing flexibility</td>
</tr>
<tr>
<td>DIP switch adjustment</td>
<td>Provides first time setting accuracy</td>
</tr>
</tbody>
</table>

Wiring Diagram

For dimensional drawing see: Appendix, page 512, Figure 17.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>FIRST DELAY</th>
<th>T1 ON TIME</th>
<th>T2 OFF TIME</th>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>FIRST DELAY</th>
<th>T1 ON TIME</th>
<th>T2 OFF TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS1A11</td>
<td>12VDC</td>
<td>On time</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>RS4A22</td>
<td>120VAC</td>
<td>On time</td>
<td>0.1 - 102.3m in 0.1m increments</td>
<td>0.1 - 102.3m in 0.1m increments</td>
</tr>
<tr>
<td>RS2A44</td>
<td>24VAC</td>
<td>Off time</td>
<td>1 - 1023h in 1h increments</td>
<td>1 - 1023h in 1h increments</td>
<td>RS4A24</td>
<td>120VAC</td>
<td>On time</td>
<td>0.1 - 102.3m in 0.1m increments</td>
<td>1 - 1023h in 1h increments</td>
</tr>
<tr>
<td>RS4A11</td>
<td>120VAC</td>
<td>On time</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>RS4A33</td>
<td>120VAC</td>
<td>On time</td>
<td>1 - 1023m in 1m increments</td>
<td>1 - 1023m in 1m increments</td>
</tr>
<tr>
<td>RS4A12</td>
<td>120VAC</td>
<td>On time</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>0.1 - 102.3m in 0.1m increments</td>
<td>RS4B12</td>
<td>120VAC</td>
<td>Off time</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>0.1 - 102.3m in 0.1m increments</td>
</tr>
<tr>
<td>RS4A13</td>
<td>120VAC</td>
<td>On time</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>1 - 1023m in 1m increments</td>
<td>RS6A13</td>
<td>230VAC</td>
<td>On time</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>1 - 1023m in 1m increments</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

© 2023 Littelfuse, Inc.
Accessories

**P1023-6 Mounting bracket**
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

**P1015-64 (AWG 14/16) Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

### Adjustment Switch Operation

<table>
<thead>
<tr>
<th>Adjustment Switch Operation</th>
<th>Time Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1…102.3</td>
</tr>
<tr>
<td>OFF ▶ ON</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>0.2</td>
<td>2</td>
</tr>
<tr>
<td>0.4</td>
<td>4</td>
</tr>
<tr>
<td>0.8</td>
<td>8</td>
</tr>
<tr>
<td>1.6</td>
<td>16</td>
</tr>
<tr>
<td>3.2</td>
<td>32</td>
</tr>
<tr>
<td>6.4</td>
<td>64</td>
</tr>
<tr>
<td>12.8</td>
<td>128</td>
</tr>
<tr>
<td>25.6</td>
<td>256</td>
</tr>
<tr>
<td>51.2</td>
<td>512</td>
</tr>
</tbody>
</table>

### Specifications

#### Time Delay

**Range**
- 0.1 - 102.3s in 0.1s increments
- 0.1 - 102.3m in 0.1m increments
- 1 - 1023m in 1m increments
- 1 - 1023h in 1h increments

**Repeat Accuracy**
±0.1% or 20ms, whichever is greater

**Setting Accuracy**
≤ ±2% or 20ms, whichever is greater

**Reset Time**
≤ 150ms

**Time Delay vs Temp. & Voltage**
≤ ± 2%

#### Input

**Voltage**
12, or 24VDC; 24, 120, or 230VAC

**Tolerance**
±20%

**AC Line Frequency/DC Ripple**
50/60 Hz / ≤ ±10%

**Power Consumption**
AC ≤ 2VA; DC ≤ 1W

#### Output

**Type**
Solid state

**Maximum Load Current**
1A steady state, 10A inrush at 60°C

**OFF State Leakage Current**
AC ≅ 5mA @ 230VAC; DC ≅ 1mA

**Protection**
AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A

**Circuitry**
Encapsulated

**Dielectric Breakdown**
≥ 2000V RMS terminals to mounting surface

**Insulation Resistance**
≥ 100 MΩ

**Polarity**
DC units are reverse polarity protected

**Mechanical**
Surface mount with one #10 (M5 x 0.8) screw

**Mounting Dimensions**
H 76.7 mm (3”); W 50.8 mm (2”);
D 38.1 mm (1.5”)

**Termination**
0.25 in. (6.35 mm) male quick connect terminals

**Environmental**

**Operating/Storage**
-40° to 75°C / -40° to 85°C

**Humidity**
95% relative, non-condensing

**Weight**
≈ 3.9 oz (111 g)

---

*For CE approved applications, power must be removed from the unit when a switch position is changed.*

© 2023 Littelfuse, Inc.
Description
The TDR Series of time-delay relays are comprised of digital circuitry and an isolated, 10A relay output. The ON and OFF delays are selected by means of two, ten position binary switches, which allow the setting of the desired delay to be precise every time.

Operation (Recycling - ON Time First)
Upon application of input voltage, the green LED glows, the output relay is energized, the red LED glows, and the T1 ON time begins. At the end of the ON time, the output de-energizes, the red LED turns OFF and the T2, OFF time begins. At the end of the OFF time, the output relay energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

Operation (Recycling - OFF Time First)
Upon application of input voltage, the green LED glows, the T1 OFF time begins, the load is OFF. At the end of the OFF time, the T2 ON time begins, the load energizes, and the red LED glows. At the end of the ON time the load de-energizes and the red LED turns OFF. The cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to the OFF time.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON &amp; OFF time delay settings</td>
<td>Independent adjustment allows for greater flexibility</td>
</tr>
<tr>
<td>3 Time Ranges Available</td>
<td>Makes it versatile for use in many applications</td>
</tr>
<tr>
<td>(0.1s to 2.8h)</td>
<td>Repeat Accuracy +/- 0.1% or 20 ms, whichever is greater; Setting Accuracy +/- 2% or 50 ms, whichever is greater</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Provides first time setting accuracy</td>
</tr>
<tr>
<td>DIP switch adjustment</td>
<td>Provides visual indication of relay status</td>
</tr>
<tr>
<td>Isolated output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>LED</th>
<th>SEQUENCE</th>
<th>ON TIME (SEC)</th>
<th>OFF TIME (SEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDR1A22</td>
<td>12VDC</td>
<td>X</td>
<td>ON time first</td>
<td>1-1023 in 1s increments</td>
<td>1-1023 in 1s increments</td>
</tr>
<tr>
<td>TDR2A23</td>
<td>24VAC</td>
<td>X</td>
<td>ON time first</td>
<td>1-1023 in 1s increments</td>
<td>10-10230 in 10s increments</td>
</tr>
<tr>
<td>TDR4A11</td>
<td>120VAC</td>
<td>X</td>
<td>ON time first</td>
<td>0.1-102.3 in 0.1s increments</td>
<td>0.1-102.3 in 0.1s increments</td>
</tr>
<tr>
<td>TDR4A12</td>
<td>120VAC</td>
<td>X</td>
<td>ON time first</td>
<td>0.1-102.3 in 0.1s increments</td>
<td>1-1023 in 1s increments</td>
</tr>
<tr>
<td>TDR4A13</td>
<td>120VAC</td>
<td>X</td>
<td>ON time first</td>
<td>0.1-102.3 in 0.1s increments</td>
<td>10-10230 in 10s increments</td>
</tr>
<tr>
<td>TDR4A22</td>
<td>120VAC</td>
<td>X</td>
<td>ON time first</td>
<td>1-1023 in 1s increments</td>
<td>1-1023 in 1s increments</td>
</tr>
<tr>
<td>TDR4A23</td>
<td>120VAC</td>
<td>X</td>
<td>ON time first</td>
<td>1-1023 in 1s increments</td>
<td>10-10230 in 10s increments</td>
</tr>
<tr>
<td>TDR4A33</td>
<td>120VAC</td>
<td>X</td>
<td>ON time first</td>
<td>10-10230 in 10s increments</td>
<td>10-10230 in 10s increments</td>
</tr>
<tr>
<td>TDR4B22</td>
<td>120VAC</td>
<td>X</td>
<td>OFF time first</td>
<td>1-1023 in 1s increments</td>
<td>1-1023 in 1s increments</td>
</tr>
<tr>
<td>TDR4B23</td>
<td>120VAC</td>
<td>X</td>
<td>OFF time first</td>
<td>1-1023 in 1s increments</td>
<td>10-10230 in 10s increments</td>
</tr>
<tr>
<td>TDR6A22</td>
<td>230VAC</td>
<td>X</td>
<td>ON time first</td>
<td>1-1023 in 1s increments</td>
<td>1-1023 in 1s increments</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
**Accessories**

**BZ1 Front Panel Mount Kit**
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

**NDS-8 Octal 8-pin Socket**
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

**PSC8 Hold-down Clips**

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**Binary Switch Operation**

<table>
<thead>
<tr>
<th>Range**</th>
<th>Time Delay vs Temp. &amp; Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>±5%</td>
</tr>
<tr>
<td>1 - 1023s in 1s increments</td>
<td>±5%</td>
</tr>
<tr>
<td>10 - 10,230s in 10s increments</td>
<td>±5%</td>
</tr>
</tbody>
</table>

**Specifications**

**Time Delay**
- **Type**: Digital integrated circuitry
- **Range****: 0.1 - 102.3s in 0.1s increments
- **Repeat Accuracy**: ±0.1% or 20ms, whichever is greater
- **Setting Accuracy**: ±2% or 50ms, whichever is greater
- **Reset Time**: ≤ 50ms
- **Recycle Time**: ≤ 150ms
- **Time Delay vs Temp. & Voltage**: ±5%

**Input**
- **Voltage**: 12, 24/28, or 110VDC; 24, 120, or 230VAC
- **Tolerance**: 12VDC & 24VDC/AC -15% to 20%; 110 to 230VAC/DC -20% to 10%
- **AC Line Frequency/DC Ripple**: 50/60 Hz/<=10%
- **Power Consumption**: ≤ 3.25W
- **Input LED Indicator**: Green; on when input voltage is applied

**Output**
- **Type**: Electromechanical relay
- **Form**: DPDT
- **Rating**: 10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
- **Life**: Mechanical - 1 x 10⁷; Electrical - 1 x 10⁹
- **Max. Switching Voltage**: 250VAC
- **Relay LED Indicator**: Red; ON when output relay energizes

**Protection**
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units reverse polarity protected

**Mechanical**
- **Mounting**: Plug-in socket
- **Dimensions**: H 81.3 mm (3.2”); W 60.7 mm (2.39”); D 45.2 mm (1.78”)
- **Termination**: Octal 8-pin plug-in
- **Operating/Storage Temperature**: -20°C to 65°C/30°C to 85°C
- **Weight**: ≅ 6 oz (170 g)

**Note**: **For CE approved applications, power must be removed from the unit when a switch position is changed.**
**Description**

The THD3C42A0 combines accurate timing circuitry with high power, solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. The THD3C42A0 has equal on and off time delays. A single $R_T$ sets both time delays. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, Digi-Power timers.

**Operation (Recycling Flasher - ON Time First)**

Upon application of input voltage, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

**Reset:** Removing input voltage resets the output and time delays, and returns the sequence to T1 ON time.

**Operation (Recycling Flasher - OFF Time First)**

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

**Reset:** Removing input voltage resets the output and the sequence to T2 OFF time.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / -0.5%, Factory calibration + / - 1%</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces labor and component costs</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct operation of motors, lamps, and heaters without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arh and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16)**
  **Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.
External Resistance vs. Time Delay

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the $R_T$ terminals, as the resistance increases the time delay increases.

When selecting an external $R_T$, add the tolerances of the timer and the $R_T$ for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm $R_T$. For 1 to 100 S use a 100 K ohm $R_T$.

Specifications

<table>
<thead>
<tr>
<th>Time Delay Range</th>
<th>0.1s - 1000m in 6 adjustable ranges or fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment</td>
<td>Single variable resistor changes both the on &amp; off times equally</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±0.5% or 20ms, whichever is greater</td>
</tr>
<tr>
<td>Tolerance (Factory Calibration)</td>
<td>≤ ±1%</td>
</tr>
<tr>
<td>Reset Time</td>
<td>≤ 150ms</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage</td>
<td>≤ ±2%</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>24, 120, or 230VAC</td>
</tr>
<tr>
<td>Tolerance</td>
<td>±20%</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>≤ 2VA</td>
</tr>
<tr>
<td>Output Type</td>
<td>Solid state</td>
</tr>
<tr>
<td>Maximum Load Current</td>
<td>Steady State Inrush**</td>
</tr>
<tr>
<td>Minimum Load Current</td>
<td>20A, 200A</td>
</tr>
<tr>
<td>Voltage Drop</td>
<td>2.5V at rated current</td>
</tr>
<tr>
<td>OFF State Leakage Current</td>
<td>5mA @ 230VAC</td>
</tr>
<tr>
<td>Protection</td>
<td>Encapsulated</td>
</tr>
<tr>
<td>Dielectric Breakdown</td>
<td>≥ 2000V RMS terminals to mounting surface</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>≥ 100 MΩ</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Surface mount with one #10 (M5 x 0.8) screw</td>
</tr>
<tr>
<td>Dimensions</td>
<td>$H$ 50.8 mm (2&quot;), $W$ 50.8 mm (2&quot;), $D$ 38.4 mm (1.51&quot;)</td>
</tr>
<tr>
<td>Termination</td>
<td>0.25 in. (6.35 mm) male quick connect terminals</td>
</tr>
<tr>
<td>Environmental</td>
<td>Temperature</td>
</tr>
<tr>
<td>Humidity</td>
<td>95% relative, non-condensing</td>
</tr>
<tr>
<td>Weight</td>
<td>≅ 3.9 oz (111 g)</td>
</tr>
</tbody>
</table>

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.
Description

The TSD3411S is a solid-state ON/OFF recycling timer with the on time always equal to the off time. When time delay is changed by the $R_T$, both the ON and the OFF periods are changed. The TSD Series is designed for more demanding commercial and industrial applications where small size, and accurate performance is required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.1% of the time delay. The TSD3411S is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 100 hours are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Recycling Flasher - ON Time First)

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the T1 ON time.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy + / - 0.1%, + / -1% time delay accuracy</td>
</tr>
<tr>
<td>Extended temperature range</td>
<td>Rated to 75°C operating temperature to withstand high heat applications</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A Steady solid-state output, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Wiring Diagram

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

P1015-64 (AWG 14/16) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
**Time Delay Relays**

**TSD3411S**

---

**External Resistance vs. Time Delay**

**Function Diagram**

- **FLASHER (ON FIRST)**
- **V = Voltage**
- **L = Load**
- **T1 = ON Time**
- **T2 = OFF Time**
- **R = Reset**

ON time plus OFF time equals one complete flash.

---

**Specifications**

**Time Delay**
- Range: 0.1s - 100h in 7 adjustable ranges
- Repeat Accuracy: ±0.1% or 20ms, whichever is greater
- Tolerance (Factory Calibration): ≤ ±1%
- Reset Time: ≤ 150ms
- Time Delay vs. Temperature & Voltage: ≤ ±1%

**Input**
- **Voltage**: 24, 120, or 230VAC
- **Tolerance**: ±20%
- **AC Line Frequency**: 50/60 Hz
- **Power Consumption**: ≤ 2VA

**Output**
- **Type**: Solid state
- **Maximum Load Current**: 1A steady state, 10A inrush at 60°C
- **Off State Leakage Current**: ≅ 5mA @ 230VAC
- **Voltage Drop**: ≅ 2.5V @ 1A

**Protection**
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 50.8 mm (2"), W 50.8 mm (2"), D 30.7 mm (1.21")
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- **Operating/Storage**
  - **Temperature**: -40° to 75°C / -40° to 85°C
  - **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 2.4 oz (68 g)

---

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R1 terminals; as the resistance increases the time delay increases.

When selecting an external R1, add the tolerances of the timer and the R1 for the R2 time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm R1. For 1 to 100 S use a 100 K ohm R1.
Description

The TSDR Series is an ON/OFF or OFF/ON recycling timing module designed to control metering pumps, chemical valves, flash lamps, or use in energy saving or duty cycling applications. The TSDR Series is designed for more demanding commercial and industrial applications where small size and accurate performance are required. The factory calibration for fixed time delays is < ±5%. The repeat accuracy, under stable conditions, is 0.5% of the time delay. The TSDR Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 1000 minutes are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Recycling - ON Time First)

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2, OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the T1 ON time.

Operation (Recycling - OFF Time First)

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of the T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2 OFF time.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat accuracy +/- 0.5%, Factory calibration +/- 5%</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Wide operating temperature range: -40° to 75°C</td>
<td>Reliable in demanding commercial and industrial applications</td>
</tr>
<tr>
<td>Compact, low cost design measuring 2 in. (50.8mm) square</td>
<td>Allows flexibility for OEM applications</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLT.</th>
<th>ADJUST.</th>
<th>T1 ON TIME</th>
<th>FIRST DELAY</th>
<th>T2 OFF TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSDR215SB18M</td>
<td>24VAC</td>
<td>Fixed</td>
<td>5s</td>
<td>Off time</td>
<td>18m</td>
</tr>
<tr>
<td>TSDR415SB18M</td>
<td>120VAC</td>
<td>Fixed</td>
<td>5s</td>
<td>Off time</td>
<td>18m</td>
</tr>
<tr>
<td>TSDR442SA1</td>
<td>120VAC</td>
<td>On time fixed, off external</td>
<td>12s</td>
<td>On time</td>
<td>1 - 100s</td>
</tr>
<tr>
<td>TSDR422MA2</td>
<td>120VAC</td>
<td>On time fixed, off external</td>
<td>2m</td>
<td>On time</td>
<td>10 - 1000s</td>
</tr>
<tr>
<td>TSDR443SA2</td>
<td>120VAC</td>
<td>On time fixed, off external</td>
<td>30s</td>
<td>On time</td>
<td>10 - 1000s</td>
</tr>
<tr>
<td>TSDR610.2SA0.2S</td>
<td>230VAC</td>
<td>Fixed</td>
<td>0.2s</td>
<td>On time</td>
<td>0.2s</td>
</tr>
<tr>
<td>TSDR610.3SA30S</td>
<td>230VAC</td>
<td>Fixed</td>
<td>10s</td>
<td>On time</td>
<td>30s</td>
</tr>
<tr>
<td>TSDR612.5SA4.5S</td>
<td>230VAC</td>
<td>Fixed</td>
<td>2.5s</td>
<td>On time</td>
<td>4.5s</td>
</tr>
<tr>
<td>TSDR615SB18M</td>
<td>230VAC</td>
<td>Fixed</td>
<td>5s</td>
<td>Off time</td>
<td>18m</td>
</tr>
<tr>
<td>TSDR6412SA1</td>
<td>230VAC</td>
<td>On time fixed, off external</td>
<td>12s</td>
<td>On time</td>
<td>1 - 100s</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.

Wiring Diagram

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat accuracy +/- 0.5%, Factory calibration +/- 5%</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Wide operating temperature range: -40° to 75°C</td>
<td>Reliable in demanding commercial and industrial applications</td>
</tr>
<tr>
<td>Compact, low cost design measuring 2 in. (50.8mm) square</td>
<td>Allows flexibility for OEM applications</td>
</tr>
</tbody>
</table>

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.
**Accessories**

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22)**
  **Female Quick Connect**
  These 0.25 in (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**External Resistance vs. Time Delay**

![Graph]  

**Function Diagrams**

**RECYCLING (ON FIRST)**

- **V** = Voltage
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD1, TD2** = Time Delay
- **R** = Reset

**RECYCLE (OFF TIME FIRST)**

- **V** = Voltage
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD1, TD2** = Time Delay
- **R** = Reset

**Specifications**

- **Time Delay**
  - Range: 0.1s - 1000m in 6 adjustable ranges or fixed
  - Repeat Accuracy: ±0.5% or 20ms, whichever is greater
  - Tolerance (Factory Calibration): ±5%
  - Reset Time: ≤ 150ms
  - Time Delay vs Temp. & Voltage: ±5%

- **Input**
  - Voltage: 24, 120, or 230VAC
  - Tolerance: ±20%
  - AC Line Frequency: 50/60 Hz
  - Power Consumption: ≤ 2VA

- **Output**
  - Type: Solid state
  - Maximum Load Current: 1A steady state, 10A inrush at 60°C
  - Off State Leakage Current: ≅ 5mA @ 230VAC
  - Voltage Drop: ≅ 2.5V @ 1A

- **Protection**
  - Circuitry: Encapsulated
  - Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
  - Insulation Resistance: ≥ 100 MΩ

- **Mechanical**
  - Mounting: Surface mount with one #10 (M5 x 0.8) screw
  - Dimensions: H 50.8 mm (2"); W 50.8 mm (2"); D 30.7 mm (1.21")
  - Termination: 0.25 in. (6.35 mm) male quick connect terminals

- **Environmental**
  - Operating/Storage Temperature: -40° to 75°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
  - Weight: ≅ 2.4 oz (68 g)
Description
The PTHF4900DK can be used for a variety of applications from chemical metering, to temperature regulating, to energy management. The infinite adjustability from 1 to 99% provides accurate percentage on control over a wide factory fixed cycle period. When mounted on a metal surface, it can be used to drive solenoids, contactors, relays, or lamps, up to 20A steady, 200A inrush. The PTHF4900DK is the suggested replacement for the PT Series.

Operation (Percentage)
Upon application of input voltage, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied. Increasing the ON time decreases the OFF time. The total cycle period is equal to the ON time plus the OFF time. The total cycle period is factory fixed. ON time range is 1 to 99 percent of cycle period.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the T1 ON time.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat accuracy + / -0.5%, Factory calibration + / - 5%</td>
</tr>
<tr>
<td>ON/OFF recycling percentage control 1 to 99%</td>
<td>Accurate control over a wide factory fixed cycle period</td>
</tr>
<tr>
<td>Compact, low cost design</td>
<td>Allows flexibility for OEM applications and reduces component and labor costs</td>
</tr>
<tr>
<td>High load currents up to 20A, 200A inrush</td>
<td>Allows direct operation of motors, lamps, and heaters without a contactor</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-13 (AWG 10/12), P1015-64 (AWG 14/16)**
  **Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.
**Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time Delay</strong></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>External or onboard knob</td>
</tr>
<tr>
<td>Range/External</td>
<td>Adjustable from 1% - 99% / (R_T = 100 , \text{k}\Omega)</td>
</tr>
<tr>
<td>Cycle Period</td>
<td>Fixed from 10s - 1000m</td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>±0.5% or 20ms, whichever is greater</td>
</tr>
<tr>
<td>Cycle Period Tolerance (Factory Calibration)</td>
<td>≤ 5%</td>
</tr>
<tr>
<td>Reset Time</td>
<td>≤ 150ms</td>
</tr>
<tr>
<td>Time Delay vs Temp. &amp; Voltage Input</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>120 or 230VAC</td>
</tr>
<tr>
<td>Tolerance</td>
<td>±20%</td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>≤ 2VA</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Solid state</td>
</tr>
<tr>
<td>Maximum Load Currents</td>
<td>Steady State 1A, Inrush* 10A</td>
</tr>
<tr>
<td>Voltage Drop</td>
<td>≅ 2.5V at rated current</td>
</tr>
<tr>
<td>OFF State Leakage Current Protection</td>
<td>≅ 5mA @ 230VAC</td>
</tr>
<tr>
<td>Circuitry</td>
<td>Encapsulated</td>
</tr>
<tr>
<td>Dielectric Breakdown</td>
<td>≥ 2000V RMS terminals to mounting surface</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>≥ 100 MΩ</td>
</tr>
</tbody>
</table>

**Mechanical**

- Mounting *
  - Surface mount with one #10 (M5 x 0.8) screw

**Dimensions**

- **Height (H)**: 50.8 mm (2")
- **Width (W)**: 50.8 mm (2")
- **Depth (D)**: 38.4 mm (1.51")
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Termination**

- Environmental
  - Operating/Storage Temperature: -40°C to 60°C / -40°C to 85°C
  - Humidity: 95% relative, non-condensing
  - Weight: 6, 10, 20A units: ≅ 3.9 oz (111 g)

*Units rated ≥ 6A must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

**Function Diagram**

- V = Input Voltage
- CP = Cycle Period
- L = Load
- T1 = ON Time
- T2 = OFF Time
- R = Reset

© 2023 Littelfuse, Inc.
**Description**
The TDMB combines both delay-on-make and delay-on-break functions into one plug-in package. Selection of the time period is accomplished with dual switches, one for the on delay and the other for the off delay. SPDT or DPDT output options provide isolated, 10A switching capability.

**Operation (Delay-on-Make/Delay-on-Break)**
Input voltage must be applied at all times. The output relay is de-energized. Upon closure of the initiate switch, the green LED glows and the delay-on-make time delay (T1) begins. At the end of T1, the output relay energizes and the red LED glows. When the initiate switch opens, the green LED turns OFF and the delay-on-break time delay (T2) begins. At the end of T2, the output relay de-energizes and the red LED turns OFF.

**Reset:** Removing input voltage resets time delay and output. Opening the initiate switch during the delay-on-make delay, resets T1. Closing the initiate switch during the delay-on-break delay, resets T2.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital circuitry</td>
<td>Repeat Accuracy +/- 0.1%, Setting accuracy +/- 2%</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT or DPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>User selectable Delay-on-Make and Delay-on-Break time delay</td>
<td>Timing settings are independently adjustable for added flexibility</td>
</tr>
<tr>
<td>Industry standard octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
<tr>
<td>LED Indication</td>
<td>Provides visual indication of initiate, timing, and relay output status</td>
</tr>
<tr>
<td>DIP switch adjustment</td>
<td>Provides first time setting accuracy</td>
</tr>
</tbody>
</table>

**Accessories**

- **BZ1 Front Panel Mount Kit**
  Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

- **NDS-8 Octal 8-pin Socket**
  8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

- **NDS-11 11-pin Socket**
  11-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

- **PSC8 or PSC11 Hold-down Clips**
  Securely mounts plug-in controls in any position. Provides protection against vibration. Use PSC8 with NDS-8 Octal Socket or PSC11 with NDS-11 Socket. Sold in sets of two.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>DELAY-ON-MAKE</th>
<th>DELAY-ON-BREAK</th>
<th>PLUG TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDMB411</td>
<td>120VAC</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>Octal (8-pin) SPDT</td>
</tr>
<tr>
<td>TDMB413D</td>
<td>120VAC</td>
<td>0.1 - 102.3s in 0.1s increments</td>
<td>10 - 10230s in 10s increments</td>
<td>11-pin DPDT</td>
</tr>
<tr>
<td>TDMB422</td>
<td>120VAC</td>
<td>1 - 1023s in 1s increments</td>
<td>1 - 1023s in 1s increments</td>
<td>Octal (8-pin) SPDT</td>
</tr>
<tr>
<td>TDMB422D</td>
<td>120VAC</td>
<td>1 - 1023s in 1s increments</td>
<td>1 - 1023s in 1s increments</td>
<td>11-pin DPDT</td>
</tr>
<tr>
<td>TDMB622</td>
<td>230VAC</td>
<td>1 - 1023s in 1s increments</td>
<td>1 - 1023s in 1s increments</td>
<td>Octal (8-pin) SPDT</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 23.
Specifications

**Time Delay**
- **Type**: Microcontroller circuitry
- **Range**:
  - 0.1 - 102.3s in 0.1s increments
  - 1 - 1023s in 1s increments
  - 10 - 10,230s in 10s increments
- **Repeat Accuracy**: ±0.1% or 20ms, whichever is greater
- **Setting Accuracy**: ≤ ±2% or 50ms, whichever is greater
- **Reset Time**: ≤ 150ms
- **Time Delay vs Temp. & Voltage**: ≤ ±2%
- **Control LED Indicator**: Green, on when the initiate switch is closed
- **Input Voltage**: 12 or 24VDC; 24, 120, or 230VAC; 24 to 240VAC/DC; 12 to 48VDC
- **Tolerance**:
  - 12VDC & 24VDC/AC: -15% - 20%
  - 110 to 230VAC/DC: -20% - 10%
- **AC Line Frequency/DC Ripple**: 50/60 Hz / ≤ 10%
- **Power Consumption**: AC ≤ 2VA; DC ≤ 2W
- **Output Type**: Electromechanical relay
- **Form**: SPDT or DPDT
- **Ratings**:
  - 10A resistive @ 120/240VAC & 28VDC
  - 1/3 hp @ 230VAC
- **Life**: Mechanical - 1 x 10^7; Electrical - 1 x 10^5
- **Max. Switching Voltage**: 250VAC
- **Relay LED Indicator**: Red; on when output relay energizes (not included on 12VDC units)

**Protection**
- **Insulation Resistance**: ≥ 100M
- **Polarity**: DC units are reverse polarity protected
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Mechanical**
  - **Mounting**: Plug-in socket
  - **Dimensions**: H 81.3 mm (3.2”); W 60.7 mm (2.4”); D 45.2 mm (1.8”)
  - **Termination**: Octal 8-pin plug-in, magnal 11-pin plug-in

**Environmental**
- **Operating/Storage Temperature**: -20° to 60°C / -30° to 85°C
- **Weight**: ≅ 6 oz (170 g)

**For CE approved applications, power must be removed from the unit when a switch position is changed.**

Digi-Set Binary Switch Operation

**Function Diagram**

- **V** = Voltage
- **S1** = Initiate Switch
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD1, TD2** = Time Delay
- **R** = Reset
- **—** = Undefined Time

**Delay-On-Make / Delay-On-Break**

0.1...102.3
0.2...0.4
0.6...0.8
1.0...1.2
1.6...1.8
3.2...3.6
6.4...6.8
12.8...13.2
25.6...25.9
51.2...51.3

**Specifications**

**Time Delay**
- **Type**: Microcontroller circuitry
- **Range**:
  - 0.1 - 102.3s in 0.1s increments
  - 1 - 1023s in 1s increments
  - 10 - 10,230s in 10s increments
- **Repeat Accuracy**: ±0.1% or 20ms, whichever is greater
- **Setting Accuracy**: ≤ ±2% or 50ms, whichever is greater
- **Reset Time**: ≤ 150ms
- **Time Delay vs Temp. & Voltage**: ≤ ±2%
- **Control LED Indicator**: Green, on when the initiate switch is closed
- **Input Voltage**: 12 or 24VDC; 24, 120, or 230VAC; 24 to 240VAC/DC; 12 to 48VDC
- **Tolerance**:
  - 12VDC & 24VDC/AC: -15% - 20%
  - 110 to 230VAC/DC: -20% - 10%
- **AC Line Frequency/DC Ripple**: 50/60 Hz / ≤ 10%
- **Power Consumption**: AC ≤ 2VA; DC ≤ 2W
- **Output Type**: Electromechanical relay
- **Form**: SPDT or DPDT
- **Ratings**:
  - 10A resistive @ 120/240VAC & 28VDC
  - 1/3 hp @ 230VAC
- **Life**: Mechanical - 1 x 10^7; Electrical - 1 x 10^5
- **Max. Switching Voltage**: 250VAC
- **Relay LED Indicator**: Red; on when output relay energizes (not included on 12VDC units)

**Protection**
- **Insulation Resistance**: ≥ 100M
- **Polarity**: DC units are reverse polarity protected
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Mechanical**
  - **Mounting**: Plug-in socket
  - **Dimensions**: H 81.3 mm (3.2”); W 60.7 mm (2.4”); D 45.2 mm (1.8”)
  - **Termination**: Octal 8-pin plug-in, magnal 11-pin plug-in

**Environmental**
- **Operating/Storage Temperature**: -20° to 60°C / -30° to 85°C
- **Weight**: ≅ 6 oz (170 g)

**For CE approved applications, power must be removed from the unit when a switch position is changed.**
Description
The ESD5 Series is an accurate, solid-state, delayed interval timer. It offers a 1A steady, 10A inrush output and is available with adjustable or fixed time delays of 0.1 seconds to 1000 minutes in six ranges. Input voltages of 24, 120, or 230VAC are available. Encapsulation offers protection against shock and vibration. Adjustment options are factory fixed, onboard or externally adjustable. The repeat accuracy, under stable conditions, is 0.1%. The factory calibration of the time delay is ±5%.

Operation (Delayed Interval)
Upon application of input voltage, the T1 delay-on-make time delay begins and the output remains de-energized. At the end of this delay, the output energizes and the T2 interval delay begins. At the end of the interval delay period, the output de-energizes. Reset: Removing input voltage resets the output and the time delays, and returns the sequence to the first delay.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact, low cost design measuring 2 in. (50.8mm) square</td>
<td>Allows flexibility for OEM applications and reduces component and labor costs</td>
</tr>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy ±/ - 0.1%, Factory calibration ±/ - 5%</td>
</tr>
<tr>
<td>1A steady, 10A inrush solid-state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Wiring Diagram

V = Voltage
L = Load
T1 = Delay-on-Make time
T2 = Interval delay time

R_T is the external adjustment component.

Note: Terminals 4, 5 and/or 7, 8 are included when external adjustment is ordered. A knob is included when onboard adjust is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in. (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.
External Resistance vs. Time Delay

**In Secs. or Mins.**

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>R&lt;sub&gt;T&lt;/sub&gt; = External Timing Resistor in Kilohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.1</td>
</tr>
<tr>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>7.5</td>
<td>75</td>
</tr>
<tr>
<td>100</td>
<td>1000</td>
</tr>
</tbody>
</table>

This chart applies to externally adjustable part numbers. The time delay is adjustable over the time delay range selected by varying the resistance across the R<sub>T</sub> terminals; as the resistance increases the time delay increases.

When selecting an external R<sub>T</sub>, add the tolerances of the timer and the R<sub>T</sub> for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm R<sub>T</sub>. For 1 to 100 S use a 100 K ohm R<sub>T</sub>.

**Function Diagram**

- **V** = Voltage
- **NO** = Normally Open Contact
- **NC** = Normally Closed Contact
- **TD1, TD2** = Time Delay
- **R** = Reset

**Specifications**

- **Time Delay**
  - Range: 0.1s - 1000m in 6 adjustable ranges or fixed
  - Repeat Accuracy: ±0.1% or 20ms, whichever is greater
  - Tolerance: ≤ ±5%
  - Reset Time: ≤ 150ms
  - Time Delay vs Temp. & Voltage: ≤ ±2%

- **Input**
  - Voltage: 24VAC
  - Tolerance: ±20%
  - AC Line Frequency: 50/60 Hz
  - Power Consumption: ≤ 2VA

- **Output**
  - Type: Solid state
  - Rating: 1A steady state, 10A inrush at 60°C
  - OFF State Leakage Current: 5mA @ 230VAC
  - Voltage Drop: 2.5V @ 1A

- **Circuitry**
  - Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
  - Insulation Resistance: ≥ 100 MΩ
  - Encapsulated
  - Mechanical
  - Mounting: Surface mount with one #10 (M5 x 0.8) screw
  - Dimensions: H 50.8 mm (2"), W 50.8 mm (2"), D 30.7 mm (1.21"
  - Termination: 0.25 in. (6.35 mm) male quick connect terminals
  - Environmental
  - Operating/Storage Temperature: -40° to 75°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
  - Weight: 2.4 oz (68g)
KRPD SERIES

Description
The KRPD Series is a factory programmed time delay relay available with 1 of 12 standard dual functions. The time delays can be factory fixed, onboard or externally adjustable or a combination of fixed and adjustable. The SPDT output relay contacts offer a full 10A rating with complete isolation. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRPD Series is a cost effective approach for OEM applications that require small size, isolation, accuracy and long life.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat Accuracy +/- 0.5%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

Accessories

- **P1004-95, P1004-95-X Versa-Pot**
  Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

- **P0700-7 Versa-Knob**
  Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT</th>
<th>ADJUSTMENT 1</th>
<th>TIME DELAY 1</th>
<th>ADJUSTMENT 2</th>
<th>TIME DELAY 2</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRPD215S190SMB</td>
<td>24VAC</td>
<td>Fixed</td>
<td>5s</td>
<td>Fixed</td>
<td>90s</td>
<td>Delay-on-Make/Delay-on-Break</td>
</tr>
<tr>
<td>KRPD417M113MRXD</td>
<td>120VAC</td>
<td>Fixed</td>
<td>7m</td>
<td>Fixed</td>
<td>13m</td>
<td>Recycling/Off Time First</td>
</tr>
<tr>
<td>KRPDA175S130SMI</td>
<td>24 to 240VAC/DC</td>
<td>Fixed</td>
<td>75s</td>
<td>Fixed</td>
<td>30s</td>
<td>Delay-on-Make/Interval</td>
</tr>
<tr>
<td>KRPDA2129RXE</td>
<td>24 to 240VAC/DC</td>
<td>Onboard</td>
<td>0.1 - 10s</td>
<td>Onboard</td>
<td>10 - 1000h</td>
<td>Recycling</td>
</tr>
<tr>
<td>KRPDD2121MB</td>
<td>12 to 48VDC</td>
<td>Onboard</td>
<td>0.1-10s</td>
<td>Onboard</td>
<td>0.1-10s</td>
<td>Delay-on-Make/Delay-on-Break</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 16.
### Specifications

**Output Current/Ambient Temperature**

![Graph showing the relationship between output current and ambient temperature.](chart)

**Function Diagrams**

- **DELAY-ON-MAKE / DELAY-ON-BREAK**
  - V = Voltage
  - S1 = Initiate Switch
  - NO = Normally Open Contact
  - NC = Normally Closed Contact
  - TD1, TD2 = Time Delay
  - R = Reset
  - Time Delay vs. Temperature & Voltage

- **DELAY-ON-MAKE / INTERVAL**
  - V = Voltage
  - TD1, TD2 = Time Delay
  - R = Reset
  - Time Delay vs. Temperature & Voltage

- **RECYCLE (OFF TIME FIRST)**
  - V = Voltage
  - TD1, TD2 = Time Delay
  - R = Reset

- **RECYCLING (ON FIRST)**
  - V = Voltage
  - TD1, TD2 = Time Delay
  - R = Reset

- **ACCUMULATIVE DELAY-ON-MAKE / INTERVAL**
  - V = Voltage
  - S1 = Initiate Switch
  - TD1, TD2 = Time Delay

---

**Time Delay**

- **Type**: Microcontroller circuitry
- **Range**: 0.1s - 1000h in 9 adjustable ranges or fixed (to 999)
- **Repeat Accuracy**: ±0.5% or 20ms, whichever is greater
- **Tolerance**: (Factory Calibration) ±2%
- **Reset Time**: ≤ 150ms
- **Initiate Time**: ≤ 40ms; 750 operations per minute
- **Time Delay vs. Temperature & Voltage**: ≤ ±2%

**Input**

- **Voltage**: 12 to 48VDC; 24 to 240VAC/DC
- **Tolerance**: 12 to 48VDC -15% - 20%
- **24 to 240VAC/DC**: -20% - 10%
- **AC Line Frequency/DC Ripple**: 50/60 Hz / ≤ 10%
- **Power Consumption**: AC ≤ 2VA; DC ≤ 2W

**Output**

- **Type**: Isolated relay contacts
- **Form**: SPDT
- **Rating (at 40°C)**: 10A resistive @ 125VAC, 5A resistive @ 230VAC & 28VDC, 1/4 hp @ 125VAC, 250VAC

**Max. Switching Voltage**

- **Life (Operations)**: Mechanical - 1 x 10^7; Electrical - 1 x 10^5

**Protection**

- **Circuitry**: Encapsulated
- **Isolation Voltage**: ≥ 1500V RMS input to output
- **Insulation Resistance**: ≥ 100 MΩ
- **Polarity**: DC units are reverse polarity protected

**Mechanical**

- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
- **Termination**: 0.25 in. (6.35 mm) male quick connects

**Environmental**

- **Operating/Storage**
  - Temperature: -40° to 60°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
- **Weight**: 2.6 oz (74 g)
CT SERIES

Delay-on-Make/Delay-on-Break Timer

Description
The CT Series combines a delay-on-make and delay-on-break time delay into one unit and may be used to control fan delays in heating and/or cooling equipment. The CT includes bypass circuitry to allow it to operate with cooling anticipators ≥ 3000 ohms. It is designed to operate in 24VAC control circuits. Several CT modules may be combined to provide sequencing of any number of loads and sequencing off of the same loads, such as electric heating elements.

Operation (Delay-on-Make/Delay-on-Break)
Forced Air Heating or Air Conditioning (as shown): When the thermostat closes, the compressor relay is immediately energized. At the end of a fixed delay-on-make delay (T1), the fan relay is energized. When the thermostat opens, the compressor relay is de-energized and the delay-on-break delay is initiated. On completion of the fixed delay-on-break delay (T2) the fan relay is de-energized. If the thermostat is reclosed during the delay-on-break delay, the delay-on-break delay is reset and the fan relay remains energized. If the thermostat is closed when input voltage is applied, the delay-on-make delay (T1) begins as normal.

Reset: Removing input voltage resets the output and time delays.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay-on-Make and Delay-on-Break in one unit</td>
<td>Simplifies wiring and installation, and optimizes efficiency of heating and cooling systems</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Interconnectability with other CT modules</td>
<td>Combine modules to provide sequencing on of a number of loads and sequencing off of the same loads</td>
</tr>
</tbody>
</table>

Accessories

P1015-64 (AWG 14/16) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

For dimensional drawing see: Appendix, page 512, Figure 16.
**Accessories**

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Function Diagram**

V = Voltage  
FS = Fan Switch  
FR = Fan Relay  
T1 = Delay-on-Make  
T2 = Delay-on-Break  
R = Reset  
_ _ _ _ = Undefined Time

**Specifications**

**Time Delay**
- **Type**: Microcontroller
- **Range**: 1 - 600s
- **Repeat Accuracy**: ±5%
- **Tolerance (Factory Calibration)**: ±20%
- **Recycle Time**: ≤ 300ms

**Input**
- **Voltage**: 24VAC
- **Tolerance**: ±15%
- **AC Line Frequency**: 50/60 Hz

**Output**
- **Type**: Solid state
- **Form**: NO
- **Rating**: 0.75A steady state, 5A inrush at 55°C
- **Voltage Drop**: ≅ 1.25V
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V rms terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ
- **Mechanical**
  - **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
  - **Dimensions**:
    - H: 50.8 mm (2")
    - W: 50.8 mm (2")
    - D: 30.7 mm (1.21")
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- **Operating/Storage Temperature**: -40° to 70°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 2.4 oz (68 g)
- **Thermostat**: Anticipator Resistor: ≥ 3000 Ω
**Description**

The T2D provides protection against short cycling of compressors and other motors. At the end of each operation, a lockout delay prevents restarting the compressor or motor until the delay is completed. 24VAC models can be used with thermostats that include a cooling anticipator resistor. It can be connected in series with the load for delay-on-make operation.

**Operation (Lockout with Random Start)**

**Connection #1:** Upon application of input voltage, a random start time delay begins. At the end of this time delay, the output is energized.

**Lockout Delay:** Input voltage must be applied prior to and during timing. When the thermostat or initiate switch opens, the output de-energizes and the lockout time delay begins. At the end of the lockout delay, the output is energized allowing the load to immediately energize when the initiate switch or thermostat closes.

**Connection #2:** Upon application of input voltage and closure of initiate switch, the time delay begins. At the end of the time delay, the output is energized and remains energized until power is removed.

**Reset:** Removing power resets the output and the time delay.

**Features & Benefits**

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lockout delay</td>
<td>Prevents rapid cycling of compressor</td>
</tr>
<tr>
<td>Random start delay</td>
<td>Prevents low voltage starting</td>
</tr>
<tr>
<td>Analog circuitry</td>
<td>Repeat Accuracy + / - 1%</td>
</tr>
<tr>
<td>Compact design</td>
<td>Allows flexibility for OEM applications</td>
</tr>
<tr>
<td>1A steady, 10A inrush output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Totally solid state and fully encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.
### Specifications

**Input**
- Voltage: 120/230VAC in 2 ranges
- Tolerance: ±20%
- AC Line Frequency: 50/60 Hz

**Output**
- Minimum Load Current: 24VAC - 100mA; 120/230VAC - 40mA
- Rating: 1A steady state, 10A inrush at 60°C
- Voltage Drop: ≈ 2.5V @ 1A

**Time Delay**
- Initiate Time: After timing - 16ms
- Type: Analog circuitry
- Lockout & Random Start Delays: 1s - 100m in 4 adjustable ranges or fixed
  - Note: The lockout & random start delays are the same length.
- Tolerance: Adjustable: ±30%; factory fixed: ±30%
- Repeat Accuracy: ±1% or 20ms, whichever is greater
- Reset Time: After timing - ≤ 16ms;
  - During timing - ≤ 200ms

**Protection**
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2”); W 50.8 mm (2”);
  - D 30.7 mm (1.21”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- Operating/Storage Temperature: -20° to 60°C / -40° to 85°C
- Humidity: 95% relative, non-condensing
- Weight: ≈ 2.4 oz (68 g)

**Cooling Anticipator**
- (24VAC Units Only)
- Minimum Cooling Anticipator: ≥ 3,000 Ω

---

### Function Diagram

**Function Diagram**
- **V = Voltage**
- **S1 = Initiate Switch**
- **L = Load (CR)**
- **E = Ready**
- **TD = Time Delay**
- **R = Reset**
Description
The TA Series prevents rapid recycling of a compressor. A lockout delay is started when the thermostat opens, or input voltage is lost. Eliminates tripped circuit breakers or blown fuses caused by a locked rotor during short cycling. The TA will not allow the compressor to start when the line voltage is low. Chatter of the compressor relay is eliminated. Because of the fast initiate time, bounce of the thermostat will not be transmitted to the compressor relay coil. A 30 second delay provides anti-reversing protection for scroll compressors.

Operation (Lockout)
On initial closure of the S1, the compressor relay energizes immediately. When S1 opens or input voltage is interrupted, a lockout time delay is initiated. During this lockout time delay, the compressor relay cannot be energized. The low voltage (brownout) protection prevents energization of the compressor when the line voltage is low.

Reset: The lockout time delay cannot be reset. After the time delay is completed, the unit automatically resets.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lockout delay</td>
<td>Prevents rapid cycling of compressor and eliminates nuisance service calls due to blown fuse or tripped breaker by locked rotor during short cycling</td>
</tr>
<tr>
<td>Anti-reversing protection for scroll compressors</td>
<td>Extends life of equipment</td>
</tr>
<tr>
<td>Brownout protection</td>
<td>Timer will not allow the compressor to start during low line voltage conditions</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
<tr>
<td>1A solid state output</td>
<td>No moving parts to arc and wear out. Provides up to 100 million operations under typical conditions</td>
</tr>
</tbody>
</table>

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.
Specifications

Input
- Voltage: 12 or 24VDC; 24VAC
- AC Line Frequency: 50/60 Hz
- Impedance: 450 Ω (anticipator by-pass)

Output
- Minimum Load Current: 75mA
- Maximum Load Current: 1A at 60°C
- Voltage Drop: ≤ 1.25V
- Time Delay: ≅ 16ms
- Lockout Time: Fixed 0.5, 1, 2, 3, or 5m
- Tolerance: -15% - 35%
- Protection: Circuitry
- Low Voltage Protection: ≅ 20V: 24VAC/DC; ≅ 9V: 12VDC
- Dielectric Breakdown: ≥ 2000V RMS terminals to mounting surface
- Insulation Resistance: ≥ 100 MΩ

Mechanical
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions:
  - H: 50.8 mm (2”)
  - W: 50.8 mm (2”)
  - D: 30.7 mm (1.21”)
- Termination: 0.25 in. (6.35 mm) male quick connect terminals
- Environmental:
  - Operating/Storage Temperature: -40° to 70°C / -40° to 85°C
  - Humidity: 95% relative, non-condensing
  - Weight: ≅ 2.4 oz (68 g)
- Thermostat: Coolant Anticipator Resistor: ≥ 1800 Ω

Function Diagram

LOCKOUT

V = Voltage
S1 = Initiate Switch
L = Load (CR)
E = Ready
TD = Time Delay
R = Reset
Description
The TAC1 Series was designed to delay the operation of a compressor relay. It eliminates the possibility of relay chatter due to half-wave failure of the output. It connects in series with the load relay coil and provides a delay-on-make time delay each time input voltage is applied. It can be used for random start, anti-short cycling, sequencing, and many other applications. It is an excellent choice for all air conditioning and refrigeration equipment.

Operation (Delay-on-Make)
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits
<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuitry</td>
<td>Repeat accuracy +/- 2%, Factory calibration +/- 20%</td>
</tr>
<tr>
<td>0.5A steady state, 10A inrush</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
<tr>
<td>Connects in series with load relay coil</td>
<td>Fail-safe design eliminates contactor chatter</td>
</tr>
<tr>
<td>Meets UL 873</td>
<td>UL Recognized for air conditioning and refrigeration equipment</td>
</tr>
<tr>
<td>Fully encapsulated</td>
<td>Protects against shock, vibration and humidity</td>
</tr>
</tbody>
</table>

Accessories
- **P1004-XX, P1004-XX-X Versa-Pot**: Panel mountable, industrial potentiometer recommended for remote time delay adjustment.
- **P1023-6 Mounting bracket**: The 90° orientation of mounting slots makes installation/removal of modules quick and easy.
- **P0700-7 Versa-Knob**: Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.
- **P1015-64 (AWG 14/16) Female Quick Connect**: These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
- **P1015-18 Quick Connect to Screw Adapter**: Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>ADJUSTMENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAC1223</td>
<td>24VAC</td>
<td>External</td>
<td>2 - 180s</td>
</tr>
<tr>
<td>TAC1411</td>
<td>120VAC</td>
<td>Fixed</td>
<td>1s</td>
</tr>
<tr>
<td>TAC1412</td>
<td>120VAC</td>
<td>Fixed</td>
<td>2s</td>
</tr>
<tr>
<td>TAC1413</td>
<td>120VAC</td>
<td>Fixed</td>
<td>3s</td>
</tr>
<tr>
<td>TAC14164</td>
<td>120VAC</td>
<td>Fixed</td>
<td>64s</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848
Accessories

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**VTP(X)(X) Plug-on Adjustment Module**
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

Selection Table for VTP Plug-on Adjustment Accessory

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>VTP P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 0.05-3s</td>
<td>VTP4B</td>
</tr>
<tr>
<td>2 - 0.5-60s</td>
<td>VTP4F</td>
</tr>
<tr>
<td>3 - 2-180s</td>
<td>VTP4J</td>
</tr>
<tr>
<td>4 - 5-600s</td>
<td>VTP5N</td>
</tr>
</tbody>
</table>

Specifications

**Time Delay**
- **Type**: Analog circuitry
- **Range**: 0.05 - 600s in 4 adjustable ranges or fixed
- **Repeat Accuracy**: ±2%
- **Tolerance** (Factory Calibration): ±20%
- **Recycle Time**: ≤ 20ms after timing, during timing - 0.1% of time delay or 75ms, whichever is greater
- **Time Delay vs Temp. & Voltage**: ≤ ±10%

**Input**
- **Voltage**: 24, 120, or 230VAC
- **Tolerance**: ±20%
- **AC Line Frequency**: 50/60 Hz

**Output**
- **Type**: Solid state
- **Form**: NO, open during timing
- **Rating**: 0.5A steady state, 10A inrush at 60°C

**Voltage Drop**
- 24VAC: ≅ 2.5V @ 0.5A
- 120 & 230VAC: ≅ 4.2V @ 0.5A
- 24VAC: ≅ 2.5V @ 0.5A

**Protection**
- **Circuitry**: Encapsulated
- **Dielectric Breakdown**: ≥ 2000V RMS terminals to mounting surface
- **Insulation Resistance**: ≥ 100 MΩ

**Mechanical**
- **Mounting**: Surface mount with one #10 (M5 x 0.8) screw
- **Dimensions**: H 50.8 mm (2”); W 50.8 mm (2”); D 30.7 mm (1.21”)
- **Termination**: 0.25 in. (6.35 mm) male quick connect terminals

**Environmental**
- **Operating/Storage Temperature**: -40° to 80°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 2.4 oz (68 g)

Selection Guide

<table>
<thead>
<tr>
<th>Desired Time Delay* (Seconds)</th>
<th>R_T (Megaohm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>5.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

* When selecting an external R_T add at least 30% for tolerance of unit and the R_T.
Description

The TL Series provides protection against short cycling of a compressor. At the end of each operation, or whenever power is lost, a lockout delay is initiated. This lockout delay prevents restarting of the compressor until the head pressure has equalized. Compressor relay chatter due to thermostat bounce is eliminated by use of optional one second delay-on-make. The TL Series should not be used with cooling anticipator resistors or solid-state switches. (See the TA Series).

Operation (Lockout)

Lockout: On initial closure of S1, the compressor relay energizes immediately (or after an optional 1s delay). When the S1 opens or input voltage is interrupted, the output opens and remains open for the lockout time delay. During this lockout time delay period, the compressor relay cannot be re-energized.

Reset: The lockout time delay cannot be reset. After the time delay is completed, the unit automatically resets.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lockout delay</td>
<td>Prevents rapid cycling of compressor and eliminates nuisance service calls due to blown fuse or tripped breaker by locked rotor during short cycling.</td>
</tr>
<tr>
<td>One second Delay-on-Make (models ending in T)</td>
<td>Eliminates contactor chatter due to thermostat bounce</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>1A steady, 10A inrush, solid state output</td>
<td>Provides 100 million operations in typical conditions</td>
</tr>
</tbody>
</table>

Accessories

- **P1023-6 Mounting bracket**: The 90° orientation of mounting slots makes installation/removal of modules quick and easy.
- **P1015-64 (AWG 14/16)** Female Quick Connect: These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
- **P1015-18 Quick Connect to Screw Adapter**: Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.
- **C103PM (AL) DIN Rail**: 35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.
- **P1023-20 DIN Rail Adapter**: Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>LOCKOUT TIME</th>
<th>DELAY-ON-MAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL120A5T</td>
<td>120VAC</td>
<td>5m</td>
<td>1s</td>
</tr>
<tr>
<td>TL230A5</td>
<td>230VAC</td>
<td>5m</td>
<td>No delay</td>
</tr>
<tr>
<td>TL24A5T</td>
<td>24VAC</td>
<td>5m</td>
<td>1s</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 16.
Specifications

Input
Voltage 24, 120, or 230VAC
AC Line Frequency 50/60 Hz
Tolerance ±20%

Output
Minimum Load Current ≤ 40mA
Maximum Load Current 1A @ 24VAC; 0.5A @ 120 & 230VAC at 60°C
Inrush Current 10A at 60°C
Voltage Drop 24VAC - 2.5V @ 1A
120 & 230VAC - 4.2V @ 0.5A

Time Delay
Initiate Time ˆ ≅ 8ms
Lockout Time* Fixed 2, 3, or 5m
Tolerance -15% - 35%
Option 1s delay-on-make eliminates contactor chatter due to thermostat bounce

Protection
Circuitry Encapsulated
Dielectric Breakdown ≥ 2000V RMS terminals to mounting surface
Insulation Resistance ≥ 100 MΩ

Mechanical
Mounting Surface mount with one #10 (M5 x 0.8) screw
Dimensions H 50.8 mm (2”); W 50.8 mm (2”);
D 30.7 mm (1.21”)
Termination 0.25 in. (6.35 mm) male quick connect terminals
Environmental Operating/Storage
Temperature -40° to 70°C / -40° to 85°C
Humidity 95% relative, non-condensing
Weight ≅ 2.4 oz (68 g)

*Power must be applied for at least 15 s to achieve a full lockout delay. Less than 15 s will result in proportionally shorter delay periods.

NOTE: Cooling anticipator resistor or leakage may cause erratic operation. See TA Series for use with 24VAC systems that include anticipator resistors or use solid-state switches.

Function Diagram

V = Voltage
S1 = Initiate Switch
L = Load (CR)
E = Ready
TD = Time Delay
R = Reset
**Anti-Short Cycle, Solid State Timer**

**Description**

The TSA141300 utilizes unique circuitry to provide random start and lockout delay in one small, rugged, inexpensive package. When connected as shown, the TSA141300 in a multiple unit situation, prevents all units from starting at one time with its random start feature. The TSA141300 also prevents the compressor from recycling rapidly which could result in a lock rotor condition. This lockout delay is initiated at the end of each operation of the compressor. A momentary loss of power would also initiate the lockout delay.

**Operation**

**Random Start:** With the thermostat closed, when line voltage is applied to system, a time delay is initiated. At the end of this delay, the compressor relay will be energized. (Random Start delay is equal to lockout delay.)

**Anti-Short Cycle:** At the end of each cycle, when the thermostat opens, a lockout delay is initiated which prevents re-energization of the compressor relay during this period. If the thermostat is closed after the time delay is completed, the compressor relay will energize immediately.

**Loss of Power:** If there is a momentary loss of power, the lockout will again be initiated preventing the compressor relay from energizing for the duration of the delay.

**Features & Benefits**

- Lockout Delay—prevents rapid recycling of compressor in air conditioning, refrigeration, and heat pump equipment
- Random Start Delay—provides staggered start up of multiple units
- Fast response time
- All Solid State with Encapsulated Circuitry

**Wiring Diagram**

For dimensional drawing see: Appendix, page 512, Figure 16.

**Specifications**

<table>
<thead>
<tr>
<th>Time Delay</th>
<th>Type</th>
<th>Factory fixed 5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeat Accuracy</td>
<td>± 5% under fixed conditions</td>
<td></td>
</tr>
<tr>
<td>Tolerance</td>
<td>± 10% max.</td>
<td></td>
</tr>
<tr>
<td>Time Delay vs. Temperature</td>
<td>Factory calibration: ± 15%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input</th>
<th>Voltage</th>
<th>120 volts AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>± 20% of nominal</td>
<td></td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60 Hz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output</th>
<th>Type</th>
<th>Solid State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Load Current</td>
<td>1 ampere steady state, 10 amperes inrush at 60°C</td>
<td></td>
</tr>
</tbody>
</table>

| Voltage Drop | 2.5 volts typical at 1 ampere |

<table>
<thead>
<tr>
<th>Protection</th>
<th>Transient</th>
<th>Protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dielectric Breakdown</td>
<td>Greater than 1500 volts RMS</td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>100 megohms min.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanical</th>
<th>Surface mount with one #8 or #10 screw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting</td>
<td>Molded housing with encapsulated circuitry</td>
</tr>
<tr>
<td>Package</td>
<td>0.25 in. (6.35 mm) male quick connect terminals</td>
</tr>
<tr>
<td>Termination</td>
<td>D 30.70 mm (1.21&quot;)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>H 50.80 mm (2.0”); W 50.80 mm (2.0”);</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>Operating/Storage</td>
</tr>
<tr>
<td>Temperature</td>
<td>-40°C to +80°C/-40°C to +85°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>95% relative, non-condensing</td>
</tr>
</tbody>
</table>

**Function Diagram**

V = Input Voltage
TH = Thermostat
CR = Compressor Relay
TD = Time Delay Relay
R = Reset
**Time Delay Relays**

**Dedicated — Coin Vending**

## HRV SERIES

**Coin Counter**

### Description

The HRV combines the accuracy of microcontroller based circuitry with an electromechanical relay output. The HRV’s switching capacity allows direct control of loads like compressors, pumps, motors, heaters, and lighting. The HRV “S” version provides a vend time after the selected number of initiate switch closures to start is reached. The HRV “A” version includes all of the “S” features and allows the total vend time to be extended for each additional initiate switch closure. The HRV is ideal for cost sensitive single coin or token vending machines. The electronic circuitry is encapsulated to protect against humidity and vibration.

### Operation

**Coin Totalizer & Vending Timer (“S” Version):**

- Input voltage must be applied prior to & during operation.
- When the total number of S1 initiate switch closures equals the number to start set on the lower 3 DIP switches, the load energizes and the vending time set on the upper 7 DIP switches begins. At the end of the vending time, the load de-energizes and the vending time is reset. Closing the initiate switch during vend timing will have no affect on vend time delay.

**Accumulating Vending Timer (“A” Version):**

- Input voltage must be applied prior to and during operation.
- When the total number of S1 initiate switch closures equals the number to start set on the lower 3 DIP switches, the load energizes and the vending time starts. For every initiate switch closure, the HRV unit adds one time per coin period, as set on the upper 7 DIP switches, to the total vending time.

**Operation Note:** If S1 is closed when input voltage is applied, the output remains de-energized and the S1 counter remains at zero closures. At least one “vend time” and one “closures to start” DIP switch must be in the “ON” position for proper operation.

**Reset:** Removing input voltage resets the vend time delay, the S1 closure counter, and de-energizes the output relay.

### Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller based</td>
<td>Repeat accuracy +/- 0.1%, Setting accuracy 0 - 2%, or 50ms</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
<tr>
<td>30A, 1Hp at 125VAC, normally open contacts</td>
<td>Allows direct control of loads like compressors, pumps, motors, and heaters without a contactor</td>
</tr>
<tr>
<td>Switch selectable coin start</td>
<td>Allows user flexibility to select the number of coins to start vending cycle</td>
</tr>
<tr>
<td>Coin switch can be connected to a counter</td>
<td>Provides user with accurate count of total number of coins collected</td>
</tr>
</tbody>
</table>

### Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>VEND TIME</th>
<th>MODE OF OPERATION</th>
<th>OUTPUT FORM &amp; RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRV11SC</td>
<td>12VDC</td>
<td>1 - 127s</td>
<td>Coin totalizer</td>
<td>30A SPDT, NO (isolated)</td>
</tr>
<tr>
<td>HRV24AC</td>
<td>24VAC</td>
<td>0.25 - 31.75m</td>
<td>Accumulating</td>
<td>30A SPDT, NO (isolated)</td>
</tr>
<tr>
<td>HRV41AE</td>
<td>120VAC</td>
<td>1 - 127s</td>
<td>Accumulating</td>
<td>30A SPDT, NO (isolated)</td>
</tr>
<tr>
<td>HRV41SE</td>
<td>120VAC</td>
<td>1 - 127s</td>
<td>Coin totalizer</td>
<td>30A SPDT, NO (isolated)</td>
</tr>
<tr>
<td>HRV42SE</td>
<td>120VAC</td>
<td>5 - 635s</td>
<td>Coin totalizer</td>
<td>30A SPDT, NO (isolated)</td>
</tr>
<tr>
<td>HRV43AE</td>
<td>120VAC</td>
<td>0.1 - 12.7m</td>
<td>Accumulating</td>
<td>30A SPDT, NO (isolated)</td>
</tr>
<tr>
<td>HRV43AN</td>
<td>120VAC</td>
<td>0.1 - 12.7m</td>
<td>Accumulating</td>
<td>30A SPDT, NO (non-isolated)</td>
</tr>
<tr>
<td>HRV43SE</td>
<td>120VAC</td>
<td>0.1 - 12.7m</td>
<td>Coin totalizer</td>
<td>30A SPDT, NO (isolated)</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 17.

© 2023 Littelfuse, Inc.
Time Delay Relays
Dedicated — Coin Vending

HRV SERIES

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Switch Adjustment

Combine upper seven switches in “ON” position for vend time in minutes.

Combine lower three switches in “ON” position for number of closures to start.

Function Diagram

Specifications

Count Functions/
Switch Type
Mechanical (counts on switch closure)

Minimum Switch Closure Time
≥ 20ms

Minimum Switch Open (between closures) Time
≥ 20ms

Count Range to Start
1 - 7 counts

Maximum Counts
(“A” Version)
250

Time Delay/Range ***
Adjustable 1s - 31.75m in 4 ranges

Adjustment
7 of a 10 position DIP switch

Setting Accuracy
0% to +2% or 50ms, whichever is greater

Repeat Accuracy
±0.1% or 20ms, whichever is greater

Reset Time
≤ 150ms

Time Delay vs Temp. & Voltage
≤ ±2%

Input

Voltage Tolerance
12 or 24VDC; 24, 120, or 230VAC

-15% - 20%

-20% - 10%

AC Line Frequency/DC Ripple
50/60 Hz / ≤ 10%

Power Consumption
AC ≤ 4VA; DC ≤ 2W

Output

Type
Electromechanical relay

Form
Isolated, SPDT or non-isolated, SPDT

Ratings
General Purpose
SPDT-NO SPDT-NC
30A 15A
30A 15A
20A 10A

Resistive
125/240VAC
1 hp* 1/4 hp**
2 hp** 1 hp**

240VAC

Motor Load
125VAC

1 hp* 1/4 hp**

2 hp** 1 hp**

Life
Mechanical - 1 x 10⁶;
Electrical - 1 x 10⁶; *3 x 10⁴, ** 6,000

Protection

Surge
IEEE C62.41-1991 Level A

Circuitry
Encapsulated

Dielectric Breakdown
≥ 1500V RMS input to output on isolated units

Insulation Resistance
≥ 100 MΩ

Mechanical

Mounting
Surface mount with one #10 (M5 x 0.8) screw

Dimensions
H 76.7 mm (3”); W 50.8 mm (2”);

D 38.1 mm (1.5”)

Termination
0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage
-40° to 70°C / -40° to 85°C

Temperature
95% relative, non-condensing

Humidity
Weight
3.9 oz (111 g)

***For CE approved applications, voltage must be removed when a switch position is changed.
FLASHERS & TOWER LIGHTING CONTROLS

Flashers for incandescent or LED lighting used with both alternating and non-alternating applications in the signaling, communications, and advertising industries. FAA approved versions for obstruction lighting control are available. Tower lighting illuminates communications towers, tall buildings, and bridges as required by FA regulation. Designs are also available for powered AM and FM towers.

**Flashers**
- FSU1000 Series .......................................................... 456
- FS100 Series Low Current Flasher .............................. 458
- FS100 Series Med Power Flasher ................................. 460
- FS200 Series ............................................................... 462
- FS300 Series ............................................................... 464
- FS491 ................................................................. 465
- FS500 Series ............................................................... 467
- SC3 / SC4 Series Sequencing Controls....................... 469

**Tower and Obstruction Lighting Controls**
- FA / FS Series ........................................................... 471
- FB Series Flasher & Incandescent Beacon Alarm Relay ... 472
- SCR490D Obstruction Lamp Alarm Relay ........................ 474
- SCR Series Universal Lamp Alarm Relay ...................... 475
- FB9L Universal Lamp Alarm Relay ............................... 477
- SCR9L Universal Lamp Alarm Relay ............................. 479
- PCR Series Photo Control ........................................... 481
Description
The FSU1000 incorporates an onboard adjustable flash rate of 10 to 100 FPM and a universal input voltage in one device. Its circuitry is encapsulated and is capable of controlling loads of up to 20A. The versatility of the FSU1000 makes it ideal for applications where various flash rates and operating voltages are required.

Operation
When input voltage is applied to terminal 2 and the load (lamp), the load energizes steadily. When input voltage is applied to terminal 3, the output flashes.

Optional Low Current Switch (S1): This low current switch could be a limit switch or contact. While open, the operator sees the load (lamp) ON and operating. When the limit switch closes, the load (lamp) flashes to attract attention.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal input voltage 24 to 240VAC</td>
<td>Allows flexibility for a wide range of applications with one part</td>
</tr>
<tr>
<td>Onboard adjustable flash rate</td>
<td>Provides flexibility for user to select flash rate between 10 - 100 FPM</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>High output rating up to 20A, 200A inrush</td>
<td>Allows direct operation of high current loads without a contactor</td>
</tr>
</tbody>
</table>

Accessories

P1015-13 (AWG 10/12), P1015-64 (AWG 14/16), P1015-14 (AWG 18/22) Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INRUSH RATING</th>
<th>LOAD RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSU1000</td>
<td>10A</td>
<td>1A</td>
</tr>
<tr>
<td>FSU1003</td>
<td>60A</td>
<td>6A</td>
</tr>
<tr>
<td>FSU1004</td>
<td>100A</td>
<td>10A</td>
</tr>
<tr>
<td>FSU1005</td>
<td>200A</td>
<td>20A</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848
Specifications

Technical Data

Operation
ON/OFF recycling solid-state flasher (continuous duty)

Flash Rate
Adjustable 10 - 100 FPM

ON/OFF Ratio
≅ 50%

Input
Range/Frequency
24 to 240VAC / 50/60Hz

Output
Load Type
Inductive, resistive, or incandescent

Maximum Load Rating
1, 6, 10, or 20A steady state

Inrush
10 times steady state current

Mechanical
Mounting*
Surface mount with one #10 (M5 x 0.8) screw

Dimensions
FSU1000
H 50.8 mm (2”); W 50.8 mm (2”);
D 30.7 mm (1.21”)

FSU1003, FSU1004
H 50.8 mm (2”); W 50.8 mm (2”);
D 38.4 mm (1.51”)

Termination
0.25 in. (6.35 mm) male quick connect terminals

Protection
Circuitry
Encapsulated

Environmental
Operating/Storage
Temperature
-20° to 60°C (240VAC +50°C) / -40° to 85°C

Weight
1A units: ≅ 2.4 oz (68 g)
≥ 6A units: ≅ 3.9 oz (111 g)

*Units rated > 6A must be bolted to a metal surface using the included heat sink compound.
The maximum mounting surface temperature is 90°C.
Flashers and Tower Lighting Controls

**FS100 SERIES**

**Low Current Flasher**

**Description**

The FS100 Series (low current) may be used to control inductive, incandescent or resistive loads. This series offers a 1A (fullwave) or a 2A (halfwave) steady state, 10A inrush solid-state output and may be ordered with an input voltage of 24 or 120VAC. The FS100 Series offers a factory fixed flash rate of 75 FPM or may be ordered with a fixed, custom flash rate ranging from 45 to 150 FPM. Ideal for OEM applications where cost is a factor.

**Operation**

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

**Reset:** Removing input voltage resets the output and the sequence to T2.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact Size: 38 x 23.9mm (1.5” x 0.94”)</td>
<td>Ideal for OEM applications</td>
</tr>
<tr>
<td>Custom Flash Rates Available</td>
<td>Tailor to specific application; custom rates range from 45 to 150 FPM</td>
</tr>
</tbody>
</table>

**Accessories**

P1023-2 “P” Clamp
Mounting Bracket Alum. 15/16

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VAC</th>
<th>OUTPUT RATING A</th>
<th>OUTPUT TYPE AC</th>
<th>LOAD TYPE</th>
<th>FLASH RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS126</td>
<td>120</td>
<td>1</td>
<td>Fullwave</td>
<td>Incandescent &amp; Resistive</td>
<td>75 FPM</td>
</tr>
<tr>
<td>FS126-45</td>
<td>120</td>
<td>1</td>
<td>Fullwave</td>
<td>Incandescent &amp; Resistive</td>
<td>45 FPM</td>
</tr>
<tr>
<td>FS126-60</td>
<td>120</td>
<td>1</td>
<td>Fullwave</td>
<td>Incandescent &amp; Resistive</td>
<td>60 FPM</td>
</tr>
<tr>
<td>FS126RC</td>
<td>120</td>
<td>1</td>
<td>Fullwave</td>
<td>Incandescent, Resistive, &amp; Inductive</td>
<td>75 FPM</td>
</tr>
<tr>
<td>FS126RC-45</td>
<td>120</td>
<td>1</td>
<td>Fullwave</td>
<td>Incandescent, Resistive, &amp; Inductive</td>
<td>45 FPM</td>
</tr>
<tr>
<td>FS127</td>
<td>120</td>
<td>2</td>
<td>Halfwave</td>
<td>Incandescent &amp; Resistive</td>
<td>75 FPM</td>
</tr>
<tr>
<td>FS146</td>
<td>24</td>
<td>1</td>
<td>Fullwave</td>
<td>Incandescent &amp; Resistive</td>
<td>75 FPM</td>
</tr>
<tr>
<td>FS146RC</td>
<td>24</td>
<td>1</td>
<td>Fullwave</td>
<td>Incandescent, Resistive, &amp; Inductive</td>
<td>75 FPM</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 512, Figure 25.
FS100 SERIES

Low Current Flasher

Specifications

Technical Data
Operation
OFF/ON solid-state flasher (continuous duty)
Flash Rate
Factory fixed at 75 FPM ±20%
Custom Flash Rates Available
From 45-150 FPM ±20%
ON/OFF Ratio
≅ 50%

Input
Voltage
24, 120VAC, ±15%
AC Line Frequency
50/60Hz

Output
Output
Fullwave AC or Halfwave rectified AC
Load Type
Incandescent, resistive, or inductive
(Choose RC suffix for inductive loads)
Maximum Load Rating
Fullwave: 1A steady state
Halfwave: 2A steady state

Inrush
10A

Mechanical
Mounting
Removable mounting bracket, use one #8 (M4 x 0.7) screw
Connection/Wires
18 AWG (0.82mm²) wires 6 in. (15.2cm)
Dimensions
H 38.1 mm (1.5”); W 23.9 mm (0.94”)

Protection
Circuitry
Encapsulated
Environmental
Operating/Storage Temperature
-20° to 60°C / -40° to 85°C
Humidity
95% relative, non-condensing
Weight
≅ 1.1 oz (31 g)

Flasher Function Diagram

V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2
**Description**

The FS100 Series (medium power) may be used to control inductive, incandescent, or resistive loads. Input voltages of 24, 120, or 230VAC are available. Fixed flash rates in stock range from 30, 50, 60, and 90 FPM, with custom flash rates ranging from 10 to 300 FPM. Encapsulation provides protection against shock, vibration, and humidity. This group of solid-state flashers has proven reliability with years of use throughout the world.

**Operation**

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

**Reset:** Removing input voltage resets the output and the sequence to T2.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A steady, 30A inrush current</td>
<td>Provides direct control of inductive, incandescent, or resistive loads</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT</th>
<th>FLASH RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS143</td>
<td>24VAC</td>
<td>90 FPM</td>
</tr>
<tr>
<td>FS152</td>
<td>120VAC</td>
<td>90 FPM</td>
</tr>
<tr>
<td>FS152-30</td>
<td>120VAC</td>
<td>30 FPM</td>
</tr>
<tr>
<td>FS152-60</td>
<td>120VAC</td>
<td>60 FPM</td>
</tr>
<tr>
<td>FS162</td>
<td>230VAC</td>
<td>90 FPM</td>
</tr>
<tr>
<td>FS162-30</td>
<td>230VAC</td>
<td>30 FPM</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
FS100 SERIES

Medium Power Flasher

Specifications

Technical Data
- Operation: OFF/ON solid-state flasher (continuous duty)
- Flash Rate: Fixed at 90 FPM ±10%
- Custom Flash Rates: 10 - 300 FPM ±10%
- ON/OFF Ratio: ≅ 50%

Input
- Voltage/Frequency: 24, 120, or 230VAC ±15% / 50/60 Hz

Output
- Load Type: Inductive, resistive, or incandescent
- Maximum Load Rating: Fullwave AC, solid state, SPST
- Inrush: 10 times steady state current

Mechanical
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2"), W 50.8 mm (2"), D 30.7 mm (1.21")
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

Protection
- Circuitry: Encapsulated

Environmental
- Operating/Storage Temperature: -20° to 60°C / -40° to 85°C
- Weight: ≅ 2.2 oz (62 g)

Flasher Function Diagram

V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2
Description
The FS200 Series may be used to control inductive, incandescent, or resistive loads. Factory fixed flash rate of 45 or 90 FPM or may be ordered with a fixed custom flash rate ranging from 10 to 180 FPM. Encapsulation provides protection against shock, vibration, and humidity. Uniform performance, high inrush current capability, and low RFI, make this series ideal for general industrial applications.

Operation
Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A steady, 30A inrush, SPST output contact</td>
<td>Provides direct control of inductive, incandescent, or resistive loads</td>
</tr>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>High inrush current capability and low RFI</td>
<td>Ideal for general industrial applications</td>
</tr>
</tbody>
</table>

Accessories

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT</th>
<th>RATING</th>
<th>FLASH RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS219-45</td>
<td>12VDC ± 20%</td>
<td>3A</td>
<td>45 FPM</td>
</tr>
<tr>
<td>FS224</td>
<td>24VDC ± 20%</td>
<td>3A</td>
<td>90 FPM</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 16.
## Specifications

**Technical Data**

**Operation**
- OFF/ON solid-state flasher (continuous duty)
- Flash Rate: Fixed at 90 FPM ±10%
- Custom Flash Rate: 10 - 180 FPM
- ON/OFF Ratio: ≅ 50%

**Input**
- Voltage: 12, 24, 36, 48, or 110VDC

**Output**
- Load Type: Inductive, resistive, or incandescent
- Maximum Load Rating: 0.25 - 3A steady state
- OFF State Leakage Current: ≤ 250 µA
- Inrush: 10 times steady state current

**Mechanical**
- Mounting: Surface mount with one #10 (M5 x 0.8) screw
- Dimensions: H 50.8 mm (2"), W 50.8 mm (2"), D 30.7 mm (1.21"
- Termination: 0.25 in. (6.35 mm) male quick connect terminals

**Protection**
- Circuitry: Encapsulated

**Environmental**
- Operating/Storage Temperature: -20° to 60°C / -40° to 85°C
- Weight: ≅ 2.2 oz (62 g)

### Flasher Function Diagram

- V = Voltage
- R = Reset
- L = Load
- T1 = ON Time
- T2 = OFF Time
- T1 ≅ T2

In the diagram, the flasher is shown with the following timing:

```
  V
  /|\  FLASHER (OFF FIRST)
  |   
  L   T2  T1    T2    T1    T2
```

T1 = ON Time
T2 = OFF Time
T1 ≅ T2
Description
The FS300 Series of solid-state flashers were specifically designed to operate lamp loads. Their two-terminal series connection feature makes installation easy. The high immunity to line noise and transients makes the FS300 Series ideal for moving vehicle applications. All solid-state construction means reliability and long life. The FS300 Series offers a factory fixed flash rate of 75 FPM or may be ordered with a fixed, custom flash rate ranging from 60 to 150 FPM.

Operation
Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>High immunity to line noise and transients</td>
<td>Designed specifically for moving vehicle applications</td>
</tr>
<tr>
<td>High surge current capability (10 times steady state)</td>
<td>Direct operation of incandescent lamp loads</td>
</tr>
<tr>
<td>Two terminal series connection</td>
<td>Provides quick and easy installation for new or existing applications</td>
</tr>
</tbody>
</table>

Accessories

- **P1023-6 Mounting bracket**
  The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

- **P1015-64 (AWG 14/16) Female Quick Connect**
  These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

- **P1015-18 Quick Connect to Screw Adapter**
  Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT</th>
<th>MAXIMUM CURRENT LOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS312</td>
<td>12VDC ± 20%</td>
<td>2.5A</td>
</tr>
<tr>
<td>FS324</td>
<td>24VDC ± 20%</td>
<td>1.5A</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848.
FS300 SERIES

Specifications

Technical Data
Operation
OFF/ON recycling solid-state flasher (continuous duty)

Flash Rate
Fixed at 75 FPM ±10%

Custom Flash Rates
60 - 150 FPM

ON/OFF Ratio
≅ 50%

Input
Voltage
12, 24, 36, 48, 72, & 110VDC

Output
Load Type
Incandescent or resistive

Maximum Load Rating
0.25 - 2.5A steady state

Inrush
10 times steady state current

Mechanical
Mounting
Surface mount with one #10 (M5 x 0.8) screw

Dimensions
H 50.8 mm (2”); W 50.8 mm (2”);
D 30.7 mm (1.21”)

Termination
0.25 in. (6.35 mm) male quick connect terminals

Protection
Circuitry
Encapsulated

Environmental
Operating/Storage
Temperature
-20° to 60°C / -40° to 85°C

Humidity
95% relative, non-condensing

Weight
≅ 2.2 oz (62 g)

Flasher Function Diagram

V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2
Description
The FS491 is a low leakage AC flasher designed to control LED, or resistive loads. This product offers a solid-state output and accepts an input voltage of 120VAC to 240VAC. It offers a factory fixed flash rate of 75 FPM. The FS491 is the perfect solution for LED lamp flashing.

Operation
Upon application of input voltage, the output energizes and the ON time begins. At the end of the ON time, the output de-energizes and the OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and the flash sequence.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally solid state</td>
<td>No moving parts to arc and wear out, up to 100 million operations under typical conditions</td>
</tr>
<tr>
<td>Fully encapsulated</td>
<td>Protects circuitry from shock, vibration and humidity</td>
</tr>
<tr>
<td>Extremely low leakage current</td>
<td>Ideal for use in LED lighting applications</td>
</tr>
</tbody>
</table>

Specifications

**Technical Data**
- **Operation**: ON/OFF solid-state flasher (continuous duty)
- **Flash Rate**: Fixed at 75 FPM ±20%
- **ON/OFF Ratio**: ≅ 50%
- **Input**: 120 - 240VAC, ± 15%
- **AC Line Frequency**: 50/60Hz
- **Output**: LED or resistive
- **Load Type**: Bridge Rectifier & FET
- **Maximum Load Rating**: 0.5A steady state; 5A inrush
- **Voltage Drop**: 250µA, 2V typical

**Mechanical**
- **Mounting**: Surface mount with one #8 (M4 x 0.7) screw
- **Dimensions**: Dia. 23.9 mm (0.94"), L 38.1 mm (1.5")

**Protection**
- **Surge**: IEEE C62.41 - 1991 Level A
- **Circuitry**: Encapsulated

**Environmental**
- **Operating/Storage Temperature**: -20° to 60°C / -40° to 85°C
- **Humidity**: 95% relative, non-condensing
- **Weight**: ≅ 1.1 oz (31 g)

For dimensional drawing see: Appendix, page 512, Figure 25.
Description
The FS500 Series flash rate is adjustable from 10 to 100 FPM. A locknut is provided to hold selected flash rate. The long-life electronic circuit combined with a quality electromechanical relay provides flexibility and reliability in most applications.

Operation
Upon application of input voltage, the output relay is energized and the ON time begins. At the end of the ON time, the output relay de-energizes and the OFF time begins. At the end of the OFF time, the output is energized and the cycle repeats as long as input voltage is applied.
Reset: Removing input voltage resets the output and the sequence.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid-state circuitry with electromechanical relay</td>
<td>Long life circuitry at a reliable low cost</td>
</tr>
<tr>
<td>Industry standard octal plug connection</td>
<td>Eliminates need for special connectors</td>
</tr>
<tr>
<td>Adjustable flash rate</td>
<td>Provides flexibility for user to select flash rate between 10 - 100 FPM</td>
</tr>
<tr>
<td>10A, DPDT isolated output contacts</td>
<td>Allows control of loads for AC or DC voltages</td>
</tr>
</tbody>
</table>

Accessories

- **BZ1 Front Panel Mount Kit**: Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.
- **NDS-8 Octal 8-pin Socket**: 8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.
- **C103PM (AL) DIN Rail**: 35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS512</td>
<td>12VDC</td>
</tr>
<tr>
<td>FS524</td>
<td>24VAC/DC</td>
</tr>
<tr>
<td>FS590</td>
<td>120VAC/DC</td>
</tr>
</tbody>
</table>

For dimensional drawing see: Appendix, page 512, Figure 24.

If you don't find the part you need, call us for a custom product 800-843-8848
Specifications

Technical Data

Operation
ON/OFF recycling flasher with adjustable flash rate

Flash Rate
Adjustable from 10 - 100 operations per minute (guaranteed range)

ON/OFF Ratio
≈ 50%

Input Voltage
12VDC, 24VAC/DC, 120VAC/DC, 230VAC

Tolerance
-15% - 20% for 12VDC & 24VAC/DC
-20% - 10% for 120VAC/230VAC

AC Line Frequency
50/60Hz

Output
Electromechanical relay

Form
DPDT

Rating
10A resistive @ 120/240VAC & 28VDC;
1/3 hp @ 120/240VAC

Mechanical

Mounting
Plug-in socket

Dimensions
H 91.6 mm (3.62”); W 60.7 mm (2.39”);
D 45.2 mm (1.78”)

Termination
Octal 8-pin plug-in

Protection
Isolation Voltage
≥ 1500V RMS input to output

Polarity
DC units are reverse polarity protected

Environmental

Operating/Storage
Temperature
-20°C to 60°C / -30°C to 85°C

Weight
≈ 5.8 oz (164 g)

Flasher Function Diagram

V = Voltage
R = Reset
T1 = ON Time
T2 = OFF Time
NO = Normally Open
NC = Normally Closed
SC3 / SC4 SERIES

Description
The SC3/SC4 Series are solid-state 3 or 4 channel chasers designed for sequential three circuit flashing of incandescent lamp loads. Unlike electromechanical chasers, there are no contacts to arc, wear, and eventually fail.

Operation
Sequential 3 or 4 circuit flashing of incandescent loads with equal time delays for each load. Upon application of input voltage, Load 1 is energized. At the end of the time delay, Load 1 de-energizes and Load 2 energizes. At the end of the time delay, Load 2 de-energizes and Load 3 energizes. This cycle continues until input voltage is removed. The set time delay (rate) is the timing for the whole cycle, for all 3 loads (output contacts).

Reset: Removing input voltage resets the unit and cycle.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally solid state and encapsulated</td>
<td>No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity</td>
</tr>
<tr>
<td>1A steady solid state output</td>
<td>Provides 100 million operations in typical conditions.</td>
</tr>
</tbody>
</table>

Accessories

**P1015-13** (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>RATING</th>
<th>CHANNEL</th>
<th>FLASH RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC3120A</td>
<td>120VAC</td>
<td>1A</td>
<td>3 Sequential</td>
<td>Adjustable 30 - 30FPM</td>
</tr>
<tr>
<td>SC4120A</td>
<td>120VAC</td>
<td>1A</td>
<td>4 Sequential</td>
<td>Adjustable 30 - 30FPM</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 513, Figure 28.
Sequential 3 circuit flashing of incandescent lamp loads. Fixed rate.

For sequential 4 circuit and adjustable rates, please contact the factory.

Fixed: 30 operations per minute (±10%)

Rate

Input

Voltage

120VAC ±15%

AC Line Frequency

50/60 Hz

Output

Type

Solid state

Rating

1A steady state per output

Mechanical

Mounting

Surface mount with two #6 (M3.5 x 0.6) screws

Termination

0.25 in. (6.35 mm) male quick connect terminals

Dimensions

H 88.9 mm (3.5”); W 63.5 mm (2.5”);

D 31 mm (1.22”)

Protection

Circuitry

Encapsulated

Dielectric Breakdown

≥ 2000V RMS terminals to mounting surface

Insulation Resistance

≥ 100 MΩ

Environmental

Operating/Storage

Temperature

-20° to 60°C / -40° to 85°C

Humidity

95% relative, non-condensing

Weight

≈ 5.4 oz (153 g)

SC4 shown.

For SC3, L4 is eliminated and L1TD begins as soon as L3TD is completed.

V = Voltage

R = Reset

L1, L2, L3, L4 = Lamps

TD = Time Delay

(all are equal)
**Description**

The FA/FS Series have proven their reliability through years of use on communication towers, smoke stacks, cooling towers, tall buildings, bridges and utility towers. The highest quality components are encapsulated in a rugged plastic housing with a molded-in heat transfer plate. The flash rate, ratio, and fail-safe design meet FAA regulations. Zero voltage switching can increase lamp life up to ten times. The FS155-30RF includes superior RF filtering circuitry for use in high RF installations, including AM hot towers.

**Operation**

**FS Series - Flasher (OFF First)**

**FA Series - Auxiliary Modules**

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until voltage is removed.

**Reset:** Removing input voltage resets the output and the sequence to T2.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero voltage switching</td>
<td>Delivers up to 10 times longer lamp life</td>
</tr>
<tr>
<td>Encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
<tr>
<td>Metalized mounting surface</td>
<td>Facilitates heat transfer in high current applications</td>
</tr>
<tr>
<td>Superior RF filtering circuitry (RF models only)</td>
<td>Ideal for AM hot towers and other high RF installations</td>
</tr>
<tr>
<td>High inrush capability up to 200A</td>
<td>Will withstand the repetitive inrush current of incandescent beacons</td>
</tr>
</tbody>
</table>

**Accessories**

**P1015-13** (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**

These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

**P1015-18 Quick Connect to Screw Adapter**

Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT VOLTAGE</th>
<th>WATTAGE</th>
<th>INRUSH RATING</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA155</td>
<td>120VAC</td>
<td>2500W</td>
<td>200A</td>
<td>Auxiliary unit to provide constant line loading</td>
</tr>
<tr>
<td>FA155-2</td>
<td>120VAC</td>
<td>2500W</td>
<td>200A</td>
<td>Auxiliary unit for synchronized operating of additional beacons. Synchronized flashing of additional beacons on a 3 wire system</td>
</tr>
<tr>
<td>FA165</td>
<td>230VAC</td>
<td>5000W</td>
<td>200A</td>
<td>Auxiliary unit to provide constant line loading</td>
</tr>
<tr>
<td>FA165-2</td>
<td>230VAC</td>
<td>5000W</td>
<td>200A</td>
<td>Auxiliary unit for synchronized operating of additional beacons. Synchronized flashing of additional beacons on a 2 wire system</td>
</tr>
<tr>
<td>FS155-30RF</td>
<td>120VAC</td>
<td>2500W</td>
<td>200A</td>
<td>For high RF interference locations including AM hot towers</td>
</tr>
<tr>
<td>FS155-30T</td>
<td>120VAC</td>
<td>2500W</td>
<td>200A</td>
<td>Standard beacon flasher</td>
</tr>
<tr>
<td>FS165-30T</td>
<td>230VAC</td>
<td>5000W</td>
<td>200A</td>
<td>Standard beacon flasher</td>
</tr>
</tbody>
</table>

*If you don’t find the part you need, call us for a custom product 800-843-8848*
**Specifications**

**Operation**
- Single & multiple beacon flashing with auxiliary modules
- Flash Rate (FS Series Only)
  - 30 ±10 FPM
- ON/OFF Ratio (FS Series Only)
  - 50 - 67% ON time; 33 - 50% OFF time
- Voltage
  - 120 or 230VAC ±20%
- AC Line Frequency
  - 50/60Hz
- Output Rating (Zero Voltage Switching)
  - 2500W @ 120VAC; 5000W @ 230VAC
- Inrush Current
  - 200A peak for 1 cycle of AC line
- Mounting*
  - Surface mount with one #10 (M5 x 0.8) screw
- Dimensions
  - H 50.8 mm (2”); W 50.8 mm (2”);
  - D 38.4 mm (1.51”)
- Termination
  - 0.25 in. (6.35 mm) male quick connect terminals
- Circuitry
  - Encapsulated
- Operating/Storage
  - Temperature
    - -55° to 65°C / -55° to 85°C
  - Humidity
    - 95% relative, non-condensing
  - Weight
    - ≅ 3.9 oz (111 g)

* Note: Must be mounted to metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C.
**FB SERIES**

Flashers and Tower Lighting Controls
Tower and Obstruction Lighting Controls

**Flasher & Incandescent Beacon Alarm Relay**

**Description**

The FB Series is used to monitor the operation of one two-lamp incandescent beacon and one beacon flasher (or auxiliary module). The flasher and lamps are monitored by sensing the flow of current in the circuit. If the lamp(s) or the flasher fail to operate properly, a solid-state output and an isolated SPDT relay energize. When connected to a site monitoring system, this unit provides the remote beacon monitoring protection required by the FAA/FCC. On a multiple beacon structure, one unit is required for each two-lamp incandescent beacon (one unit per beacon for LED beacons).

**Operation**

If one lamp in an incandescent beacon fails, the relay and solid-state lamp failure outputs energize after 10s. If the flasher fails in the ON or OFF condition, the relay and the solid-state flasher failure output energizes after 6s. If both failures occur, all three outputs energize after their trip delays.

**Note:** If both incandescent lamps fail, all three outputs will energize. The relay and solid-state flasher failure output energizes after 6s, and the solid-state lamp failure output energizes after 10s.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toroidal current sensing</td>
<td>Reliable low cost monitoring of the flasher and lamps through built-in CT and provides isolation from the monitored circuit</td>
</tr>
<tr>
<td>Failsafe beacon monitoring</td>
<td>Alarm monitors for failed incandescent lamps in addition to flasher function</td>
</tr>
<tr>
<td>One isolated, 5A, SPDT alarm output plus two, 1A, solid-state line voltage alarm outputs</td>
<td>When connected to a site monitoring system, it provides the remote beacon monitoring protection required by the FAA/FCC.</td>
</tr>
<tr>
<td>Fixed trip delays for flasher (6s) and lamp (10s) failures</td>
<td>Prevents nuisance alarms</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LINE VOLTAGE</th>
<th>LAMP TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB120A</td>
<td>120VAC</td>
<td>Incandescent Beacon</td>
</tr>
<tr>
<td>FB230A</td>
<td>230VAC</td>
<td>Incandescent Beacon</td>
</tr>
</tbody>
</table>

If you don't find the part you need, call us for a custom product 800-843-8848

**Specifications**

**Input Voltage**

- FB120A: 120VAC ±15%
- FB230A: 230VAC ±15%

**AC Line Frequency**

- 50/60Hz
- ±10%; 50/60Hz

**Lamp Socket Voltage**

- 3 total - 1 relay, 2 solid state;
- One isolated SFDT relay rated 5A resistive
- Two solid-state line voltage outputs rated 0.5A steady, 5A inrush

**Lamp Failure Detection**

- For two 620W or 700W lamps
- For two 900W or 700W lamps

**Flasher Failure**

- Fixed at 6s; -0/+40%
- Fixed at 10s; -0/+40%

**Termination**

- 7 position barrier block for 20 AWG (0.5 mm²) to 14 AWG (2.5 mm²) wire

**Environmental**

**Operating/Storage**

- -55° to 60°C / -55° to 85°C

**Weight**

- 7 oz (198 g)

For dimensional drawing see: Appendix, page 514, Figure 47.
Description
The SCR490D is used to provide remote monitoring of steady burning incandescent marker and obstruction lighting. Four onboard switches allow operator programming for lighting systems with two through nine lamps on a single AC circuit. The SCR490D uses a toroidal sensor and electronic circuitry to sense the failure of one or more lamps.

Operation
When a lamp fails, the SCR490D senses a decrease in current flow. Then, after a fixed time delay, it transfers to its alarm mode. In alarm mode, the LED indicator, the output relay (SPDT isolated contacts), and a non-isolated solid-state output are energized. Replacement of the failed lamps resets the alarm outputs and the LED indicator. To prevent false alarm signals, power must be applied to the SCR490D at the same time that lamps are energized.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toroidal current sensing</td>
<td>Reliable low cost monitoring of incandescent marker and obstruction lighting through built-in CT which also provides isolation from the lighting circuit</td>
</tr>
<tr>
<td>Monitors 2 - 9 lamps</td>
<td>Senses failed obstruction lamps on a single AC circuit</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT alarm output plus one 1A, solid-state line voltage alarm output</td>
<td>Provide alarm indication and can also be used for remote monitoring of the lighting system</td>
</tr>
<tr>
<td>Fixed trip delay (6s)</td>
<td>Prevents nuisance alarms</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Lamps</td>
</tr>
<tr>
<td>Lamp Wattage</td>
</tr>
<tr>
<td>Rated Lamp Voltage</td>
</tr>
<tr>
<td>Monitored Voltage</td>
</tr>
<tr>
<td>Trip Delay</td>
</tr>
<tr>
<td>Voltage</td>
</tr>
<tr>
<td>AC Line Frequency</td>
</tr>
<tr>
<td>Tolerance</td>
</tr>
<tr>
<td>120VAC</td>
</tr>
<tr>
<td>Line Voltage Output (Solid State Rated)</td>
</tr>
<tr>
<td>Isolated Alarm Output</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Mounting</td>
</tr>
<tr>
<td>Dimensions</td>
</tr>
<tr>
<td>Termination</td>
</tr>
<tr>
<td>Circuitry</td>
</tr>
<tr>
<td>Operating/Storage</td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Humidity</td>
</tr>
<tr>
<td>Weight</td>
</tr>
</tbody>
</table>
**Description**

The SCR series is a universal lamp alarm relay designed to sense the failure of flashing or steady incandescent beacon lamps or steady side lights. The toroidal current sensor provides isolation and allows monitoring of more than one line at a time. The SCR Series energizes when one or more lamps fail. It will monitor the operation of one to four side lights and up to four beacon lamps.

**Operation**

When a lamp fails, the SCR Series senses a decrease in current flow. After a fixed time delay, the LED glows and the two alarm outputs energize. The outputs and the LED are reset when the failed lamps are replaced and the current returns to the nominal setting, or when the input voltage is removed. The SCR will sense an open flasher, it will not sense a continuously ON flasher (see FB Series).

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toroidal current sensing</td>
<td>Provides isolation from the lighting circuit and allows monitoring of multiple lines simultaneously</td>
</tr>
<tr>
<td>Monitors 1-4 side lights or up to 4 beacon lamps</td>
<td>Senses failed incandescent flashing beacon or steady obstruction lamps</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT alarm output plus one 1A, solid-state line voltage alarm output</td>
<td>Provides alarm indication and can also be used for remote monitoring of the lighting system</td>
</tr>
<tr>
<td>Fixed trip delay (6s)</td>
<td>Prevents nuisance alarms</td>
</tr>
<tr>
<td>Switch selectable number, voltage, and wattage of lamps</td>
<td>User selectable to meet wide application needs with one relay</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT</th>
<th>LAMP TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR430T</td>
<td>120VAC</td>
<td>Incandescent</td>
</tr>
<tr>
<td>SCR630T</td>
<td>230VAC</td>
<td>Incandescent</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848
**Selection Range**

<table>
<thead>
<tr>
<th>SCR430T</th>
<th>SCR630T</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 620 W</td>
<td>116 W</td>
</tr>
<tr>
<td>b. 120 V</td>
<td>130 V</td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>4L</td>
<td>4L</td>
</tr>
<tr>
<td>3L</td>
<td>3L</td>
</tr>
<tr>
<td>2L</td>
<td>2L</td>
</tr>
<tr>
<td>1L</td>
<td>1L</td>
</tr>
</tbody>
</table>

a. Lamp Wattage - Select the lamp wattage of the lamps in use.
b. Lamp Voltage - Select the lamp voltage shown on the lamp (SCR430T)
c. Lamps ON - Select the number of lamps on during normal operation. Only one lamp switch at a time may be transferred to the right.

**Programming Example**

1. Select lamp wattage: 116 or 620 watts
2. Select the number of lamps ON (1 thru 4) during normal operation. Only one lamp switch may be transferred to the right.

Example Shown: SCR430T-620 watts at 120 VAC lamps, two lamps are ON during normal operation.

**Specifications**

**Operation**

- **Lamp Monitoring**
- **Capacity (in lamps)**
  - SCR430T - 120VAC Lamps: 4
  - SCR630T - 230VAC Lamps: n/a

**Time Delay**

- **Trip Delay**
  - Factory fixed ≈ 6s

**Input**

- **Input Voltage/Tolerance**
  - SCR430T - 120VAC ±10%
  - SCR630T - 230VAC ±10%

**AC Line Frequency**

- 50/60Hz

**Output**

- **Line Voltage Output (Solid-state Rated)**
  - ≤ 125W @ 120VAC
  - ≤ 250W @ 240VAC

- **Isolated Alarm Output (SPDT)**
  - 10A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC

**Mechanical**

- **Mounting**
  - Two #6 (M3.5 x 0.6) screws

- **Dimensions**
  - H 88.9 mm (3.5”); W 63.5 mm (2.5”); D 44.5 mm (1.75”)

**Termination**

- Screws with captive clamps for up to 14 AWG (2.45 mm²) wire

**Protection**

- **Circuitry**
  - Encapsulated

**Environmental**

- **Operating Temperature**
  - -55° to 65°C

- **Weight**
  - ≈ 6.8 oz (193 g)
**Description**

The FB9L is a universal lamp alarm relay designed to sense the failure of flashing LED beacon lamps. It will monitor the operation of one to eight beacons connected to a single flasher and/or auxiliary modules and the operation of the flasher. The FB9L output relay energizes when one or more lamps fail. All monitored lamps must be the same wattage and voltage. The 0.5A solid-state output energizes when a flasher failure is sensed.

**Operation**

When a LED beacon lamp fails, the FB9L senses a decrease in current flow. After a 10s lamp failure trip delay, the isolated SPDT (4-5-6) and non-isolated SPNO (3-1) relay contacts energize. These contacts are used to indicate a beacon failure has occurred. The “L” onboard LED indicator flashes green during the trip delay and glows red after the output relay energizes. Connected to a site monitoring system, it provides remote beacon monitoring required by FAA-AC No: 150/5345-43E.

The FB9L also monitors the operation of the flasher. If the flasher remains in the ON or OFF condition for more than 6s the solid-state output energizes and the “F” flasher failure onboard LED glows red. This output is normally used to energize an external flasher bypass relay. The contacts of the bypass relay are used to route voltage around the failed flasher and to indicate an alarm condition.

**Note:** In a single flasher, single beacon system, if the beacon lamp fails, zero current flow is detected. This will cause the flasher failure output to energize after 6s and then the beacon failure outputs after 10s. This is normal operation and can be expected anytime zero current is flowing through the monitored conductor.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self calibrating</td>
<td>Saves time at installation. No fine adjustment required.</td>
</tr>
<tr>
<td>Failsafe beacon monitoring</td>
<td>Alarm monitors for failed LED lamps in addition to flasher function</td>
</tr>
<tr>
<td>Number of beacons monitored is switch selectable for up to 8</td>
<td>User selection allows quick set up and easy adaption to multiple applications</td>
</tr>
<tr>
<td>Universal voltage 120 to 230VAC</td>
<td>Meets wide application requirements</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT alarm output contacts</td>
<td>Provides remote beacon monitoring when connected to a site monitoring system, which is required by the FAA</td>
</tr>
</tbody>
</table>

**Accessories**

- **C103PM (AL) DIN Rail**
  35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

- **P1023-20 DIN Rail Adapter**
  Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

---

FB9L

Universal Lamp Alarm Relay

Wiring Diagram

For dimensional drawing see: Appendix, page 513, Figure 31.
## Specifications

### Sensors

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration Range (total all Lamps)</td>
<td>150mA - 8.0A</td>
</tr>
<tr>
<td>Absolute Max Current (total all Lamps)</td>
<td>15A max. (may not calibrate above 8A)</td>
</tr>
<tr>
<td>Single Lamp Current</td>
<td>150mA - 8.0A (total all lamps ≤ 8.0A)</td>
</tr>
<tr>
<td>Trip Delay</td>
<td>Fixed at 6s; -0/+40%</td>
</tr>
<tr>
<td>Lamp Failure</td>
<td>Fixed at 10s; -0/+40%</td>
</tr>
</tbody>
</table>

### Input

- **Input Voltage/Tolerance**: 120 to 230VAC / ±15%
- **AC Line Frequency**: 50/60Hz

### Output

- **Line Voltage Output (SPNO)**: 5A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC, 1/2 hp @ 250VAC
- **Isolated Alarm Output (SPDT)**: 10A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC, 1/2 hp @ 250VAC
- **Solid-State Line Voltage Output (F)**: 0.5A steady; 5A inrush

### Mechanical

- **Mounting**: One #10 (M5 x 0.8) screw
- **Dimensions**: H 76.7 mm (3''); W 50.8 mm (2''); D 41.7 mm (1.64'')
- **Termination**: IP20 screw terminals for up to 14 AWG (2.45 mm²) wire or two 16 AWG (1.3 mm²) wires

### LEDs

- **Power/Timing/Lamp Failure (Bi-color)**: Glows red when one or more lamps fail
- **Flasher Failure (Red)**: Glows red when the flasher fails

### Protection

- **Circuitry**: Encapsulated

### Environmental

- **Operating/Storage Temperature**: -40° to 60°C / -40° to 85°C
- **Weight**: ≅ 3.9 oz (111 g)
- **FAA-AC No.**: 150/5345-43E

### Indicator Table

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Green</td>
</tr>
<tr>
<td>L</td>
<td>Green Flashing</td>
</tr>
<tr>
<td>L</td>
<td>Red</td>
</tr>
<tr>
<td>L</td>
<td>Red/Green Flashing</td>
</tr>
<tr>
<td>L</td>
<td>Red Flashing</td>
</tr>
<tr>
<td>F</td>
<td>Red</td>
</tr>
</tbody>
</table>

**Legend**:
- **L**: Lamp Failure
- **F**: Flasher Failure

**Legend for LED Indicators**:
- **Green**: Input ON & Calibrated
- **Red Flashing**: Trip Delay
- **Red**: Lamp Failure
- **Red/Green Flashing**: Calibrating
- **Red Flashing**: Not Calibrated
- **Red**: Flasher Failure
**Description**

The SCR9L is a universal lamp alarm relay designed to sense the failure of flashing or steady LED beacon lamps or obstruction lamps. The SCR9L energizes when one or more lamps fail. It will monitor the operation of one to eight beacon or obstruction lamps. All monitored lamps must be the same wattage and voltage. When connected to a site monitoring system, it provides the remote lamp monitoring protection required by the FAA-AC No: 150/5345-43E.

**Operation**

When a lamp fails, the SCR9L senses a decrease in current flow. After a 10s trip delay, the onboard LED glows and the two alarm outputs energize. The outputs and the LED are reset when the failed lamps are replaced and the unit is recalibrated. The SCR9L will sense an open flasher; it will not sense a continuously ON flasher (see FB Series). Removing input voltage de-energizes the output and the LED’s. It does not change the calibration.

**Features & Benefits**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self calibrating</td>
<td>Designed for use with all types of LED beacon and obstruction lamps</td>
</tr>
<tr>
<td>Failsafe beacon monitoring</td>
<td>Relay will also provide an alarm signal on a failed flasher (open)</td>
</tr>
<tr>
<td>Number of lamps monitored is switch selectable up to 8</td>
<td>User selection allows quick set up and easy adaption to multiple applications</td>
</tr>
<tr>
<td>Universal voltage 120 to 230VAC</td>
<td>Designed for use in most applications</td>
</tr>
<tr>
<td>Isolated, 10A, SPDT alarm output contacts</td>
<td>Provides remote beacon monitoring when connected to a site monitoring system, as is required by the FAA</td>
</tr>
<tr>
<td>LED indication</td>
<td>Provides visual relay status of operation, alarm, trip delay, and calibration</td>
</tr>
<tr>
<td>Fully encapsulated</td>
<td>Protects against shock, vibration, and humidity</td>
</tr>
</tbody>
</table>

**Accessories**

**C103PM (AL) DIN Rail**
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

**P1023-20 DIN Rail Adapter**
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.
**Calibration**

Alarm relays must be calibrated at initial installation and when LED lamps are replaced. Due to LED lamp aging, recalibration is recommended every 12 months.

1. Remove input voltage
2. Move calibration switch to off position
3. Re-apply input voltage
4. LED will flash red to indicate the unit is ready for calibration
5. Visually inspect structure’s lighting to make sure all lamps and flashers (if used) are operating properly
6. Remove input voltage
7. Adjust lamp selector switches for the correct number of lamps to be monitored (see adjustment diagram below)
8. Re-apply input voltage
9. LED should flash red
10. Move calibrate switch to ON position
11. The LED will alternate flashing red and green
12. LED will glow steady green within 30 secs. Calibration is complete

**Calibration Failed**

If the LED double blinks red, calibration failed. Remove input voltage and repeat steps 6-8.

**Notes:**

a. Monitoring a mixture of LED beacons and LED obstruction lamps is not possible with the SCR9L.

b. This alarm relay is not designed to monitor incandescent lamps.

c. Applying input voltage when the calibrate switch is in the OFF position, erases the previous calibration settings. The LED will flash Red. The output relays are OFF and the unit will not sense lamp failures.

d. Only one temperature compensated LED beacon can be monitored with this product. A combination of temperature compensated and standard LED beacons cannot be monitored.

**Adjustment Example**

Example Shown: SCR9L two lamps are ON during normal operation.

---

**Indicator Table**

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Input ON &amp; Calibrated</td>
</tr>
<tr>
<td>L</td>
<td>Green Flashing</td>
</tr>
<tr>
<td>L</td>
<td>Red</td>
</tr>
<tr>
<td>L</td>
<td>Red/Green Flashing</td>
</tr>
<tr>
<td>L</td>
<td>Red Flashing</td>
</tr>
</tbody>
</table>

**Specifications**

<table>
<thead>
<tr>
<th>Sensors</th>
<th>Calibration Range (total all Lamps)</th>
<th>150mA - 8.0A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Max Current (total all Lamps)</td>
<td>15A max. (may not calibrate above 8A)</td>
<td></td>
</tr>
<tr>
<td>Single Lamp Current</td>
<td>150mA - 8.0A (total all lamps &lt; 8.0A)</td>
<td></td>
</tr>
<tr>
<td>Time Delay</td>
<td>Factory fixed = 10s</td>
<td></td>
</tr>
<tr>
<td>Trip Delay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage/Tolerance</td>
<td>120 to 230VAC ±15%</td>
<td></td>
</tr>
<tr>
<td>AC Line Frequency</td>
<td>50/60Hz</td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line Voltage Output (SPNO)</td>
<td>5A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC</td>
<td></td>
</tr>
<tr>
<td>Isolated Alarm Output (SPDT)</td>
<td>10A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC ≤ 2A @ 230VAC</td>
<td></td>
</tr>
<tr>
<td>Auxilliary Input Voltage (H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>H 76.7 mm (3”); W 51.3 mm (2.02”); D 41.7 mm (1.64”)</td>
<td></td>
</tr>
<tr>
<td>Termination</td>
<td>IP20 screw terminals for up to 14 AWG (2.45 mm²) wire or two 16 AWG (1.3 mm²) wires</td>
<td></td>
</tr>
<tr>
<td>Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuitry</td>
<td>Encapsulated</td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating / Storage Temperature</td>
<td>-40° to 60°C / -40° to 85°C</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>≈ 3.9 oz (111 g)</td>
<td></td>
</tr>
</tbody>
</table>
Flashers and Tower Lighting Controls
Tower and Obstruction Lighting Controls

PCR SERIES

Photo Control

Description
The PCR Series of photo controls is a combination of precision electronic circuitry, electromechanical output, and unique molded plastic housing. Designed and built to meet the demands of the most rigorous requirement of tower and obstruction lighting control, each unit is factory calibrated to meet FAA and FCC specifications. Electronic circuit, output contactor, and terminal block are all contained within front plastic housing. Edge support molded into the bottom edge of housing allows easy wiring of new and existing installations. Available with or without cast aluminum junction box.

Operation
When the amount of light sensed falls below the actuation level for energization, the output relay energizes. Conversely, when the amount rises above the actuation level for de-energization, the output relay de-energizes.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS plastic housing with gasket seal</td>
<td>Withstands outdoor environmental hazards and protects circuitry from moisture damage</td>
</tr>
<tr>
<td>Two 20A relay contacts</td>
<td>Allows direct control of a lighting circuit without a separate contactor</td>
</tr>
<tr>
<td>Fixed time delay</td>
<td>Eliminates contact chatter</td>
</tr>
<tr>
<td>Reliable photo sensor</td>
<td>Provides automatic lighting circuit operation from dusk to dawn</td>
</tr>
</tbody>
</table>

Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>INPUT</th>
<th>DESCRIPTION</th>
<th>REPLACES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCR10</td>
<td>120VAC</td>
<td>Photo Control without aluminum box</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hughey &amp; Phillips</td>
</tr>
<tr>
<td>PCR11</td>
<td>120VAC</td>
<td>Photo Control without aluminum box</td>
<td>PC800 120V</td>
</tr>
<tr>
<td>PCR12</td>
<td>230VAC</td>
<td>Photo Control with aluminum box</td>
<td>n/a</td>
</tr>
<tr>
<td>PCR13</td>
<td>230VAC</td>
<td>Photo Control with aluminum box</td>
<td>PC800 240V</td>
</tr>
</tbody>
</table>

If you don’t find the part you need, call us for a custom product 800-843-8848

For dimensional drawing see: Appendix, page 514, Figure 45.
## Specifications

**Indication**  
LED indicates power is applied

**Light Actuation Levels (Factory Calibrated)**  
Energized: ≤ 35 fc  
De-energized: ≥ 60 fc

**Voltage**  
120VAC or 230VAC

**AC Line Frequency**  
50/60Hz

**Tolerance**  
120 & 230VAC: -20% to 10%

**Output Rating**  
Two SPST NO 20A contacts  
1 hp @ 120VAC  
2.5 hp @ 240VAC

**Termination**  
Screw terminals for up to #8 (M4 x 0.7) AWG wire

**Dimensions**  

<table>
<thead>
<tr>
<th>H</th>
<th>159.51 mm (6.28”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>127 mm (5.0”)</td>
</tr>
<tr>
<td>D</td>
<td>131.75 mm (5.19”)</td>
</tr>
</tbody>
</table>

**Mounting**  
ABS plastic housing with gasket seal. Multiple knockout holes for optional mounting to Crouse Hinds or Hughey & Phillips cast aluminum electrical boxes.

**Operating/Storage Temperature**  
-40° to 60°C / -55° to 85°C
ACCESSORIES

Software................................................................................................................. 484
Electrical.................................................................................................................. 485
Ground Reference Modules, High-Tension Couplers, & Relay Testers.................. 488
Remote Indication................................................................................................. 489
Communication Adapters & Modules................................................................. 492
Terminations & Adapters...................................................................................... 493
Liquid Level Control............................................................................................. 495

Current Transformers (CTs)
CT Selection Guide............................................................................................... 495
Current Transformers............................................................................................ 496
Instrumentation & Metering Transformers.......................................................... 497
Current Transformer Sizing Chart...................................................................... 498
ELCT Series.......................................................................................................... 499
ZSCT Series.......................................................................................................... 501

Mounting Adapters and Enclosures
Panel-Mount Adapters......................................................................................... 503
DIN Rail & Mounting Adapters.......................................................................... 505
Brackets & Clips.................................................................................................... 506
Enclosures & Watertight Covers......................................................................... 507
Sockets.................................................................................................................... 508

For More Information… on Retrofits, Panel Mount Adapters and more accessories, visit Littelfuse.com/relayaccessories
Protection Relays and Alarm Systems are supplied with free software. The software simplifies programming and allows the user to save setpoint files and reuse them for similar applications. The software gives the ability to change parameters and see the impact on the protection time current curves. It also allows another device curve to be entered to view simple coordination.

<table>
<thead>
<tr>
<th>SOFTWARE</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solutions-M</strong></td>
<td>Provides the ability to configure and monitor Modbus networks. The features include data logging, real-time data monitoring and fault and event monitoring. Devices can be added and configured manually or the software can scan an existing network to identify devices which can be used as is or reconfigured by the user. Setpoints for each device can be uploaded and downloaded for easy monitoring and reconfiguration.</td>
<td>RS485 TCP/IP networks MotorSaver and PumpSaver Devices</td>
</tr>
<tr>
<td><strong>SE-COMM-RIS</strong></td>
<td>Provides remote access to metering, control, data logging, and programming features. Setpoints can be accessed individually, downloaded as a file, and protective curves can be plotted. Metered data can be observed or logged for later study.</td>
<td>FPU-32 MPS FPS MPU-32 EL731</td>
</tr>
<tr>
<td><strong>SE-FLASH</strong></td>
<td>Used to update relay firmware to add new features.</td>
<td>FPU-32 MPS FPS MPU-32 EL731</td>
</tr>
<tr>
<td><strong>SE-MON330</strong></td>
<td>Used to receive data from the SE-330. It displays relay set points and measured values, and features data logging of information at a selectable interval.</td>
<td>SE-330 SE-330HV SE-330AU</td>
</tr>
<tr>
<td><strong>VMPU</strong></td>
<td>Allows the user to scroll through the MPU-32 Motor Protection Relay menu.</td>
<td>MPU-32</td>
</tr>
<tr>
<td><strong>VMPS</strong></td>
<td>Allows the user to scroll through the MPS Motor Protection System menu.</td>
<td>MPS</td>
</tr>
<tr>
<td><strong>VFPU</strong></td>
<td>Allows the user to scroll through the FPU-32 Feeder Protection Relay menu.</td>
<td>FPU-32</td>
</tr>
<tr>
<td><strong>MPU-32 Tutorial</strong></td>
<td>Online Self-Training tutorial for MPU-32 programming.</td>
<td>MPU-32</td>
</tr>
</tbody>
</table>
## ELECTRICAL ACCESSORIES

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PGA-1100.0010</strong> Diode Logic Unit</td>
<td>Used in installations with more than one breaker and more than one Littelfuse Arc-Flash Relay. It separates the trip paths, so the breakers can be tripped independently from each other. For full datasheet, see pg. 81</td>
<td>PGR-8800 AF0500 AF0100 D0920 D1000</td>
</tr>
<tr>
<td><strong>P1004-XX-(X) Versa-Pot</strong></td>
<td>Panel mountable, industrial potentiometer recommended for remote time delay adjustment. The shaft is slotted for screwdriver adjustment and serrated for slip-proof finger adjustment. Accepts Versa-Knob or Lock Shaft. May be ordered with two 8 in (20.3 cm) wires soldered to pot (clockwise increase) and female quick connect terminals on other ends by adding suffix -X to end of part number.</td>
<td>P1004-95 &amp; P1004-95-X: Consult individual datasheet for compatibility P1004-174 &amp; P1004-175: PHS Series P1004-16 &amp; P1004-16-X: Series: ERDM ERDI ERD3 TRB TRM TRS TS1 TS6</td>
</tr>
<tr>
<td><strong>P0700-7 Versa-Knob</strong></td>
<td>Versa-Knob is designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.</td>
<td>P1004-XX-(X)</td>
</tr>
<tr>
<td><strong>P0700-8 Lock Shaft</strong></td>
<td>Fits 0.25 in (6.35 mm) potentiometer shafts. Locks by tightening nut onto four tapered/slotted fingers. Pressure on the shaft locks control against mis-adjustment. Nickel plated brass finish.</td>
<td>P1004-XX-(X)</td>
</tr>
<tr>
<td><strong>P1004-9, P1004-10, P1004-31 Mini-Pot</strong></td>
<td>A high quality, industrial potentiometer for remote time delay adjustment. The shaft extends through the timer's center hole for easy panel mounting. Use mini-mount bracket for standup mounting of timer. Adjustment by screwdriver or mini-knob. May be ordered with two 3 in (7.6 cm) wires soldered to pot (clockwise increase) and female quick connect terminals on other ends by adding suffix -X to end of part number.</td>
<td>Series: TAC1 TS1 TS2 TS4 TS6 TSD7 TSU2000</td>
</tr>
<tr>
<td><strong>P0700-21 Mini-Knob</strong></td>
<td>Mini-Knob is designed for 0.125 in (3.2 mm) shaft of Mini-Pot. Semi-gloss industrial black finish.</td>
<td>P1004-9 P1004-10 P1004-31</td>
</tr>
</tbody>
</table>
# Electrical Accessories

## P0200-19
Heat Sink Compound
- 2 grams
- Single package/container of heat sink compound consisting of primarily zinc oxide and having a 12 month shelf life (EOD date on the label).
- P0200-19 mounts one high current, plated 2 x 2 in (50.8 x 50.8 mm) timer or flasher. P0200-20 mounts 50+ units.
- Accessory for: Any 2 x 2 in (50.8 x 50.8 mm) plated timer or flasher.

## P0200-20
Heat Sink Compound
- 100 grams
- Screw adaptor terminal designed for use with all modules with 0.25 in (6.35 mm) male quick connect terminals. Screw terminal accepts ring or spade terminals.
- Accessory for: Modules with 0.25 in (6.35 mm) male quick connect terminals. Consult the individual datasheet to determine compatibility.

## P1015-18
Quick Connect Screw Adaptor
- Female Quick Connect Terminals
- These 0.25 in (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.
- Accessory for: Consult individual datasheet to determine compatibility.

## P0400
Time Adjustment Dials

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>RANGE</th>
<th>INCREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0400-12</td>
<td>0.05 - 1 s</td>
<td>0.1 s</td>
</tr>
<tr>
<td>P0400-86</td>
<td>0.1 - 10 m</td>
<td>1 m</td>
</tr>
<tr>
<td>P0400-82</td>
<td>0.1 - 10 s</td>
<td>1 s</td>
</tr>
<tr>
<td>P0400-17</td>
<td>1 - 30 s</td>
<td>5 s</td>
</tr>
<tr>
<td>P0400-83</td>
<td>1 - 60 s</td>
<td>10 s</td>
</tr>
<tr>
<td>P0400-27</td>
<td>0 - 10</td>
<td>MRD*</td>
</tr>
</tbody>
</table>

*Multiplier Reference Dial

## VTPXX
VTP
- Dials for use with remote Versa-Pot and panel mounted Mini-Pot. Reverse screen printed on clear plastic to avoid damage to printed image.
- Accessory for: P1004-9 P1004-10 P1004-12 P1004-13 P1004-16 P1004-31 P1004-95

## VTP Series
- The VTP Series mounts on modules with in-line adjustment terminals. Rated at 0.25 W at 55 °C.
- Available in resistance values from 5 kΩ to 5 MΩ.

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>R1 VALUE</th>
<th>RANGE</th>
<th>PART NUMBER</th>
<th>R1 VALUE</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VTP0E</td>
<td>250 kΩ</td>
<td>0.5–20s</td>
<td>VTP3L</td>
<td>2 MΩ</td>
<td>0.1–4 m</td>
</tr>
<tr>
<td>VTP1B</td>
<td>0.5 MΩ</td>
<td>0.05–3s</td>
<td>VTP4B</td>
<td>3 MΩ</td>
<td>0.05–3 s</td>
</tr>
<tr>
<td>VTP1C</td>
<td>0.5 MΩ</td>
<td>0.1–10s</td>
<td>VTP4F</td>
<td>3 MΩ</td>
<td>0.5–60 s</td>
</tr>
<tr>
<td>VTP1D</td>
<td>0.5 MΩ</td>
<td>0.5–10s</td>
<td>VTP4J</td>
<td>3 MΩ</td>
<td>2–180 s</td>
</tr>
<tr>
<td>VTP2A</td>
<td>1 MΩ</td>
<td>0.05–1s</td>
<td>VTP4P</td>
<td>3 MΩ</td>
<td>1–100 m</td>
</tr>
<tr>
<td>VTP2C</td>
<td>1 MΩ</td>
<td>0.1–10s</td>
<td>VTP5G</td>
<td>5 MΩ</td>
<td>1–100 s</td>
</tr>
<tr>
<td>VTP2E</td>
<td>1 MΩ</td>
<td>0.5–20s</td>
<td>VTP5K</td>
<td>5 MΩ</td>
<td>10–1000 s</td>
</tr>
<tr>
<td>VTP2F</td>
<td>1 MΩ</td>
<td>0.5–60s</td>
<td>VTP5N</td>
<td>5 MΩ</td>
<td>0.1–10 m</td>
</tr>
<tr>
<td>VTP2J</td>
<td>1 MΩ</td>
<td>2–180s</td>
<td>VTP5P</td>
<td>5 MΩ</td>
<td>1–100 m</td>
</tr>
<tr>
<td>VTP2P</td>
<td>1 MΩ</td>
<td>1–100m</td>
<td>VTPDF</td>
<td>50 kΩ</td>
<td>0.5–60 s</td>
</tr>
<tr>
<td>VTP3B</td>
<td>2 MΩ</td>
<td>0.05–3s</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ELECTRICAL ACCESSORIES

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPSM003ZXID</td>
<td>Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 V ac/dc</td>
<td>Class CC and Midget-Style fuses</td>
</tr>
<tr>
<td>LPSM003Z</td>
<td>10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 V ac/500 V dc</td>
<td>FH3P LPSM003ZXID LPSM003Z</td>
</tr>
<tr>
<td>OKLK002.T</td>
<td>The VRM6048 accessory module allows the voltage monitor to monitor a 3-phase 550 to 600 V ac Line.</td>
<td></td>
</tr>
<tr>
<td>VRM6048</td>
<td>Voltage Monitor Accessory Module</td>
<td></td>
</tr>
<tr>
<td>V150LA10AP</td>
<td>The V150LA10AP, a transient voltage surge suppressor, is a radial leaded varistors (MOV) that is designed to be operated continuously across ac power lines. This UL Recognized varistor requires very little mounting space.</td>
<td>Any of our products that operate below 150 V ac or 200 V dc.</td>
</tr>
</tbody>
</table>

#### Voltage Monitor Accessory Module

- **Package:** Molded housing with encapsulated circuitry
- **Mounting:** Surface mount with one #10 (M5 x 0.8) plastic screw. May be DIN-rail mounted using P1023-20 Adaptor.
- **Termination:** Screw terminals with captive wire clamps for up to No.12 AWG wire.
- **Operating Temperature:** -40 °C to 70 °C
- **Storage Temperature:** -40 °C to 85 °C
- **Humidity:** 95 % relative, non-condensing
- **Voltage Input:** 600 V ac, 575 V ac, 550 V ac
- **Voltage Output:** 480 V ac, 460 V ac, 440 V ac

*The VRM6048 must be connected as shown. If the voltage monitor is disconnected, the VRM output voltage equals the input voltage.*

#### Series:
- PLM
- PLR
- PLS
- TVM
- TVW

(Manufactured after December 2003)

### Product

#### LA Varistor

- **Max. Operating Voltage:**
  - AC (V): 150
  - DC (V): 200
- **Max. Impulse Current:**
  - 80.20 μs: 4500 A
- **Varistor Voltage at 1MA DC Test Current:**
  - Min. (V): 216
  - Max. (V): 264
- **Peak Clamping Voltage with 80.20 μs Wave:**
  - 395 V
- **Capacitance:** 50 pF
- **Disc Diameter Size:** 800 mm, 14 mm
### GROUND-REFERENCE MODULES

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-GRM024</td>
<td>Ground Reference Module Connects the SE-601 relay to an ungrounded 24 V dc bus.</td>
<td>SE-601</td>
</tr>
<tr>
<td>SE-GRM048</td>
<td>Ground Reference Module Connects the SE-601 relay to an ungrounded 48 V dc bus.</td>
<td>SE-601</td>
</tr>
<tr>
<td>SE-GRM125</td>
<td>Ground Reference Module Connects the SE-601 relay to an ungrounded 125 V dc bus.</td>
<td>SE-601</td>
</tr>
<tr>
<td>SE-GRM250</td>
<td>Ground Reference Module Connects the SE-601 relay to an ungrounded 250 V dc bus.</td>
<td>SE-601</td>
</tr>
<tr>
<td>SE-GRM500</td>
<td>Ground Reference Module Connects the SE-601 relay to an ungrounded 500 V dc bus.</td>
<td>SE-601</td>
</tr>
<tr>
<td>SE-GRM780</td>
<td>Ground Reference Module Connects the SE-601 relay to an ungrounded 780 V dc bus.</td>
<td>SE-601</td>
</tr>
<tr>
<td>SE-GRM1000</td>
<td>Ground Reference Module Connects the SE-601 relay to an ungrounded 1000 V dc bus.</td>
<td>SE-601</td>
</tr>
</tbody>
</table>

### HIGH-TENSION COUPLERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGH-5000</td>
<td>High Tension Couplers Allows 5 kV systems to be connected to relay.</td>
<td>PGR-6100, PGR-3200</td>
</tr>
<tr>
<td>PGH-6000</td>
<td>High Tension Couplers Allows 6 kV systems to be connected to relay.</td>
<td>PGR-6100, PGR-3200</td>
</tr>
</tbody>
</table>

### PROTECTION RELAY TESTERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-100T</td>
<td>Ground-Fault Relay Tester Tests the current pickup level ground-fault protection. Tests the entire ground-fault circuit.</td>
<td>Any Relay on Substations, MCCs, Central Distribution Panels, Switchboards, and Test Benches</td>
</tr>
<tr>
<td>SE-400</td>
<td>Ground-Fault-Relay Test Unit Tests the current pickup level, time delay and coordination of ground-fault protection. Tests the entire ground-fault circuit.</td>
<td>Any Relay on Substations, MCCs, Central Distribution Panels, Switchboards, and Test Benches</td>
</tr>
</tbody>
</table>
## INPUT MODULES & METERS

### INPUT MODULES

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPS-RTD</td>
<td>Provides 8 programmable inputs to connect Pt100, Ni100, Ni120, and Cu10 RTDs.</td>
<td>MPU-32 MPS</td>
</tr>
<tr>
<td>MPS-DIF</td>
<td>Adds motor differential protection, compatible with core balance and summation current transformer connections.</td>
<td>MPU-32 MPS</td>
</tr>
<tr>
<td>MPU-CIM</td>
<td>Interface between current transformers and MPU-32 or FPU-32 series relays. Reduces potential for open CT hazard.</td>
<td>MPU-32 FPU-32</td>
</tr>
<tr>
<td>PGA-LS10</td>
<td>Line-of-sight light sensor detects an arc as small as 3 kA within a 2 m half-sphere. Local LED continually displays sensor health or trip state.</td>
<td>PGR-8800 AF0500 AF0100</td>
</tr>
<tr>
<td>PGA-LS20</td>
<td>Used to detect light and coordinate with current detection to eliminate nuisance tripping. 8 m (26.2 ft) active; 10 m (32.8 ft) total.</td>
<td>PGR-8800 AF0500 AF0100</td>
</tr>
<tr>
<td>PGA-LS30</td>
<td>Used to detect light and coordinate with current detection to eliminate nuisance tripping. 18 m (59 ft) active; 20 m (66 ft) total</td>
<td>PGR-8800 AF0500 AF0100</td>
</tr>
<tr>
<td>A0200/A0300</td>
<td>Line-of-sight light sensor detects an arc as small as 3 kA within a 2 m half-sphere. Available in both 180° and 360°.</td>
<td>D0920</td>
</tr>
<tr>
<td>A0220</td>
<td>Line-of-sight light sensor detects an arc as small as 3 kA within a 2 m half-sphere. Available with 10 or 15 m cable. <em>For full datasheet and ordering information, see pg. 80</em></td>
<td>PGR-8800 AF0500 AF0100 D0920 D1000</td>
</tr>
<tr>
<td>LCSC10T12</td>
<td>Remote monitoring of currents up to 50 A. Inner diameter 9.14 mm (0.36”).</td>
<td>DCSA Series</td>
</tr>
</tbody>
</table>

### REMOTE INDICATION & METERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>RK-105</td>
<td>Panel-mounted remote indication and reset with NEMA 1 rating.</td>
<td>SE-105 SE-107</td>
</tr>
<tr>
<td>RK-105I</td>
<td>Panel-mounted remote indication with NEMA 1 rating.</td>
<td>SE-105 SE-107</td>
</tr>
<tr>
<td>RK-102</td>
<td>Panel-mounted remote indication and reset, standard 22 mm mounting, with NEMA 4 and NEMA 13 rating.</td>
<td>SE-105 SE-107</td>
</tr>
<tr>
<td>RK-132</td>
<td>Panel-mounted remote indication and reset, standard 22 mm mounting, with NEMA 4 and NEMA 13 rating.</td>
<td>SE-134C SE-135 SE-145</td>
</tr>
<tr>
<td>RK-325</td>
<td>Panel-mounted remote indication and reset with NEMA 1 rating.</td>
<td>SE-325</td>
</tr>
</tbody>
</table>
### REMOTE INDICATION & METERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>RK-325I Remote Indication Assembly</td>
<td>Panel-mounted remote indication with NEMA 1 rating.</td>
<td>SE-325</td>
</tr>
<tr>
<td>RK-302 Remote Indication and Reset Kit</td>
<td>Panel-mounted remote indication and reset, standard 22 mm mounting with NEMA 4 and NEMA 13 rating.</td>
<td>SE-325</td>
</tr>
<tr>
<td>RK-332 Remote Indication and Reset Kit</td>
<td>Panel-mounted remote indication and reset, standard 22 mm mounting with NEMA 4 and NEMA 13 rating.</td>
<td>SE-330 SE-330AU</td>
</tr>
<tr>
<td>PGA-0500 Analog % Current Meter</td>
<td>Panel-mounted analog meter displays ground-fault current as a percentage of the set point.</td>
<td>SE-601 SE-701 SE-703 PGR-4300 PGR-6100</td>
</tr>
<tr>
<td>PGA-0510 Analog Ohm Meter</td>
<td>Panel-mounted analog ohmmeter displays insulation resistance from 0 Ω to infinity.</td>
<td>PGR-3200 PGR-6100 PGR-6101-120</td>
</tr>
</tbody>
</table>

### SENSING RESISTORS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER-600VC (PGE-600V) Sensing Resistor</td>
<td>Used on systems up to 1 kV. (Continuous duty)</td>
<td>SE-330 SE-330AU SE-325</td>
</tr>
<tr>
<td>SE-MRE-600 Enclosure</td>
<td>Used in outdoor enclosures. (ER-600 VC ordered separately)</td>
<td>ER-600VC</td>
</tr>
<tr>
<td>ER-5KV (PGE-05KV) Sensing Resistor</td>
<td>Used on systems up to 5 kV. (Continuous duty)</td>
<td>SE-330 SE-330AU SE-325</td>
</tr>
<tr>
<td>ER-5WP (PGE-05WV) Sensing Resistor</td>
<td>Used on systems up to 5 kV, includes weather-protected terminals for use in outdoor enclosures. (Continuous duty)</td>
<td>SE-330 SE-330AU SE-325</td>
</tr>
<tr>
<td>ER-15KV (PGE-15KV) Sensing Resistor</td>
<td>Used on systems up to 15 kV. (Non-continuous duty)</td>
<td>SE-330 SE-330AU SE-325 SE-330HV</td>
</tr>
<tr>
<td>ER-25KV (PGE-25KV) Sensing Resistor</td>
<td>Used on systems up to 25 kV. (Non-continuous duty)</td>
<td>SE-330 SE-330AU SE-325 SE-330HV</td>
</tr>
<tr>
<td>ER-35KV (PGE-35KV) Sensing Resistor</td>
<td>Used on systems up to 35 kV. (Non-continuous duty)</td>
<td>SE-330 SE-330AU SE-330HV</td>
</tr>
<tr>
<td>ER-72KV (PGE-72KV) Sensing Resistor</td>
<td>Used on systems up to 72 kV. (Non-continuous duty)</td>
<td>SE-330HV</td>
</tr>
</tbody>
</table>
# REMOTE INDICATION & MONITORING

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM1000</td>
<td>Motor-monitoring device to be used in conjunction with the 777 family of products (excluding the P1 Series), 77C family of products, and the 601 voltage monitors, via Modbus protocol with a communications module. The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring.</td>
<td>777 series, 77C series, 601 series</td>
<td>RM1000-3R RM1000 NEMA 4</td>
</tr>
<tr>
<td>RM2000</td>
<td>Motor-monitoring device to be used in conjunction with the 777 family of products (excluding the P1 Series), 77C family of products and the Model 601 voltage monitors, via Modbus protocol with a communications module. The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring.</td>
<td>777 series, 77C series, 601 series</td>
<td>RM2000 RM2000CBM+ RM2000-RTDW</td>
</tr>
<tr>
<td>INFORMER</td>
<td>Hand-held diagnostic tool designed for use with single-phase pump relays. The Informer uses an infrared receiver to access information sent from the relay which can be helpful for troubleshooting the system. Comes with IR Kit-12 (12” long).</td>
<td>111P 111P-ENCL 231-Insider-P 232-Insider 233P-1.5 233P-1.5-ENCL 234-P 235P 235P-ENCL</td>
<td>INFORMER</td>
</tr>
<tr>
<td>IR Kit-36 (36” long)</td>
<td>Use with the Informer. Simply attaches to the face of the unit to provide remote diagnostics without opening the panel.</td>
<td>111-Insider-P 231-Insider-P</td>
<td>IR Kit-36</td>
</tr>
<tr>
<td>INFORMER-MS</td>
<td>Hand-held diagnostic tool designed for use with the Littelfuse 455 series. The Informer-MS uses an infrared receiver to read valuable information transmitted from the 455, which can be helpful for troubleshooting the system.</td>
<td>455 series</td>
<td>INFORMER-MS</td>
</tr>
<tr>
<td>OL-RESET</td>
<td>Allows the 777 line of motor and pump relay products to be manually reset without opening the panel door. Simply connect the module to the 777 communication port, connect a wire to each of the two applicable pins on the OL-RESET and to a normally-open push-button switch (sold separately). Mount the push-button switch in a convenient location.</td>
<td>777 series</td>
<td>OL-RESET</td>
</tr>
<tr>
<td>777-MRSW</td>
<td>Allows the 777 line of motor and pump relay products to be manually reset without opening the panel door. Simply connect the 9-pin adapter to the 777 communication port and mount the push-button switch in a convenient location.</td>
<td>777 series</td>
<td>777-MRSW</td>
</tr>
<tr>
<td>M500</td>
<td>Automatic, portable, battery-powered insulation tester. This unit is specifically designed as an inexpensive alternative to costly swing needle megohmmeters. The M500 measures insulation resistance values of motors, generators and transformers up to 1000 megohms at 500 V ac, indicating the condition of insulation on the zone scale. Its compact design and ease of use makes the M500 a great diagnostic tool for motor rewind shops, electrical maintenance personnel and pump installers.</td>
<td></td>
<td>M500</td>
</tr>
</tbody>
</table>
## COMMUNICATION ADAPTERS & MODULES

### COMMUNICATION ADAPTERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS485-RS232</td>
<td>Allows RS485 devices to be connected to a PC via the RS232 (serial) port. The converter provides convenient terminal blocks for making signal and dc power supply connections. An optional power supply may be required for laptops or other computers with low power serial ports, or for very large networks. Pre-wired for easy installation on the RS485MS-2W module.</td>
<td>RS485MS-2W</td>
</tr>
<tr>
<td>RS485-USB</td>
<td>Allows RS485 devices to be connected to a PC via the USB port. The converter provides convenient terminal blocks for making signal and dc power supply connections. An optional power supply may be required for laptops or other computers with low power serial ports, or for very large networks. Pre-wired for easy installation on the RS485MS-2W module.</td>
<td>RS485MS-2W</td>
</tr>
<tr>
<td>AC700-CUA</td>
<td>Optical network-interface and firmware-upgrade communication adapter. Field-installed.</td>
<td>EL731</td>
</tr>
</tbody>
</table>

### COMMUNICATION MODULES

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS485MS-2W</td>
<td>This module is required when the RM1000, RM2000 or other Modbus capable device is used with 77X-type products. For full datasheet, see pg. 254</td>
<td>RM1000 77X</td>
</tr>
<tr>
<td>CIO-DN-P CIO-120-DN-P</td>
<td>Convenient and cost-effective Devicenet™ interfaces capable of providing discrete control and monitoring of motor starters, drives and other devices over a Devicenet network. For full datasheet, see pg. 257</td>
<td>777 series</td>
</tr>
<tr>
<td>CIO-EN</td>
<td>The CIO-EN Module (non-POE) is a convenient and cost-effective Modbus-TCP and Modbus-RTU interface capable of providing discrete control and monitoring of an overload relay over a Modbus network. For full datasheet, see pg. 260</td>
<td>777 series</td>
</tr>
<tr>
<td>CIO-MB CIO-120-MB</td>
<td>Convenient and cost-effective Modbus-RTU interfaces capable of providing discrete control and monitoring of an overload relay over a Modbus network. For full datasheet, see pg. 255</td>
<td>777 series</td>
</tr>
<tr>
<td>CIO-777-PR</td>
<td>Convenient and cost-effective Profibus interface capable of providing discrete control and monitoring of motor starters, drives and other devices over a Profibus network. For full datasheet, see pg. 259</td>
<td>777 series ending in P, -P, or -P2</td>
</tr>
<tr>
<td>CIO-601CS-DN-P1</td>
<td>Convenient and cost-effective DeviceNet device capable of providing discrete control and monitoring of motor starters, drives and other devices over a DeviceNet network.</td>
<td>601-CS-D-P1</td>
</tr>
<tr>
<td>COM 4-20</td>
<td>Send a 4-20 mA signal proportional to the output power. It can also be used to send the input power by setting the efficiency setting on the 777-AccuPower monitor to one. This module allows communication to a PLC with an analog input and no Modbus input. For full datasheet, see pg. 261</td>
<td>777-AccuPower</td>
</tr>
<tr>
<td>TERMINATIONS &amp; ADAPTERS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Product</strong></td>
<td><strong>Features</strong></td>
<td><strong>Accessory For</strong></td>
</tr>
<tr>
<td>1N5339B Termination Device</td>
<td>5 W axial-lead ground-check termination. Included with SE-105 and SE-107.</td>
<td>SE-105 SE-107</td>
</tr>
<tr>
<td>SE-TA6-SM Stud-Mount Termination Assembly</td>
<td>50 W ground-check termination that is robust and compact for submersible pumps. Wire lead simplifies installation. (Replacement for 1N4553B)</td>
<td>SE-105 SE-107</td>
</tr>
<tr>
<td>SE-TA6 Termination Assembly</td>
<td>50 W ground-check termination with convenient mounting holes and screw terminals.</td>
<td>SE-105 SE-107</td>
</tr>
<tr>
<td>SE-TA6A (PGA-0T6A) Termination Assembly</td>
<td>Temperature compensated 50 W ground-check termination with convenient mounting holes and screw terminals.</td>
<td>SE-105 SE-107 SE-134C</td>
</tr>
<tr>
<td>SE-TA6A-WL Termination Assembly</td>
<td>Temperature compensated 50 W ground-check termination with convenient mounting holes and screw terminals.</td>
<td>SE-105 SE-107 SE-134C</td>
</tr>
<tr>
<td>SE-TA12A Termination Assembly</td>
<td>Temperature compensated 50 W ground-check termination with convenient mounting holes and screw terminals.</td>
<td>SE-135 SE-145</td>
</tr>
<tr>
<td>SE-TA12A-WL Termination Assembly</td>
<td>Temperature compensated 50 W ground-check termination with convenient mounting holes and screw terminals.</td>
<td>SE-135 SE-145</td>
</tr>
<tr>
<td>SE-TA12A SE-TA12B Termination Assemblies</td>
<td>Used together to allow an SE-134C to monitor a splitter box and two cables.</td>
<td>SE-134C</td>
</tr>
<tr>
<td>PPI-600V Parallel Path Isolator</td>
<td>Parallel ground-path rejection for ground-check monitors. Eliminates intermachine arcing and prevents stray dc currents from flowing in a monitored ground wire.</td>
<td>SE-105 SE-134C SE-135</td>
</tr>
<tr>
<td>RK-13 Relay Interface Module</td>
<td>Separate ground-fault and ground-check indication contacts for the SE-105, and separate ground-fault and resistor-fault contacts for the SE-325. Used to provide output to a PLC and operate standard pilot lights. Complete with conformally coated circuit boards.</td>
<td>SE-105 SE-107 SE-325</td>
</tr>
<tr>
<td>SE-485-PP Port-Powered Serial Converter</td>
<td>Converts an RS-485 signal to an RS-232 signal. Used for set-point programming and updating flash memory. 115.2 kbit/s maximum transfer rate.</td>
<td>MPU-32 FPS</td>
</tr>
<tr>
<td>CA-945 Serial Connector Adapter Kit</td>
<td>Connects an RJ45 to a 9-pin serial connector. Includes 1.5 m cable and plug-in adapter.</td>
<td>MPU-32</td>
</tr>
</tbody>
</table>
### LIQUID LEVEL PROBES & PROBE HOLDERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LLP-24</strong>&lt;br&gt;Liquid Level Probe</td>
<td>Threaded stainless steel probe measuring 24 in (61 cm) long. Designed for use with PHST-38QTN liquid level control electrodes.</td>
<td>PHST-38QTN</td>
</tr>
<tr>
<td><strong>PHST-38QTN</strong>&lt;br&gt;Probe Holder</td>
<td>Designed for use with all conductive liquid level controls. Composed of insulators and metal parts made of number 300 series stainless steel. These internally conductive probe holders are designed for a maximum steam pressure of 240 PSI; 400 °F maximum. Maximum voltage from electrode to ground. PHST-38QTN is UL 353 Recognized.</td>
<td>Series: LLC1 LLC2 LLC4 LLC5 LLC6 LLC8 PC-XXX-LLC-CZ PC-XXX-LLC-GM 460-15-100-LLS</td>
</tr>
<tr>
<td>PRODUCT</td>
<td>GROUND-FAULT CT</td>
<td>GROUND-FAULT TRIP LEVEL (or insulation level)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>SE-601</td>
<td>No CTs required</td>
<td>1–20 mA</td>
</tr>
<tr>
<td>PGR-3100</td>
<td>No CTs required</td>
<td>Indication only</td>
</tr>
<tr>
<td>PGR-3200</td>
<td>No CTs required</td>
<td>Warnings at 30 kΩ &amp; 50 kΩ Alarm at 10 kΩ</td>
</tr>
<tr>
<td>SE-701/SE-703</td>
<td>CT200 series</td>
<td>10–198 A</td>
</tr>
<tr>
<td></td>
<td>EFCT series</td>
<td>50 mA–4.95 A</td>
</tr>
<tr>
<td></td>
<td>SE-CS30 series</td>
<td>300 mA–29.7 A</td>
</tr>
<tr>
<td>SE-704</td>
<td>SE-CS30 series</td>
<td>10 mA–5 A</td>
</tr>
<tr>
<td>EL731</td>
<td>EFCT series</td>
<td>30–5,000 mA ac and dc</td>
</tr>
<tr>
<td>SE-105/SE-107</td>
<td>CT200 series</td>
<td>0.5–4 A</td>
</tr>
<tr>
<td>SE-134C/SE-135</td>
<td>SE-CS10 series</td>
<td>0.5–12.5 A</td>
</tr>
<tr>
<td>SE-330</td>
<td>CT200 series</td>
<td>12–200 A</td>
</tr>
<tr>
<td></td>
<td>EFCT series</td>
<td>100 mA–5 A</td>
</tr>
<tr>
<td></td>
<td>SE-CS30 series</td>
<td>600 mA–30 A</td>
</tr>
<tr>
<td>SE-325</td>
<td>CT200 series</td>
<td>0.5–4 A</td>
</tr>
<tr>
<td>MPU-32*</td>
<td>CT200 series</td>
<td>10–200 A</td>
</tr>
<tr>
<td></td>
<td>EFCT series</td>
<td>50 mA–5 A</td>
</tr>
<tr>
<td></td>
<td>SE-CS30 series</td>
<td>300 mA–30 A</td>
</tr>
<tr>
<td>MPS*</td>
<td>CT200</td>
<td>10–200 A</td>
</tr>
<tr>
<td></td>
<td>EFCT series (5-A Primary)</td>
<td>50 mA–5 A</td>
</tr>
<tr>
<td></td>
<td>SE-CS30 series (30-A Primary)</td>
<td>300 mA–30 A</td>
</tr>
<tr>
<td>MPU-32-X69X-PMA16</td>
<td>Existing CTs can be used or same as MPU-32</td>
<td></td>
</tr>
<tr>
<td>MPS-469X-PMA24</td>
<td>Existing CTs can be used or same as MPS.</td>
<td></td>
</tr>
<tr>
<td>FPU-32*</td>
<td>CT200 series</td>
<td>10–200 A</td>
</tr>
<tr>
<td></td>
<td>EFCT series</td>
<td>50 mA–5 A</td>
</tr>
<tr>
<td></td>
<td>SE-CS30 series</td>
<td>300 mA–30 A</td>
</tr>
<tr>
<td>FPS*</td>
<td>CT200</td>
<td>10–200 A</td>
</tr>
<tr>
<td></td>
<td>EFCT series (5-A Primary)</td>
<td>50 mA–5 A</td>
</tr>
<tr>
<td></td>
<td>SE-CS30 series (30-A Primary)</td>
<td>300 mA–30 A</td>
</tr>
<tr>
<td>PGR-8800#</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: See page 502 for additional information on CT selection. See page 482 for CT sizing chart.

*Phase CTs should be selected with a primary rating of 100–300 % of rated current to maintain specified accuracy.
‡Select a CT with a primary rating approximately equal to the system's rated current.
## CURRENT TRANSFORMERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Inner Diameter</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CT200 (PGC-2056)</strong></td>
<td>Detects phase current or ground-fault current (200-A primary)</td>
<td>56 mm (2.20&quot;)</td>
<td>FPS MPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FPU-32 SE-330 SE-325</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PGR-8800 SE-107 SE-105</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS SE-701 SE-707</td>
</tr>
<tr>
<td><strong>CT200L (PGC-2089)</strong></td>
<td>Detects phase current or ground-fault current (200-A primary)</td>
<td>89 mm (3.50&quot;)</td>
<td>FPS FPU-32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-8800 SE-701</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPU-32 SE-105</td>
</tr>
<tr>
<td><strong>EFCT-26 (PGC-3026)</strong></td>
<td>Sensitive current transformer used to detect ground-fault current (5-A primary)</td>
<td>26 mm (1.02&quot;)</td>
<td>EL731 FPS FPU-32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS MPU-32 SE-330</td>
</tr>
<tr>
<td><strong>EFCT-1 (PGC-3082)</strong></td>
<td>Sensitive current transformer used to detect ground-fault current (5-A primary)</td>
<td>82 mm (3.23&quot;)</td>
<td>EL731 FPS FPU-32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS MPU-32 SE-330</td>
</tr>
<tr>
<td><strong>EFCT-2 (PGC-3140)</strong></td>
<td>Sensitive current transformer used to detect ground-fault current (5-A primary)</td>
<td>140 mm (5.50&quot;)</td>
<td>EL731 FPS FPU-32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS MPU-32 SE-701</td>
</tr>
<tr>
<td><strong>EFCT-1FC (PGC-31FC)</strong></td>
<td>Fits in the EFCT-1 window to reduce saturation and prevent false operation due to large surge currents</td>
<td>70 mm (2.75&quot;)</td>
<td>EFCT-1</td>
</tr>
<tr>
<td><strong>SE-CS10-2.5 (PGC-4064)</strong></td>
<td>Detects ground-fault current</td>
<td>64 mm (2.50&quot;)</td>
<td>SE-134C SE-135 SE-145</td>
</tr>
<tr>
<td><strong>SE-CS10-4 (PGC-4108)</strong></td>
<td>Detects ground-fault current</td>
<td>108 mm (4.25&quot;)</td>
<td>SE-134C SE-135 SE-145</td>
</tr>
<tr>
<td><strong>SE-CS10-6 (PGC-4160)</strong></td>
<td>Detects ground-fault current</td>
<td>160 mm (6.31&quot;)</td>
<td>SE-134C SE-135 SE-145</td>
</tr>
<tr>
<td><strong>SE-CS10-8 (PGC-4210)</strong></td>
<td>Detects ground-fault current</td>
<td>210 mm (8.25&quot;)</td>
<td>SE-134C SE-135 SE-145</td>
</tr>
<tr>
<td><strong>SE-CS30-26 (PGC-5025)</strong></td>
<td>Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)</td>
<td>25 mm (0.98&quot;)</td>
<td>FPS FPU-32 SE-330</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6100 SE-701</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6101 SE-704</td>
</tr>
<tr>
<td><strong>SE-CS30-70 (PGC-5060)</strong></td>
<td>Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)</td>
<td>60 mm (2.36&quot;)</td>
<td>FPS FPU-32 SE-330</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6100 SE-701</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6101 SE-704</td>
</tr>
<tr>
<td><strong>SE-CS30-4 (PGC-5095)</strong></td>
<td>Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)</td>
<td>95 mm (3.74&quot;)</td>
<td>FPS FPU-32 SE-330</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6100 SE-701</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6101 SE-704</td>
</tr>
<tr>
<td><strong>SE-CS30-5 (PGC-5130)</strong></td>
<td>Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)</td>
<td>130 mm (5.12&quot;)</td>
<td>FPS FPU-32 SE-330</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6100 SE-701</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6101 SE-704</td>
</tr>
<tr>
<td><strong>SE-CS30-8 (PGC-5200)</strong></td>
<td>Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)</td>
<td>200 mm (7.87&quot;)</td>
<td>FPS FPU-32 SE-330</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6100 SE-701</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPS PGR-6101 SE-704</td>
</tr>
<tr>
<td><strong>SE-CS40-6</strong></td>
<td>Detects ground-fault current</td>
<td>160 mm (6.31&quot;)</td>
<td>SE-135 SE-145</td>
</tr>
</tbody>
</table>

**NOTE:** Contact factory for additional CT offerings.
Description
Littelfuse offers a wide array of instrument rated current transformers in 1–3 inch diameter opening.
Voltage class: 600 V
BIL rating: 10 kV
Certification: cRUus (WICC File E100575)

Dimensional Drawing

Donut Style

Foot Mounted

Ordering Information

<table>
<thead>
<tr>
<th>DONUT MODEL</th>
<th>WINDOW</th>
<th>CURRENT RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT-0050-D10</td>
<td>1.0&quot;</td>
<td>50:5</td>
</tr>
<tr>
<td>CT-0075-D10</td>
<td>1.0&quot;</td>
<td>75:5</td>
</tr>
<tr>
<td>CT-0100-D10</td>
<td>1.0&quot;</td>
<td>100:5</td>
</tr>
<tr>
<td>CT-0150-D10</td>
<td>1.0&quot;</td>
<td>150:5</td>
</tr>
<tr>
<td>CT-0200-D10</td>
<td>1.0&quot;</td>
<td>200:5</td>
</tr>
<tr>
<td>CT-0300-D10</td>
<td>1.0&quot;</td>
<td>300:5</td>
</tr>
<tr>
<td>CT-0200-D20</td>
<td>2.0&quot;</td>
<td>200:5</td>
</tr>
<tr>
<td>CT-0300-D20</td>
<td>2.0&quot;</td>
<td>300:5</td>
</tr>
<tr>
<td>CT-0400-D20</td>
<td>2.0&quot;</td>
<td>400:5</td>
</tr>
<tr>
<td>CT-0500-D20</td>
<td>2.0&quot;</td>
<td>500:5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FOOTED MODEL</th>
<th>WINDOW</th>
<th>CURRENT RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT-0050-F10</td>
<td>1.0&quot;</td>
<td>50:5</td>
</tr>
<tr>
<td>CT-0100-F10</td>
<td>1.0&quot;</td>
<td>100:5</td>
</tr>
<tr>
<td>CT-0150-F10</td>
<td>1.0&quot;</td>
<td>150:5</td>
</tr>
<tr>
<td>CT-0200-F10</td>
<td>1.0&quot;</td>
<td>200:5</td>
</tr>
<tr>
<td>CT-0300-F10</td>
<td>1.0&quot;</td>
<td>300:5</td>
</tr>
<tr>
<td>CT-0150-F20</td>
<td>1.5&quot;</td>
<td>1200:5</td>
</tr>
<tr>
<td>CT-0200-F20</td>
<td>2.0&quot;</td>
<td>200:5</td>
</tr>
<tr>
<td>CT-0300-F20</td>
<td>2.0&quot;</td>
<td>300:5</td>
</tr>
<tr>
<td>CT-0400-F20</td>
<td>2.0&quot;</td>
<td>400:5</td>
</tr>
<tr>
<td>CT-0800-F20</td>
<td>2.0&quot;</td>
<td>600:5</td>
</tr>
<tr>
<td>CT-0400-F30</td>
<td>3.0&quot;</td>
<td>400:5</td>
</tr>
<tr>
<td>CT-0800-F30</td>
<td>3.0&quot;</td>
<td>800:5</td>
</tr>
</tbody>
</table>

Part Numbering System

Series

CT - xxx - D10

Current Ratio

xxx:5 current ratio

Window Size

10 = 1.0 inch
15 = 1.5 inches
20 = 2.0 inches
30 = 3.0 inches

Style

D = Donut Style
F = Footed Style
## Accessories
### Current Transformer (CTs)

### INSTRUMENTATION & METERING TRANSFORMERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Inner Diameter</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CT-XXXX-DXX</strong> Series Donut Style Transformer</td>
<td>Littelfuse offers a wide array of instrument rated current transformers in 1–3 inch diameter opening. For full datasheet and ordering information, see page 481.</td>
<td>25.4 - 76.2 mm (1 - 3&quot;)</td>
<td>Series: 777 ECSW LSR-0 LSR-XX LSRU LSRX TCS TCSA LCSC10T12</td>
</tr>
<tr>
<td><strong>CT-XXXX-FXX</strong> Series Footed Style Transformer</td>
<td>Littelfuse offers a wide array of instrument rated current transformers in 1–3 inch diameter opening. For full datasheet and ordering information, see page 481.</td>
<td>25.4 - 76.2 mm (1 - 3&quot;)</td>
<td>Series: 777 ECSW LSR-0 LSR-XX LSRU LSRX TCS TCSA LCSC10T12</td>
</tr>
</tbody>
</table>

### Current Transformer Sizing Chart

<table>
<thead>
<tr>
<th>Conductor Size (AWG/kcmil)</th>
<th>Minimum CT Window Size (Inner Diameter in mm)</th>
<th>Number of Conductors (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>1/0</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>2/0</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>3/0</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>4/0</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>250</td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>350</td>
<td></td>
<td>33</td>
</tr>
<tr>
<td>500</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>750</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td>55</td>
</tr>
</tbody>
</table>

### Installation Instructions:

When installing the Zero-Sequence CTs, ensure the following:

1. Only the load carrying conductors pass through the center of the CT. This means L1 + N for 1-phase and L1 + L2 + L3 for 3-phase.
2. The power conductors pass through the center of the CT and are preferably bound together to keep the conductors uniformly spaced.
3. The power conductors pass perpendicular to the CT and, where practical, continue perpendicular to the CT on both sides of the CT for 3”.
4. The power conductors should not be installed in a way that allows them to run along the side edges of the CT.
5. Where practical, locate the CT away from noise-generating devices such as transformers, frequency converters, etc.
ELCT SERIES

Current Transformer

Description
The ELCT series is a sensitive current transformer with integrated flux conditioner used with Littelfuse relays to detect low levels of earth-leakage current.

Accessories
CBLTP
Twisted-pair wire for connection to CT. Order in desired length in meters.

Specifications

<table>
<thead>
<tr>
<th>Current Rating</th>
<th>ELCT5: 5.05 A</th>
<th>ELCT30: 30.05 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy ELCT5</td>
<td>3 % @ 0.01 VA</td>
<td>ELCT30: 3 % @ 0.06 VA</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 to 400 Hz</td>
<td></td>
</tr>
<tr>
<td>Insulation Level</td>
<td>600 V</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40 °C to 55 °C (-40 °F to 131 °F)</td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td>SE-701</td>
<td></td>
</tr>
<tr>
<td>Wire Gauge</td>
<td>0.05–3.3 mm² (12–30 AWG)</td>
<td></td>
</tr>
<tr>
<td>Tightening Torque</td>
<td>0.5 N·m</td>
<td></td>
</tr>
<tr>
<td>Certification</td>
<td>UL, cUL, CE</td>
<td></td>
</tr>
<tr>
<td>Compliance</td>
<td>RoHS, IEC 61869-2, ANSI/IEEE C57.13</td>
<td></td>
</tr>
</tbody>
</table>

Note: One frequency response may be extended for specific product families

Recommended Relay
Series: SE-330
SE-704 (ELCT30-series)

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>TURNS RATIO</th>
<th>WINDOW SIZE, ID</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELCT5-31</td>
<td>100:1</td>
<td>31 mm (1.22 in)</td>
<td>127.0 g (0.28 lbs)</td>
</tr>
<tr>
<td>ELCT5-88</td>
<td>100:1</td>
<td>88 mm (3.46 in)</td>
<td>635.0 g (1.40 lbs)</td>
</tr>
<tr>
<td>ELCT30-31</td>
<td>600:1</td>
<td>31 mm (1.22 in)</td>
<td>131.5 g (0.29 lbs)</td>
</tr>
<tr>
<td>ELCT30-88</td>
<td>600:1</td>
<td>88 mm (3.46 in)</td>
<td>680.4 g (1.50 lbs)</td>
</tr>
</tbody>
</table>

SECONDARY EXCITING VOLTAGE (VOLTS)

<table>
<thead>
<tr>
<th>SECONDARY EXCITING CURRENT (MILLIAMPERES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELCT5-31</td>
</tr>
<tr>
<td>ELCT5-88</td>
</tr>
</tbody>
</table>

SECONDARY EXCITING VOLTAGE (VOLTS)

<table>
<thead>
<tr>
<th>SECONDARY EXCITING CURRENT (MILLIAMPERES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELCT30-31</td>
</tr>
<tr>
<td>ELCT30-88</td>
</tr>
</tbody>
</table>
Dimensions and Mounting Diagram

Inches [millimeters]

Mount the ELCT5-31 and ELCT30-31 using M5 or #10 screws.
Mount the ELCT5-88 and ELCT30-88 using M6 or ¼" screws.
Accessories
Current Transformers (CTs)

ZSCT SERIES

Current Transformer

Description
The ZSCT series is a current transformer used with Littelfuse relays to detect low levels of earth-leakage current.

Accessories
CBLTP
Twisted-pair wire for connection to CT. Order in desired length in meters.

Specifications

<table>
<thead>
<tr>
<th>Current Rating</th>
<th>ZSCT5: 5:0.05 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZSCT30: 30:0.05 A</td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>ZSCT5: 3 % @ 0.01 VA</td>
</tr>
<tr>
<td>ZSCT30: 3 % @ 0.06 VA</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>50 to 400 Hz</td>
</tr>
<tr>
<td>Insulation Level</td>
<td>600 V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40 °C to 55 °C (-40 °F to 131 °F)</td>
</tr>
<tr>
<td>Application</td>
<td>MP8000</td>
</tr>
<tr>
<td>Wire Gauge</td>
<td>0.05-3.3 mm² (12–30 AWG)</td>
</tr>
<tr>
<td>Tightening Torque</td>
<td>0.5 N-m</td>
</tr>
<tr>
<td>Certification</td>
<td>UL, cUL, CE</td>
</tr>
<tr>
<td>Compliance</td>
<td>RoHS, IEC 61869-2, ANSI/IEEE C57.13</td>
</tr>
</tbody>
</table>

Note: One frequency response may be extended for specific product families.

Ordering Information

<table>
<thead>
<tr>
<th>ORDERING NUMBER</th>
<th>TURNS RATIO</th>
<th>WINDOW SIZE, ID</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZSCT5-31</td>
<td>100:1</td>
<td>31 mm (1.22 in)</td>
<td>117.9 g (0.26 lbs)</td>
</tr>
<tr>
<td>ZSCT5-88</td>
<td>100:1</td>
<td>88 mm (3.46 in)</td>
<td>499.0 g (1.10 lbs)</td>
</tr>
<tr>
<td>ZSCT30-31</td>
<td>600:1</td>
<td>31 mm (1.22 in)</td>
<td>113.4 g (0.25 lbs)</td>
</tr>
</tbody>
</table>

SECONDARY EXCITING VOLTAGE (VOLTS)

<table>
<thead>
<tr>
<th>SECONDARY EXCITING CURRENT (MILLIAMPERES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
</tr>
<tr>
<td>0.5</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>5.0</td>
</tr>
</tbody>
</table>

SECONDARY EXCITING VOLTAGE (VOLTS)

<table>
<thead>
<tr>
<th>SECONDARY EXCITING CURRENT (MILLIAMPERES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
</tr>
<tr>
<td>0.5</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>5.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECONDARY EXCITING VOLTAGE (VOLTS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
</tr>
<tr>
<td>0.5</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>5.0</td>
</tr>
</tbody>
</table>
Dimensions and Mounting Diagram

Inches [millimeters]
Mount the ZSCT5-31 and ZSCT30-31 using M5 or #10 screws.
Mount the ZSCT5-88 using M6 or ¼” screws.

TOP VIEW AND MOUNTING DETAIL

FRONT VIEW

SIDE VIEW

ZSCT5-31 and ZSCT30-31

ZSCT5-88
PMA SERIES

Panel Mount Adapters — Retrofits

Description
A variety of protection relay retrofit adapter plates are available for the products listed below. These adapter plates simplify the process of updating electromechanical or poorly functioning existing relays. Consult factory if you have a specific product to replace that is not featured. Adapters are available in either plate style for panel mounting or drawout style depending on the relay being replaced.

Motor, feeder and ground-fault protection upgrades are available for electromechanical or solid state relays that are nearing the end of their life.

Features & Benefits

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting</td>
<td>Fits in existing mounting holes and panel openings</td>
</tr>
<tr>
<td>Multiple adapter sizes</td>
<td>Plate style or drawout style adapters are available to fit various outdated relays</td>
</tr>
</tbody>
</table>

Adapter Plates

<table>
<thead>
<tr>
<th>RELAY TO REPLACE</th>
<th>PANEL MOUNT</th>
<th>NEW RELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB BULLETIN 1406</td>
<td>PMA-14</td>
<td>MPS</td>
</tr>
<tr>
<td>FPL-GFRM</td>
<td>PMA-6</td>
<td>SE-701/SE-704</td>
</tr>
<tr>
<td>GE S1</td>
<td>PMA-9</td>
<td>MPU-32/FPU-32</td>
</tr>
<tr>
<td>GE LODTRAK III</td>
<td>PMA-10</td>
<td>MPU-32</td>
</tr>
<tr>
<td>GE MULTILIN 169, 269, or 369</td>
<td>PMA-16</td>
<td>MPU-32</td>
</tr>
<tr>
<td>GE MULTILIN 469</td>
<td>PMA-24</td>
<td>MPS</td>
</tr>
<tr>
<td>GE MULTILIN P4A</td>
<td>PMA-15</td>
<td>MPU-32/FPU-32</td>
</tr>
<tr>
<td>GEC/MCGG</td>
<td>PMA-3</td>
<td>SE-701/SE-704</td>
</tr>
<tr>
<td>GE &amp; WESTINGHOUSE FT-11</td>
<td>PMA-12</td>
<td>MPU-32</td>
</tr>
<tr>
<td>P &amp; B GOLDS</td>
<td>Contact Factory</td>
<td>FPU-32</td>
</tr>
<tr>
<td>WESTINGHOUSE CO9 &amp; CO11</td>
<td>Contact Factory</td>
<td>FPU-32</td>
</tr>
</tbody>
</table>

Example Shown: PMA-3

Example of a panel mount adapter (PMA-3). Relay is for illustrative purposes only and must be purchased separately from adapter plate. For more information on our complete offering of panel mount adapters see the following page.

For a complete list of the Littelfuse Panel Mount Adapter Plates please see next page.
## PANEL-MOUNT ADAPTERS

### PANEL MOUNT ADAPTERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PMA-2</strong> Adapter Plate</td>
<td>Used when replacing the AB Bulletin 1406.</td>
<td>MPU-32</td>
</tr>
<tr>
<td><strong>PMA-3</strong> Adapter Plate</td>
<td>Used when replacing GEC/MCGG ground-fault relays. Requires PMA-55 or PMA-60.</td>
<td>SE-704 SE-701</td>
</tr>
<tr>
<td><strong>PMA-4</strong> Adapter Plate</td>
<td>Used when replacing the Multilin 139/239.</td>
<td>MPU-32</td>
</tr>
<tr>
<td><strong>PMA-6</strong> Adapter Plate</td>
<td>Used when replacing FPL-GFRM ground-fault relays. Requires PMA-55 or PMA-60.</td>
<td>SE-701</td>
</tr>
<tr>
<td><strong>PMA-7</strong> Adapter Plate</td>
<td>Used when replacing the GE Lodtrak II.</td>
<td>MPU-32</td>
</tr>
<tr>
<td><strong>PMA-8</strong> Adapter Plate</td>
<td>Used when replacing an Atkinson Omser II with an SE-130-Series Monitor.</td>
<td>SE-134C SE-135</td>
</tr>
<tr>
<td><strong>PMA-9</strong> Adapter Plate</td>
<td>Used when replacing relays in the GE S1 Case. Requires PMA-55 or PMA-60.</td>
<td>MPU-32 FPU-32</td>
</tr>
<tr>
<td><strong>PMA-10</strong> Adapter Plate</td>
<td>Used when replacing the GE Lodtrak III.</td>
<td>MPU-32</td>
</tr>
<tr>
<td><strong>PMA-12</strong> Adapter Plate</td>
<td>Used when replacing GE and Westinghouse FT-11 relays.</td>
<td>MPU-32</td>
</tr>
<tr>
<td><strong>PMA-13</strong> Adapter Plate</td>
<td>Used when replacing the GE Multilin 169, 269, or 369.</td>
<td>MPS</td>
</tr>
<tr>
<td><strong>PMA-14</strong> Adapter Plate</td>
<td>Used for rough cutouts and when replacing the AB Bulletin 1406.</td>
<td>MPS</td>
</tr>
<tr>
<td><strong>PMA-15</strong> Adapter Plate</td>
<td>Used for rough cutouts and when replacing the GE Multilin P4A.</td>
<td>MPU-32 FPU-32</td>
</tr>
<tr>
<td><strong>PMA-16</strong> Adapter Plate</td>
<td>The PMA-16 mounting plate is used when replacing the GE Multilin 169, 269, and 369 relays. The PMA-16-RTDB is a mounting bracket for the optional MPS-RTD Temperature Input Module.</td>
<td>MPU-32 FPU-32</td>
</tr>
<tr>
<td><strong>PMA-17</strong> Adapter Plate</td>
<td>Used when replacing Sprecher &amp; Schuh Cet 4.</td>
<td>MPU-32</td>
</tr>
<tr>
<td><strong>PMA-18</strong> Adapter Plate</td>
<td>Used when replacing Sprecher &amp; Schuh Cet 3.</td>
<td>MPU-32</td>
</tr>
<tr>
<td><strong>PMA-21</strong> Adapter Plate</td>
<td>Used when replacing an ABB RACIF.</td>
<td>FPU-32</td>
</tr>
<tr>
<td><strong>PMA-23</strong> Adapter Plate</td>
<td>Custom mounting plate for FPU-32 to replace 3 Westinghouse C0 relays.</td>
<td>FPU-32</td>
</tr>
<tr>
<td><strong>PMA-24</strong> Adapter Plate</td>
<td>Used when replacing the GE Multilin 469.</td>
<td>MPS</td>
</tr>
<tr>
<td><strong>PMA-55</strong> Adapter Plate</td>
<td>Used to panel mount the SE-601 and SE-701.</td>
<td>SE-601 SE-701 SE-704 PGR-4300</td>
</tr>
<tr>
<td><strong>PMA-60</strong> Adapter Plate</td>
<td>Used to panel mount the relay; IP 53 and NEMA 3 rating, tamper resistant.</td>
<td>SE-601 SE-701 SE-704 PGR-4300</td>
</tr>
<tr>
<td><strong>MPU-32-SMK</strong> Surface-Mount Kit</td>
<td>Used to surface mount the MPU-32 or FPU-32.</td>
<td>MPU-32 FPU-32</td>
</tr>
</tbody>
</table>

Note: Relays are not included with the PMA-Series Panel Mount Adapters.
## DIN Rail & Mounting Adapters

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C103PM (Al)</strong></td>
<td>Industry standard 35 mm aluminum or steel DIN rail. C103PM aluminum rail is available in a 36 in. (91.4 cm) length.</td>
<td>Can be used with all DIN-rail compatible units.</td>
</tr>
<tr>
<td>DIN Rail</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AC700-SMK</strong></td>
<td>DIN-rail and Surface-mount adapter for back-plane mounting.</td>
<td>EL731</td>
</tr>
<tr>
<td>Mount Adapter</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>D0050</strong></td>
<td>Plastic clip allowing DIN-rail mounting of the PGR-8800 and AF0500 Arc-Flash Relay.</td>
<td>AF0500 PGR-8800</td>
</tr>
<tr>
<td>DIN-Rail Adapter Clip</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>P1023-20</strong></td>
<td>Allows any 2 x 2 in (50.8 x 50.8 mm) or 2 x 3 in (50.8 x 76.2 mm) module to be mounted on a 35 mm DIN type rail. Comes complete with mounting hardware (one #10 - 24 x 1.00 screw and one #10 - 24 x 1.25 screw) for 0.75 in (19 mm) and 1 in (25.4 mm) thick modules.</td>
<td>Consult the individual datasheet to determine part compatibility.</td>
</tr>
<tr>
<td>DIN Rail Mount Adaptor</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>P0500-178</strong></td>
<td>P0500-178 is surface mountable with 2 Quick Mount Fasteners.</td>
<td>ASXX/DSXX Series Timers</td>
</tr>
<tr>
<td>Surface Mount Adapter</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>P0500-179</strong></td>
<td>P0500-179 snaps onto DIN rail.</td>
<td>ASXX/DSXX Series Timers</td>
</tr>
<tr>
<td>DIN Rail Mount Adapter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## BRACKETS & CLIPS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BZ1</strong> Front Panel Mount Kit</td>
<td>Provides an easy method of through-the-panel mounting of 8-pin or 11-pin plug-in timers, flashers, and other controls. May be mounted in panels up to 0.125 in (3.2 mm) thick. Includes two clamps and two screws.</td>
<td>Series: ARP FS500 LLC4 LLC5 LLC6 PLM PLMU PLR PLS PRLM TDB TDBH TDBL TDI TDIH TDIL TDM TDMB TDMH TDML TDR TDS TDSH TDSL TRB TRDU TRM TRS TRU</td>
</tr>
<tr>
<td><strong>P1023-6</strong></td>
<td>Provides a convenient method of mounting modules. The 90° orientation of mounting slots makes installation/removal of modules quick and easy. Made from steel with a cadmium surface finish.</td>
<td>Used on many 2&quot; x 2&quot; timers. Refer to individual series datasheet to determine if this accessory is compatible.</td>
</tr>
<tr>
<td><strong>P1023-7</strong></td>
<td>Designed for use with P1011-6 socket. Securely mounts 8-pin plug-in controls in any position, and provides protection against vibration. Sold in pairs.</td>
<td><strong>P1011-6</strong></td>
</tr>
<tr>
<td><strong>P1023-2</strong></td>
<td>Removable P clamp bracket for mounting MSM series timers and FS100 and FS400 series flashers.</td>
<td><strong>PSC8</strong> Hold-down Brackets</td>
</tr>
<tr>
<td><strong>PSC8</strong></td>
<td>Securely mounts plug-in controls in any position. Also provides protection against vibration. Select the PSC8 for use with NDS-8, or the PSC11 for use with NDS-11 sockets. Sold in pairs.</td>
<td><strong>NDS-8 Socket</strong> <strong>NDS-11 Socket</strong></td>
</tr>
<tr>
<td><strong>PSC11</strong></td>
<td>Also provides protection against vibration. Select the PSC8 for use with NDS-8, or the PSC11 for use with NDS-11 sockets. Sold in pairs.</td>
<td><strong>Timers series:</strong> MSM <strong>Flasher series:</strong> FS100 FS400</td>
</tr>
</tbody>
</table>
## ENCLOSURES & WATERTIGHT COVERS

### ENCLOSURES

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGRM-ENC</td>
<td>NEMA 4 painted steel control panel, complete with the SE-325 or SE-330, and a fused 600/480:120 V PT for relay control power. Suitable for indoor or outdoor mounting, CSA certified. When NGR Monitor is back-plane mounted, 22 mm NEMA 4 indicators and reset button are included. Please contact factory for additional information. For full datasheet and ordering information, see pg. 67</td>
<td>SE-325, SE-330</td>
</tr>
<tr>
<td>NEMA-3R-L A</td>
<td>Metal NEMA-3R electrical box with lenses for viewing the single-phase PumpSaver® status lights. <a href="#">H 6.0” x W 6.0” x D 4.0”</a></td>
<td>Single-Phase PumpSaver</td>
</tr>
<tr>
<td>RM-1000-ENCL</td>
<td>Steel enclosure for protecting the RM1000 from weather and vandalism. Protects from UV, hail, and it seals to keep rain from contacting the RM1000 connections. The enclosure also features a built-in padlock tab (padlock not included). <a href="#">H 6.4” x W 6.3” x D 1.7”</a></td>
<td>RM1000</td>
</tr>
</tbody>
</table>

### WATERTIGHT COVERS

<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Accessory For</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPU-16A-Y92A-96N</td>
<td>Watertight cover for outdoor applications.</td>
<td>MPU-32, FPU-32</td>
</tr>
<tr>
<td>SE-IP65CVR-M</td>
<td>Watertight cover. Tamper-resistant. IP65 protection.</td>
<td>MPS, FPS</td>
</tr>
<tr>
<td>SE-MRE-600</td>
<td>Protects the connection terminals from snow and rain in outdoor applications.</td>
<td>ER-600VC, ER-1000HV</td>
</tr>
</tbody>
</table>
# SOCKETS

- **OT08PC**
  - **Product**: Octal Socket 8-Pin
  - **Features**: 8-pin 35 mm DIN-rail or surface mount octal socket. Rated at 10 A @ 600 V ac and has pressure clamp terminals.
  - **Accessory For**: AWG 12 to 22 (3.2 to 0.33 mm²) wire sizes. Consult individual datasheet for compatibility.

- **NDS-8**
  - **Product**: Octal Socket 8-Pin
  - **Features**: 8-pin 35 mm DIN-rail or surface mount octal socket. Rated at 10 A @ 300 V ac. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. A spring mechanism allows easy removal. Uses PSC8 hold-down clips.
  - **Accessory For**: Up to two #14 AWG (2.45 mm²) wire size
  - **Series**: ARP, FS500, LLC4, LLC5, PRL, TDB, TDBH, TDL, TDBL, TDM, TDMB, TDMH, TDSL, TDS, TDSH, TDSL, TRD, TRDU, TRS, TRU

- **P1011-6**
  - **Product**: Octal Socket 8-Pin
  - **Features**: 8-pin surface mount socket with binder head screw terminals. Rated at 10 A @ 600 V ac. UL Listed combination when used with TDM, TDB, TDS series timers. Uses PSCRB8 hold-down brackets.
  - **Accessory For**: 11-pin Plug-in units
  - **Series**: ARP, LLC6, TDB, TDBH, TDBL, TDM, TDMB, TDS, TDSH, TDSL, TRB, TRDU, TRS, TRU

- **OT11PC**
  - **Product**: Magnal Socket 11-Pin
  - **Features**: Magnal Sockets are for plug-in units

- **SD12-PC**
  - **Product**: Rectangle Socket 12-pin
  - **Features**: 12-pin surface Rectangle Socket.

- **NDS-11**
  - **Product**: 11-pin Magnal Socket
  - **Features**: 11 pin 35 mm DIN-rail or surface mount socket. Rated at 10 A @ 300 V ac. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. A spring mechanism allows easy removal. Uses PSC11 hold-down clips.
  - **Accessory For**: AWG 12 to 22 (3.2 to 0.33 mm²) wire sizes
  - **Series**: ARP, LLC6, TDB, TDBH, TDBL, TDM, TDMB, TDS, TDSH, TDSL, TRB, TRDU, TRS, TRU
OVERVIEW

Glossary of Terms ................................................................. 510
Introduction ........................................................................... 513
  I. Introduction to Protection Relays ..................................... 513
  II. Relay Application .............................................................. 514
  III. CT Application ............................................................... 522
  IV. Resistance-Grounding Conversion ................................. 523
IEEE/ANSI Device Numbers .............................................. 526
Typical Suffixes ................................................................. 526

For More Information… and to download our Protection Relay Overview, visit Littelfuse.com/TechnicalCenter
Active Power—Measured in kW. In a diesel generator application, it is the power produced by the engine.

Alarm Level—A setting on a protection relay at which an LED or output contact operates.

Alarm Relay Contact—An output of a relay that acts as a switch and is typically connected to a visual or audible alarm.

Analog Output—A discrete, continually variable 0-1 mA, 4-20 mA, or 0-5 Vdc signal from a protection relay used to pass information to a device or controller.

Apparent Power—The vector sum of the active and reactive power.

Arc Flash Hazard—A dangerous condition associated with the possibility of release of energy caused by an electric arc.

Arc Flash Risk Assessment—A study investigating a worker’s potential exposure to arc flash energy, conducted for the purpose of injury prevention and to determine safe work practices, arc flash boundary, and the necessary types of personal protective equipment (PPE).

Arc Flash Suit—A complete arc-rated clothing and equipment system covering the entire body, except for hands and feet.

Arc Flash Boundary—When an arc flash hazard exists, the boundary is an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur.

Arc Rating—The value attributed to materials that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of break open threshold (EBT). A material system exhibit a break open response below the ATPV value. Arc rating is reported as either ATPV or EBT, whichever is the lower value.

Asynchronous Motor—A motor in which the speed of the rotor is not the same as the connected system frequency.

Charging Current—System charging current is the current that will flow into the grounding connection when one phase of an ungrounded system is faulted to ground. Although not physically connected to ground, electrical conductors and the windings of all components are capacitively connected to ground. Consequently, a small current will flow to ground from each phase. This current does not occur at any particular location; rather, it is distributed throughout the system just as the capacitance to ground is distributed throughout the system.

Conformal Coating—A Silicone coating used to protect circuit boards from pollutants, corrosion, mildew, etc.

Core-Balance Current Transformer—See Earth-Fault Current Transformer.

Current Transformer (CT)—A transformer that produces a current in its secondary circuit in a known proportion to current in its primary circuit.

CT Verification—A continuous check of CT continuity to verify connection.

CT Saturation—A condition that occurs when a CT cannot maintain a secondary current proportional to a relatively large primary current.

CT Local Saturation—A condition where the magnetic flux is not evenly distributed throughout the CT. A resulting secondary current could be induced when no ground fault is present; it may lead to the false operation of a protective relay. This could occur if conductors are not centered in a CT window.

CT Saturation Compensation—A feature in which a protective relay can recognize that a CT is saturated and compensate for the condition in order to maintain service.

Data Logging—Collecting and storing information in a format that can be reviewed for trending, troubleshooting, and reporting.

De-energized—Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.

DFT—See Discrete Fourier Transform.


Digital Harmonic Filter—The use of digital signal-processing techniques such as a discrete Fourier Transform to eliminate the measurement of harmonic components. With regard to ground-fault detection, this allows for a setting below the background noise level.

Discrete Fourier Transform—A mathematical algorithm used to extract a single frequency, such as the fundamental frequency, from a signal.

Earth Leakage—See Leakage Current.

Earth-Fault Current Transformer—A current transformer used to measure low-level ground-fault current.

Electrical Hazard—A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

Electrical Safety—Recognizing hazards associated with the use of electrical energy and taking precautions so hazards do not cause injury or death.

Electrically Safe Work Condition—An electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Fail-Safe Mode (also known as Undervoltage or UV)—An output relay is energized during normal (not tripped) operation. If the protection relay loses supply voltage, the system will trip or alarm. (Also see Non-Fail-Safe.)

Fault Current—A current that flows when a phase conductor is faulted to another phase or ground.

Feeder—All circuit conductors between the service equipment or other power-supply source and the load or branch-circuit overcurrent device.
Overview
Glossary of Terms

Feeder Protection—Overcurrent or overvoltage devices installed on a feeder circuit to interrupt the supply in the event of a fault.

Flux Conditioner—A ring of magnetically permeable material inserted in an earth-fault current transformer window; used to reduce local saturation.

Fundamental Frequency—In an alternating-current power system, the frequency of the generated voltage. In North America this is typically 60 Hz (60 cycles per second).

Ground Check Conductor—An insulated conductor in a trailing cable used to assist in monitoring continuity of the ground conductor. Typically designed to be the smallest conductor, it is the first to break connection when cable couplers are disconnected.

Ground-Check Loop—A circuit that includes a ground-check conductor, a ground-check termination device, and a ground conductor.

Ground-Check Termination—A device installed at the load end of a ground-check loop.

Ground-Continuity Monitor—A protection relay that continuously monitors a ground-check loop and trips if the loop opens or shorts.

Ground Fault—An unintentional contact between a phase conductor and ground or equipment frame. The words “ground” and “earth” are used interchangeably.

Ground-Fault Current—A current that returns to the supply neutral through a ground-fault and ground-return path.

Ground-Fault Current Transformer—See Earth-Fault Current Transformer.

Ground-Fault Relay—A protection relay designed to detect a phase-to-ground fault on a system and trip or alarm when the condition exceeds its pickup setting for longer than its time delay.

Ground-Fault Protection—The use of a ground-fault relay or indication system in order to interrupt the supply or alarm personnel in the event of a ground fault.

Ground Reference Module—A resistor network that limits ground-fault current and provides a system reference for a DC ground-fault relay.

Harmonic Filter—A device or method to remove or ignore non-fundamental frequency components of a signal.

Harmonic Frequency—Harmonic-frequency components (voltage and current) are multiples of the fundamental frequency and, in a power system, can be considered noise. Harmonic-frequency components are often present with the use of adjustable-speed drives.

High-Resistance Grounding—Using a neutral-grounding resistor to limit the current to a low level. Typically, High-Resistance Grounding limits ground-fault current to 25 A or lower. (Also see Low-Resistance Grounding.)

High Tension Coupler—An accessory used to isolate system voltage from a protective relay.

I\(^t\) (I squared t)—Thermal capacity, or used thermal capacity. With regard to motor protection, thermal capacity is used to measure and describe motor heating in terms of current (I). This method is more accurate than temperature sensing because of temperature-sensor placement and the time delay inherent in temperature measurement.

IEEE Device Numbers—The devices in switching equipment are referred to by numbers, according to the functions they perform. These numbers are based on a system which has been adopted as standard for automatic switchgear by the IEEE. This numbering system is used on connection diagrams, in instruction literature, and in specifications.

Incident Energy—The amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. One of the units used to measure incident energy is calories per centimeter squared (cal/cm\(^2\)).

Incident Energy Analysis—Used to predict the incident energy of an arc flash for a specified set of conditions.

Insulation Monitoring—Monitoring the resistance from phase to ground to detect insulation breakdown on a system.

Insulation Resistance—A measurement of the ability of an insulator, such as a cable jacket, to prevent current flow when a voltage is applied; typically measured in megaohms (MΩ). Insulation resistance change can be monitored to predict failure.

Inverse-Time Overcurrent Protection—A method by which time-to-trip of a protective device, such as an overcurrent or ground-fault relay, decreases as the magnitude of the fault increases.

Leakage Current—Low-level ground-fault current, typically measured in milliamperes (mA).

Low-Resistance Grounding—A Resistance-Grounding System that allows high currents to flow during a ground fault. Typically, 100 A and higher is considered Low-Resistance Grounding. (Also see High-Resistance Grounding.)

LSIG Protection—An acronym for Long-time, Short-time, Instantaneous overcurrent, and Ground-fault protection; a term often used to describe protection required for a power-distribution feeder, or a protection relay with these functions.

Motor Protection—Technology designed to ensure that a motor operates within its rated thermal capacity in order to maximize its service life.

Neutral-Grounding Resistor (NGR)—A current-limiting resistor connecting the power-system neutral to ground.

N.C. Contact (Normally Closed Contact)—A relay contact that is closed when the relay is not energized.

N.O. Contact (Normally Open Contact)—A relay contact that is open when the relay is not energized.

Non-Fail-Safe Mode (also known as Shunt Trip or SH)—An output relay is energized and contacts change state when a trip occurs. If the protective device loses supply voltage, the system can continue to operate but will not be protected. (Also see Fail-Safe Mode.)
Non-Volatile Memory—Data is retained when power is removed.

Nuisance Trip—A false operation of a protective relay.

Phase Current—Current present in a phase conductor.

Phase-Current Transformer—A current transformer installed so that current from one phase conductor flows in its primary winding. With regard to motor protection, feeder protection, and metering in a three-phase system, three current transformers are typically used to measure phase currents.

Phase-Differential Protection—Protection designed to detect low-level winding-to-winding and winding-to-ground failures in an AC motor.

Phase Voltage—The voltage measured between a phase conductor and ground, or another phase.

Power factor (cosφ)—The relation between the active power [kW] and apparent power [kVA].

Primary Rating (for CTs)—The current rating of the primary side of a current transformer. For example, the first number in the ratio 500:5 is the primary rating. 500 A of primary current flowing through the CT will produce 5 A of current out of the secondary terminals.

Pulsing Ground-Fault Systems—Modulating the ground-fault current on a resistance-grounded system using a contactor to short out part of the NGR elements (or to open one of two NGRs connected in parallel). This technique is used to locate ground faults by tracing the pulsing ground-fault current to the source of the fault.

Online or Offline Monitoring—Monitoring system parameters such as insulation integrity when the system is energized or de-energized, respectively.

Open-CT Hazard—An open-circuited CT secondary which can develop a dangerously high voltage when primary current is present.

Reactive Power—Measured in kVAR. The power used for magnetization of asynchronous alternators, motors and transformers, coils etc. The amount of reactive power has no effect on the torque of the prime mover (e.g. diesel engine). Therefore the reactive power has no effect on the engine. It is however very important for the alternator, as the total load on the alternator is the vector sum of active and reactive load.

Relay (1)—An electrical switch that opens and closes a contact (or contacts) under the control of another circuit. Typically an electromagnet.

Relay (2)—A device that receives inputs, compares them to set points, and provides outputs based upon that comparison.

Relay Operating Mode—Method of operation used for undervoltage or shunt-trip breakers. (Also see Fail-Safe Mode, Non-Fail-Safe Mode.)

Resistance-Grounded System—An electrical system in which the transformer or generator neutral is connected to ground through a current-limiting resistor. (Also see Solidly Grounded System, Ungrounded System.)

Reverse Power—An active power [kW] fed into a generator that thus is working as an electric motor, turning the prime mover. As this would damage the prime mover (e.g. an internal combustion engine), reverse power relays are used in applications where generators run in parallel with each other or with the utility. These relays detect the amount and direction of the power, and in case of excessive reverse power, disconnect the generator breaker.

Ride-Through Time—The amount of time a protection relay can maintain operation during a supply voltage loss.

RTD (Resistance Temperature Detector)—A device that experiences a linear change in resistance with a change in temperature. It is used to provide temperature metering. Common RTDs are 100 Ω platinum, 100 Ω nickel, 120 Ω nickel, and 10 Ω copper.

Sensitive Ground-Fault Protection—Protection designed to accurately detect low-level ground-fault current.

Shock Hazard—A dangerous condition associated with possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.

Solidly Grounded System—An electrical system in which the neutral point of a wye-connected supply transformer is connected directly to ground. (Also see Resistance-Grounded System, Ungrounded System.)

Switchgear, Arc-Resistant—Equipment designed to withstand the effects of an internal arcing fault and that directs the internally released energy away from the employee.

Time Delay—A setting on a protection relay that determines the time between the fault detection and relay operation.

Trailing Cable—A power cable used to supply electrical power to mobile equipment. They typically contain three phase conductors, two ground conductors, and a pilot wire (also known as a ground-check conductor).

Trip Level—A setting on a protection relay at which an LED or output contact operates.

Trip Relay Contact—An output of a relay that acts as a switch and is typically connected to an undervoltage-release or shunt-trip coil of a circuit breaker.

Trip State—The state of the output contact during a relay trip.

True RMS—“Root-Mean-Square” calculation used to derive an average current or voltage value in a waveform.

Ungrounded System—An electrical system in which no point of the system is intentionally grounded, such as a delta-connected supply transformer.

Zero-Sequence Current Transformer—See Earth-Fault Current Transformer.
I. INTRODUCTION TO PROTECTION RELAYS

What is a protection relay?
- Inputs and Settings
- Processes
- Outputs

How do protection relays solve electrical problems?
- Stage 1 – Early stages of a failure
- Stage 2 – During a failure
- Stage 3 – After a failure

II. RELAY APPLICATION

Ground-Fault Protection
- Definition of Ground Fault
- DC Systems
- Ungrounded AC Systems
- Solidly Grounded Systems
- Resistance-Grounded Systems
- System Capacitive Charging Current
- Resistor Monitors
- Ground-Continuity Monitors

Motor Protection
- Overview
- Common Motor Problems and Solutions
- Motor Protection and the NEC®

Arc-Flash Protection
- Overview
- Arc-Flash Safety Standards
- Arc-Flash Mitigation
- Arc-Flash Relays
- Selection Criteria

III. CT APPLICATION
- Current Transformers
- Lead Length
- CT Installation

IV. RESISTANCE GROUNDING CONVERSION

What is a Protection Relay?
A protection relay is a smart device that receives inputs, compares them to set points, and provides outputs. Inputs can include current, voltage, resistance, or temperature. Outputs can include visual feedback in the form of indicator lights and/or an alphanumeric display, communications, control warnings, alarms, and turning power off and on. A diagram is shown below.

Protection relays can be either electromechanical or electronic/microprocessor-based. Electromechanical relays consist of mechanical parts that require routine calibration to stay within intended tolerances. Microprocessor-based or electronic relays provide quick, reliable, accurate, and repeatable outputs. Using an electronic or microprocessor-based relay instead of an electromechanical design provides numerous advantages including improved accuracy, additional functions, reduced maintenance, smaller space requirements and lower life-cycle costs.

Inputs
A relay needs information from the system to make a decision. These inputs can be collected in a variety of ways. In some cases, the wires in the field can be connected directly to the relay. In other applications, additional devices are needed to convert the measured parameters to a format that the relay can process. These additional devices can be current transformers, potential transformers, high-tension couplers, RTDs, or other devices.

Settings
Many protection relays have adjustable settings. The user selects settings (pick-up levels) that allow the relay to make a decision. The relay compares the inputs to these settings and responds accordingly.

Processes
Once the inputs are connected and the settings are made, the relay compares these values and makes a decision. Depending on the need, different types of relays are available for different functions.
Outputs
A relay can have several ways of communicating that a decision has been made. Typically the relay will operate a switch (relay contact) to indicate that an input has surpassed a setting, or the relay can provide notification through visual feedback such as a meter or LED. One advantage of many electronic or microprocessor-based relays is an ability to communicate with a network or a PLC.

As an example, a thermostat can be evaluated using the diagram in Figure 1. The input that is measured is temperature and the input device is the temperature sensor. The user sets the desired temperature setting (pick-up level). The relay measures the existing air temperature and compares it to the setting. The outputs can be used to provide controls (turning an air conditioner or furnace on and off) and visual indication on the thermostat display.

How Do Protection Relays Solve Electrical Problems?
Similar to how the thermostat solves the problem of automating the control of the air conditioner or furnace in a home, protection relays can solve electrical problems.

The purpose of the protection relay is to detect a problem, ideally during its initial stage, and to either eliminate or significantly reduce damage to personnel and/or equipment. The following stages illustrate how an electrical problem develops:

Stage 1: When conductors with good insulation are exposed to fault initiators such as moisture, dust, chemicals, persistent overloading, vibration or just normal wear, the insulation will slowly deteriorate. Such small changes will not be immediately obvious until the damage is severe enough to cause an electrical fault. Relays can detect that a problem is developing by identifying slight deviations in current, voltage, resistance, or temperature. Due to the small magnitude in change, only a sophisticated device such as a sensitive protection relay or a monitor can detect these conditions and indicate that a problem may be developing, before any further damage occurs.

Stage 2: As the problem becomes more severe, further changes take place such as insulation breakdown, overheating, or overvoltage. Since the change from normal to abnormal is great, traditional devices can be used to interrupt power. Protection relays can also be used to provide additional protection by detecting the fault contributors (overheating, overvoltage, etc.) not possible with fuses and circuit breakers.

Stage 3: At this point, the problem has occurred and caused damage. Different types of protection relays and monitors can reduce or eliminate damage because they detect problems in advance of traditional devices.

As an example, if a facility is continually resetting circuit breakers, replacing fuses, or repairing equipment and cannot locate the problem, they may be experiencing overcurrents. If this is the case, the user can install a protection relay that has an overcurrent feature. The relay measures the current (input) and allows the user to program limits (settings). The settings typically are more sensitive than the fuses or circuit breakers. Once these limits are exceeded, the relay will operate an internal switch (relay contacts). The user has the option to use the switch to turn on a light (alarm indication) or remove power (trip) before greater problems occur. The user can use the alarm indication to help identify the faulty equipment prior to the traditional fuse or circuit breaker clearing the fault.

II. RELAY APPLICATION

Ground-Fault Protection
The primary purpose of grounding electrical systems is to provide protection against electrical faults. However, this was not common practice until the 1970’s. Until then, most commercial and industrial systems were ungrounded. Although ungrounded systems do not cause significant damage during the first ground fault, the numerous disadvantages associated with ground faults resulted in a change to the grounding philosophy. There are other advantages for a grounded system, such as reduction of shock hazards and protection against lightning.

Electrical faults can be divided into two categories: phase-to-phase faults and ground faults. Studies have shown that 98% of all electrical faults are ground faults (Source: Woodham, Jack, PE. “The Basics of Grounding Systems” May 1, 2003 <http://www.ecmweb.com/mag/electric basics _grounding_systems_2/index.html>). While fuses can protect against phase-to-phase faults, additional protection, such as protection relays, are typically required to protect against ground faults.

Definition of Ground Fault
A ground fault is an inadvertent contact between an energized conductor and ground or the equipment frame. The return path of the fault current is through the grounding system and any equipment or personnel that becomes part of that system. Ground faults are frequently the result of insulation breakdown. It’s important to note that damp, wet, and dusty environments require extra diligence in design and maintenance. Since contaminated water is conductive, it exposes degradation of insulation and increases the potential for hazards to develop.

Table 1 shows the leading initiators of electrical faults.

<table>
<thead>
<tr>
<th>LEADING INITIATORS OF FAULTS</th>
<th>% OF ALL FAULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure to moisture</td>
<td>22.5%</td>
</tr>
<tr>
<td>Shorting by tools, rodents, etc.</td>
<td>18.0%</td>
</tr>
<tr>
<td>Exposure to dust</td>
<td>14.5%</td>
</tr>
<tr>
<td>Other mechanical damage</td>
<td>12.1%</td>
</tr>
<tr>
<td>Exposure to chemicals</td>
<td>9.0%</td>
</tr>
<tr>
<td>Normal deterioration from age</td>
<td>7.0%</td>
</tr>
</tbody>
</table>

TABLE 1
As an example, in the toaster circuit above, the black or hot wire is shorted to the metal casing of the toaster. When the circuit closes, all or part of the current is channeled through the toaster frame and then through the green ground wire. When sufficient current flows (typically $6 \times 15\,\text{A} = 90\,\text{A}$), the circuit breaker will open. A protection relay could be installed to detect currents as low as 10 mA, which would open the circuit breaker at a significantly lower level, hence, much quicker than the traditional circuit breaker.

Although the example above shows a solidly grounded single-phase circuit, the philosophy is the same on three-phase circuits discussed later. Relays and monitors are specifically designed to look for the leading initiators shown in Table 1 by detecting low-level changes in current, voltage, resistance or temperature.

**DC Systems**

Direct current (DC) systems have positive and negative buses. If either bus is intentionally grounded, then it is referred to as a grounded system. If neither bus is grounded, then it is referred to as an ungrounded DC system. A ground fault on a DC system may cause damage to the source as well as in the field.

If the system is ungrounded, then it is possible to use a ground-fault relay by installing a ground-reference module between the two buses to establish a neutral point (see Figure 3). The ground-fault relay uses this neutral point as a reference to detect low-level ground faults.

- An ungrounded system has no point in the system that is intentionally grounded (other than the normal bonding which is always present to connect the non-current-carrying metal parts to ground). Grounding occurs only through system capacitance to ground (as shown in Figure 4).
- Continuity of operation occurs because the system can operate with one phase faulted to ground.
- An intermittent or arcing fault can produce high transient overvoltages to ground. These voltages are impressed on the phase conductors throughout the system until the insulation at the weakest point breaks down. This breakdown can occur at any point in the electrical system, causing a phase-to-ground-to-phase fault.
- Although a ground fault can be detected or alarmed on the system, it is difficult to determine the location of the fault.

There are two methods used to detect ground faults on ungrounded systems. One method is to monitor the voltages between the phases and ground. As a ground fault develops, the faulted phase will collapse to ground potential, causing an indicator light to dim. The indicator lights on the unfaulted phases become brighter.

A second method to detect a ground fault is to measure the insulation resistance. As the insulation deteriorates, a relay continuously monitoring the insulation resistance can alarm at different levels for predictive maintenance. A visual indicator or meter can also be used.
**Solidly Grounded Systems**

Due to the problem of ungrounded systems, a shift in philosophy occurred and designs moved from ungrounded to grounded systems. In most cases, the type of grounding system chosen was solidly grounded. A solidly grounded system is a system of conductors in which at least one conductor or point is intentionally grounded (usually the neutral point of transformer or generator windings). The problem with the direct connection is that ground-fault current can be excessive, causing Arc-Flash hazards, extensive equipment damage, and possible injury to personnel. A solidly grounded system cannot continue to operate with a ground fault.

- In a solidly grounded system, the wye point (or neutral) of the power source is connected solidly to ground and offers a very stable system that maintains a fixed phase-to-ground voltage.
- The high ground-fault current is easy to detect with fuses, circuit breakers, or protection relays, allowing for selective tripping (tripping the faulted feeder and not the main feeder).
- When a ground fault occurs, high point-of-fault damage can quickly result since the energy available to the ground fault is only limited by the system impedance (which is typically very low).
- Due to excessive ground-fault current and Arc-Flash Hazards, the faulted feeder must be removed from service. This does not allow for continuous operation during a ground fault.

Figure 6 illustrates an example of the dangers associated with solidly grounded systems. In this example, a ground fault occurs and the overcurrent protection is set at 600 A.

Assume that this ground-fault is not a bolted fault, but an arcing fault due to an insulation breakdown or a partial reduction of clearances between the line and ground.

- Because of the arc resistance, fault current may be as low as 38% of the bolted-fault level. This can be in the range of a normal load or a slight overload.
- The fault current may be low enough that the overcurrent device (600-A circuit breaker) does not sense a fault, or may pick it up but not trip for a long time.
- The energy being supplied by the source is concentrated at the arc and could cause severe equipment damage very quickly. This energy release could cause a fire that in turn, could damage the premises and present an extreme hazard to personnel.

Aside from converting this solidly grounded system to resistance grounding, the best way to prevent damage is to detect low-level ground leakage prior to it becoming a ground fault. In order to accomplish this, the protection relay must be able to sense a low-level ground leakage without nuisance tripping.

In modern facilities, equipment often generates noise or harmonics that can interfere with a protection relay’s ability to function properly. For example, the noise or harmonics may be higher than the desired ground-fault relay settings, causing the relay to falsely operate when there is no fault on the system. The protection relay must be able to filter out noise or harmonics to provide reliable protection.

**Resistance-Grounded Systems**

Resistance grounding solves the problems commonly associated with both ungrounded systems and solidly grounded systems. The name is derived from the addition of a resistor between the system neutral and ground (as shown in Figure 7). The specifications of the resistor are user-determined to achieve a desired ground-fault current, which must be greater than the system capacitive charging current (explained later in this section).
• Transient overvoltages can be eliminated by correctly sizing the neutral-grounding resistor (NGR) to provide an adequate discharge path for the system capacitance.
• Continuity of operation with one ground fault is typically allowable when ground-fault current is ≤10 A.
• The NGR limits the available ground-fault current. This eliminates or minimizes point-of-fault damage (Arc-Flash Hazards) and controls the ground-fault voltage.
• Pulsing current can be used to locate ground faults when ground-fault current is ≤10 A. Pulsing current is created by using a shorting contactor to short out half of the resistance, causing the ground-fault current to double (usually one cycle per second). A hand-held zero-sequence meter is used to detect the fluctuating ground-fault current, and locate the ground fault.
• The only disadvantage of resistance grounding is that if the resistor fails, the system will become ungrounded. Resistor monitoring is recommended to protect against this.

A protection relay for resistance-grounded systems is used to detect a ground fault and to monitor the neutral-to-ground connection. It can be used to provide alarms or to trip the feeder from service upon the detection of a ground fault. The relay can provide a pulsing circuit that can be used to locate the ground fault. The relay can also alarm or trip if the neutral-to-ground path fails. For systems 5 kV and less, high-resistance grounding can be used. High-resistance grounding typically limits the resistor current to 10 A or less. By doing so, the ground fault can remain on the system, given that the system is rated for the voltage shift.

For systems above 5 kV, neutral-grounding resistors are typically rated for 25 A or more, and ground-fault current is cleared within 10 s.

**System Capacitive Charging Current**

Although not physically connected to ground, electrical conductors and the windings of all components are capacitively connected to ground. Consequently, a small current will flow to ground from each phase. This current does not occur at any particular location; rather, it is distributed throughout the system just as the capacitance to ground is distributed throughout the system. For analysis, it is convenient to consider the distributed capacitance as lumped capacitance, as shown in Figures 5, 6, 7, and 8.

Even if the distributed capacitance is not balanced, the ammeter will read zero because all the current flowing through the CT window must return through the CT window.

System charging current is the current that will flow into the grounding connection when one phase of an ungrounded system is faulted to ground (see Figure 9). It can be measured as shown below if appropriate precautions are taken:

• If the fault occurs on the supply side of the CT, the sum of the currents in the CT window is not zero.
• Ammeter A will read the sum of the capacitive currents in the unfaulted phases. This value is the charging current of all the equipment on the load side of the CT.

![](image.png) **FIGURE 9**

A single-line diagram of a three-feeder, resistance-grounded system with a fault on feeder 3 is shown in Figure 10.

• A CT (A1 and A2) on unfaulted feeders will detect the charging current of that feeder.
• A CT (A3) on a faulted feeder will detect the sum of the resistor current \( I_R \) and the charging currents \( I_1 + I_2 \) of the unfaulted feeders.

![](image.png) **FIGURE 10**
Selective coordination in a resistance-grounded system can be achieved if the pick-up setting of each ground-fault relay is greater than the charging current of the feeder it is protecting. If the pick-up setting of a ground-fault relay is less than the charging current of the feeder it is protecting, it will trip when a ground fault occurs elsewhere in the system. This is known as sympathetic tripping. Sympathetic tripping can be avoided by choosing a relay pickup setting larger than the charging current from the largest feeder. If the relative size of the feeders can change, or if the advantage of using one operating value for all ground-fault relays in a system is recognized, then it is prudent to select a pick-up setting for all ground-fault relays that is larger than the system charging current.

In order to eliminate transient overvoltages associated with an ungrounded system, it is necessary to use a grounding resistor with a let-through current equal to or larger than the system charging current. What is the minimum acceptable NGR current? Select a pick-up setting for the ground-fault relays that exceeds the largest feeder charging current and multiply the operating value by an acceptable tripping ratio. Use the greater of this value or system charging current and select the next-largest available standard let-through current rating.

Resistor Monitors

As discussed in the resistance-grounded systems section, a failure in the neutral-to-ground path will lead to a dangerous situation. Some examples of failure are stolen wires, loose connections, corrosion, and broken resistor elements. The resistor monitor continuously monitors the path from system neutral to ground for a problem. When a problem occurs, the monitor provides an alarm.

Ground-Continuity Monitors

Ground-check monitors are used to detect problems in equipment ground conductors. The cable powering mobile equipment typically has an extra wire, or pilot wire, routed with the phase conductors. A monitor uses this pilot wire to send a signal to a terminating device in the equipment, where the signal is sent back on the cable ground conductor to the monitor. The monitor continuously monitors this loop for open or short circuits, indicating that a problem has occurred. The monitor provides an alarm for this condition.

As an example, portable loads are grounded via single or multiple conductors in a trailing cable. A ground fault on a portable load will cause fault current to flow through the ground conductors and all other ground-return paths. A hazardous touch voltage can develop when the ground conductor opens and a ground fault develops, assuming there is not enough current to trip a ground-fault relay. If the portable equipment has rubber tires or is not in good contact with earth, then a person who touches the equipment under fault conditions will become part of the ground-return path.

Motor Protection

Overview

Motors are a significant investment and often run critical processes. Motor protection relays are used to protect the windings from damage due to electrical faults and thermal overloads. Adequate motor protection not only prevents motor damage, but also ensures optimal process efficiency and minimal interruption. Cost recovery for protection is achieved by extending the life of the motor, preventing motor rewinds and reducing downtime.

Common Motor Problems

Overload and Overtemperature

Insulation breakdown is a common reason for motor failure. Windings in the motor are insulated with organic materials including epoxy and paper. Insulation degradation occurs when winding temperature exceeds its rating. The National Electrical Manufacturers Association (NEMA) states that the time-to-failure of organic insulation is halved for each 8 to 10°C rise above the motor insulation-class rating. This point is illustrated in Figure 11.

Solution: An I²t Thermal Model provides thermal-overload protection of motor windings during all phases of operation. By integrating the square of the current over time, a thermal model can predict motor temperature and react much quicker than embedded temperature devices. A thermal model takes into consideration the motor service factor, full-load current and class. A dynamic thermal model adjusts the time-to-trip depending on how much motor thermal capacity has been used. Figure 12 illustrates the adjustment in trip time for different current levels at different levels of used thermal capacity (I²t).

A dynamic thermal model allows accurate protection of a motor and allows operations to get the maximum work out of a motor without sacrificing available life. If the motor is hot (high % used thermal capacity) it will trip more rapidly during an overload than if the motor is cold (0% used thermal capacity). In the event of a stall condition, when available motor torque is lower than the torque required by the load, the motor can be de-energized before it overheats.

Many old-technology electronic thermal overloads do not take into consideration the values of load current below the full-load current (FLA) pick-up value. Modern overload relays should model currents above and below the FLA pick-up current to achieve maximum output of the motor and maximum life of insulation.

On larger induction motors, blockage or loss of ventilation can cause motor hot spots that current-based protection cannot detect without the use of temperature sensors. Resistance temperature detectors (RTDs) are inexpensive devices installed between the stator windings during manufacturing and may be included on motor-end bearings.
An RTD has a linear change in resistance over its rated temperature range. Using information from an RTD, motor-protection relays can provide protection for loss-of-ventilation, loss-of-cooling, or high-ambient-temperature.

The RTD temperature reading can also be used as an input to the thermal model to improve protection. When hot-motor compensation is enabled, the maximum stator-RTD temperature is used to bias the thermal model by increasing used $\text{I}^2\text{t}$ when the RTD temperature is greater than the thermal-model temperature.

**Overcurrent, Jam and Undercurrent**

Overcurrent faults, also referred to as short circuits, can cause catastrophic motor failures and fires. Overcurrents can be caused by phase-to-phase, phase-to-ground, and phase-to-ground-to-phase faults.

A mechanical jam, such as a failed bearing or load, can cause stalling and locked-rotor current to be drawn by the motor, resulting in overheating.

Undercurrent protection is loss-of-load protection and is required by some codes as a safety measure. A water pump that cavitates can be dangerous. The water typically provides pump cooling. Without the cooling water, case temperature can reach an extremely high value. If valves are opened under these conditions and cold water is allowed to reach red-hot metal parts, the resulting steam pressures can destroy the pump and pose a serious personnel hazard.

**Solution:** A multifunction motor protection relay has multiple trip and alarm settings for current protection. Overcurrent protection is typically set above locked rotor current and has a minimal delay time. Overcurrent protection may be used to trip a breaker instead of a starter due to the high fault levels. Jam protection is set below overcurrent and has a slightly longer delay time. Jam protection prevents motor heating that would otherwise lead to an overload trip. Jam protection is enabled after the motor is running to avoid tripping on starting current. Undercurrent is set below full-load current to detect loss of load.

**Under and Overvoltage**

Overvoltages cause insulation stress and premature breakdown. Undervoltages, such as those caused by brownouts, can lead to increased motor heating. Torque developed by an electric motor changes as the square of the applied voltage. A 10% reduction in voltage results in a 19% reduction in torque. If the motor load is not reduced, the motor will be overloaded.

**Solution:** Under and overvoltage protection are features found in higher-end motor protection relays. Voltage protection can be used pro-actively to inhibit a start.

**Ground Faults**

Ground faults are the most common fault and can lead to more serious problems. Ground-fault protection, described elsewhere in this text, is an important consideration in motor loads.

**Solution:** The motor protection relay should be able to detect low-level ground-fault current when used on a resistance-grounded system.
**High-Resistance Winding Faults**

Winding-to-winding and winding-to-ground failures inside the motor are difficult to detect using the phase and ground-fault CTs due to low magnitudes of current.

**Solution:** Differential protection in high-end motor protection relays use multiple CTs to compare the current entering and leaving the winding. If there is a difference in currents then leakage is occurring. This sensitive protection is used on very large or critical motors.

**Current and Voltage Imbalance, Phase Loss, Phase Reverse**

Older motor protection devices did not consider current imbalance and today it is often overlooked. Imbalance increases negative-sequence current which causes additional rotor heating.

Phase loss is also referred to as single phasing. When a phase loss occurs, negative-sequence current is equal to the positive-sequence current and imbalance is 100%. In this condition, one motor winding attempts to do the work of three, inevitably leading to overheating.

Phase reversal causes the negative-sequence current and voltage to be greater than the positive-sequence current and voltage. Voltage-based protection is advantageous to prevent a start with incorrect sequence. In some applications attempting to spin the motor backwards will result in damage to the load. An example of this is certain impeller designs in downhole pumps.

**Solution:** Modern motor protection relays use digital signal analysis to measure true-sequence components. These sequence components are used for thermal model calculations and take the extra heating into consideration. Voltage imbalance which drives current imbalance can be used as a start inhibit. Sequence components are also used for calculating imbalance, phase loss and phase reversal.

**Motor Jogging**

NEMA-designed motors are rated for two starts from cold and one start from hot per hour. Motor jogging refers to excessive starts and can cause overheating. The motor may not get up to full speed and the forced air cooling is not effective.

**Solution:** Since the thermal model accurately tracks the motor’s used thermal capacity at all times, including during starts and between starts, the starts-per-hour feature may not be required.

It is included for compatibility with protection relays that do not have dynamic thermal-modeling capability.

**Motor Protection and the NEC**

The NEC® requires the motor to be protected by overload devices against excessive heating due to overload and failure to start (Article 430 Section III). Article 430, Section IV also specifies the use of devices to protect against overcurrents such as short circuits and grounds. Both of these NEC® requirements and many additional functions can be met with the use of a multifunction motor protection relay.

Article 430.32 (A)(4) requires the use of a protection device having embedded temperature detectors that cause current to the motor to be interrupted when the motor attains a temperature rise greater than marked on the nameplate in an ambient temperature of 40°C for motors larger than 1500 hp.

The NEC defines minimum requirements and is intended to provide protection from fire. Protection relays can provide many enhancements above simple fire protection.

**Communications**

Network communications can be added to a motor protection relay to allow remote metering of currents, voltages and temperatures. Data logging is a useful feature for troubleshooting and comparing event sequences with process stages. Analysis of information can often show operational issues.

**Arc-Flash Protection**

**The Consequences of Arc Flash**

Arcing and arc flashes are uncontrolled, intense, luminous discharges of electrical energy that occur when electric current flows across what is normally an insulating medium. The most common cause of arc faults is insulation failure. These failures may be caused by defective or aging insulation material, poor or incorrect maintenance, dust, moisture, vermin, and human error (touching a test probe to the wrong surface or a tool slipping and touching live conductors).

Arc-Flash events are dangerous, and potentially fatal, to personnel. According to OSHA, industrial Arc-Flash events cause about 80% of electrically-related accidents and fatalities among qualified electrical workers. Even if personnel injuries are avoided, Arc Flash can destroy equipment, resulting in costly replacement and downtime.

**Arc-Flash Safety Standards**

NFPA 70E, Handbook for Electrical Safety in the Workplace, outlines the practices and standards that companies should follow to protect workers and equipment from Arc Flash and other electrical hazards. It specifies practices designed to make sure that an electrically safe work condition exists. In Canada, CSA Z462, Workplace electrical safety, specifies safe workplace practices. There are also various provincial regulations pertaining to electrical safety.

The NFPA 70E and the CSA Z462 hold both employers and their employees responsible for creating a workplace for electrical workers that is not just safe but puts in place the best possible processes and procedures that are fully understood, practiced and enforced for optimal results. Using Arc-Flash relays is one way to protect the functional reliability of the distribution board and at the same time comply with the requirements of NFPA 70E and CSA Z462.
Arc-Flash Mitigation

NFPA 70E goes into great detail on procedures to avoid electrical shock and Arc-Flash events. Sometimes, though, it’s necessary to work on live circuits. For these cases, NFPA 70E specifies approach distances and use of personal protection equipment (PPE).

Current limiting fuses or current-limiting circuit breakers help protect against arc flashes. They allow only a certain amount of energy to pass before they open a circuit. Because an Arc Flash can draw a fraction of bolted-fault current, circuit breakers cannot be relied upon to distinguish between the arcing current and a typical inrush current.

High-resistance grounding (HRG) is another technique for protecting against arc flashes. If a phase faults to ground, then the resistance limits current to just a few amps; not enough to cause downtime by tripping the overcurrent protection device, and not enough to allow an Arc Flash. It is important to remember that while resistance grounding prevents Arc Flash from phase-to-ground shorts, it has no effect on phase-to-phase shorts.

Another way to mitigate the dangers of arc flashing is by redesigning the switchgear. Switchgear cabinets can be designed to contain and channel energy away from personnel during an Arc Flash.

Arc-Flash relays

Arc-Flash relays are microprocessor-based devices that use optical sensors to detect the onset of a flash. The sensors are strategically placed in various cubicles or drawers inside the switchboard.

Installing an Arc-Flash relay to rapidly detect developing arc flashes greatly reduces the total clearing time and the amount of energy released through an arc fault. In turn, there is less damage to equipment and fewer and less severe injuries to nearby personnel.

Arc-Flash Relay Selection Criteria

When selecting an Arc-Flash relay, there are six important criteria:

1. Reaction time
2. Trip reliability
3. Avoidance of nuisance tripping
4. Sensor design and installation
5. Ease of use

Reaction Time

Since light is the earliest detectable indication that an Arc Flash is occurring, Arc-Flash relays use optical light sensors to detect the arc that is forming. The output of the light sensor is hard-wired to the Arc-Flash relay, which trips a circuit that interrupts the energy supply in the Arc.

The response time of an Arc-Flash relay is approximately 1-5 ms at light intensities of about 10,000 lux or higher. Within that time frame, the optical sensor output can actuate a switch or circuit breaker to cut off current feeding the arc. The overall current clearing time depends on the protection strategy used and the performance of the external switch or circuit breaker used. The breaker will typically take an additional 35-50 ms to open, depending on the type of breaker and how well it is maintained.

The electronic output to turn on is a function of the type of output relay used. Solid-state outputs (for example, insulated gate bipolar transistors (IGBTs)) are much faster than electromechanical relays and can operate within 200 microseconds.

Trip Reliability

Reliable tripping is the most important characteristic of an Arc-Flash relay, because this ensures mitigation of an arc fault. Two aspects of reliability should be considered: trip redundancy and system-health monitoring.

Redundant Tripping. Arc-Flash relays should offer a redundant tripping feature, which means it has both primary and secondary trip path logic. The primary path is controlled by the internal microprocessor and its embedded software, and works by activating the coil of the primary trip relay.

The redundant path typically uses a discrete solid-state device that does not go through the microprocessor. Any failure in the primary (microprocessor) path will cause the unit to automatically switch to its redundant path, which activates a shunt-trip relay without delay when a sensor input is above the light detection threshold.

An often overlooked advantage of a solid-state trip path compared to a microprocessor-based circuit is the reaction time when the relay first powered up. Wiring mistakes, tools left in hazardous locations, and the regular stresses of powering up all contribute to the risk of an Arc Flash on power up. A microprocessor can require 200 ms or more before it is able to start scanning the optical sensors. However, a solid-state trip path can detect an Arc and send a trip signal in as little as 2 ms. In addition, there are fail-safe features that alert operators when, for example, the microprocessor fails.

Health monitoring. Health monitoring makes sure the system is in good operating condition and should extend from the light sensors to the output of the Arc-Flash relay trip circuitry. Health monitoring starts on the sensors. A signal is sent from the relay to the light sensors, where a test light is detected by the sensor and sent back to the relay. In the case of a fiber-optic sensor, this also verifies the entire length of the fiber is not pinched or broken. On-sensor health indication is critical in preventing maintenance work on equipment where protection is not working. It also has the added benefit of providing rapid fault location.

Following the path of a trip signal from the sensor, internal monitoring must also include the primary and redundant trip circuit. Low voltage across the IGBT indicates a wiring fault or an error in the trip coil, and a high voltage is a sign of an error in the IGBT switch, both of which are also reported and logged.

The IGBT is also thermally protected against overloads, and will turn off if it overheats. However, the thermal protection has a 100 ms delay before acting, meaning that even a dangerously overheated coil will attempt to signal a trip before resuming thermal protection.
III. CT APPLICATION

Current Transformers (CTs)

A current transformer is defined as a transformer that produces a current in its secondary circuit that is in proportion to current in its primary circuit.

Although there are other types of CTs, only the window (or ring) type will be discussed here. Window-type CTs get their name from their design that consists of a ring-shaped core. This core is formed by a single length of strip ferromagnetic material tightly wound to form the ring-shaped core.

A CT operates on a principle of flux balance, as shown in Figure 1. If the primary winding is energized with the secondary circuit open-circuited, the transformer becomes an iron-cored inductor. The primary current generates a magnetic flux in the core as shown (flux direction can be determined by the right-hand rule). When the secondary winding is connected to a burden or is short circuited, current flows through the secondary winding creating magnetic flux in the core in opposition to the magnetizing flux created by the primary current. If losses are ignored, the secondary flux balances exactly to the primary flux. This phenomenon is known as Lenz’s Law.

Lead Length

The secondary lead resistance of CTs cannot be ignored, particularly with low Volt-Amperes (VA) CTs. For example, let’s look at an electronic overload relay.

The relay’s CT input impedance or burden \( (Z_B) = 0.01 \, \Omega \)

The maximum current \( (I) = 10 \, A \)

The CT rating \( (P) = 5 \, VA \)

Now let’s solve for the maximum length of #14 AWG leads that will result in a rated accuracy for a 10 A secondary current. Solving for maximum total impedance \( (Z_T) \):

\[
P = I^2Z_T
\]

\[
Z_T = P / I^2 = 5 / 10^2 = 0.05 \, \Omega
\]

**Avoidance of Nuisance Tripping**

A typical Arc-Flash Relay system has an integrated three-phase current measurement function that detects and reacts to short circuit and overcurrent conditions. Although this is not a requirement for the system to operate, this option will increase the reliability of the system (minimize unwanted tripping).

If the microprocessor logic receives an input from a light sensor, it checks for a rapidly rising input from the current transformers. Two conditions need to be fulfilled before the trip is sent to the circuit breaker: a certain current flow that exceeds the normal operating current of the system (the threshold level is adjustable from 10-1000% of the full load current) and a signal from the arc-flash sensor, implying that the sensor has reacted to a high-intensity light source.

**Sensor Design and Installation**

Arc-Flash relay installations utilize multiple fixed-point light sensors near vertical and horizontal bus bars where arcing faults are apt to occur in feeder switchgear cabinets. Sufficient numbers of sensors should be installed to cover all accessible areas, even if policy is to only work on de-energized systems. At least one sensor should have visibility to an arc fault if a person blocks another sensor’s field of view. Light sensors may also be installed in other electrical cabinets and on panels that are subject to routine maintenance and repairs.

A fiber-optic sensor, which have a 360° field of view for detecting light, allows more flexible positioning of the light sensing locations, as the fiber-optic strands can be looped throughout an enclosure or panel to cover challenging component layouts.

**Easy to Use Hardware and Software**

Another important factor to consider is ease of use. Some relays may require field assembly, calibration, or advanced configuration before installing. It is critical to consider those extra steps and the capabilities of the operators who will be using the devices. Often, very complicated devices can be misused because of incorrect setup or configuration, which can defeat the purpose of the device altogether. A few Arc-Flash Relays have software that provides event logging. To make troubleshooting easier, this software should record the specific sensor that initiated the fault in the data records.
Solving for the maximum lead resistance (Z_W):

\[
Z_T = Z_W + Z_B \\
Z_W = 0.05 - 0.01 = 0.04 \ \Omega \\
\text{If we look up the #14 AWG resistance we find it equals} \\
2.6 \text{ ohms/1000 ft} \\\n\text{Therefore, lead length} = \frac{Z_W}{\#14 \text{ AWG resistance}} \\
\text{Maximum lead length} = \frac{(0.04 \times 1000)}{2.6} = 15.4 \text{ ft}
\]

IV. RESISTANCE-GROUNDING CONVERSION

Convert Ungrounded to Resistance-Grounded Systems

Resistance grounding protects a system against transient overvoltages caused by intermittent ground faults and it provides a method to locate ground faults. (Transient overvoltages and inability to locate ground faults are the most common safety issues with ungrounded systems.)

Conversion of delta-connected or wye-connected sources with inaccessible neutrals require a zigzag transformer to derive an accessible neutral for connection to a neutral grounding resistor (NGR). The neutral is only used for the NGR and not for distribution. During normal operation the only current that flows in the zigzag transformer is an extremely small magnetizing current. When one phase is grounded, the NGR and the zigzag transformer provide a path for ground-fault current to flow.

Design Note 1: A zigzag conversion requires a three-phase connection to the existing power system, typically at the main transformer or switchgear. See Figure 1.

Design Note 2: The resistor let-through current must be greater than the system capacitive charging current (see Section I).

Design Note 3: Protection, coordination, and annunciation systems depend on the integrity of the NGR. NGR monitoring with an SE-330 or SE-325 is recommended.

CT Installation

A CT should not be operated with its secondary open-circuited. If the secondary is opened when primary current is flowing, the secondary current will attempt to continue to flow so as to maintain the flux balance. As the secondary circuit impedance increases from a low value to a high value the voltage across the secondary winding will rise to the voltage required to maintain current flow. If the secondary voltage reaches the breakdown voltage of the secondary winding, the insulation will fail and the CT will be damaged. Furthermore, this situation presents a personnel shock hazard.

When a ring-type CT is used to monitor a single conductor or multiple conductors, the conductors should be centered in the CT window, as shown below in Figure 2, and should be perpendicular to the CT opening.

In some applications it is difficult or impossible to install the primary conductor through the CT window (example: existing bus bar structure). For these applications a split core CT is sometimes used. Performance of split core CTs may be less than that of solid core CTs.

CT characteristics are normally specified at a single frequency such as 50 or 60 Hz. Therefore the question arises: What happens when CTs are used with variable frequency drives (VFDs)? For CTs that are linear to approximately 10x rated primary current at 60 Hz, the Volts/Hertz ratio is approximately constant. That is, for all other conditions held the same at 6 Hz, the CT will be linear to only 1x rated current and at 30 Hz the CT will be linear to 5x rated current. For a standard silicon-steel-core CT, the upper bandwidth frequency is approximately 5 kHz.
UNGROUNDED SYSTEM

**Advantages**
- Operation possible with one faulted phase

**Disadvantages**
- Ground faults are difficult to locate
- Transient overvoltages damage equipment

SOLIDLY GROUNDED SYSTEM

**Advantages**
- Eliminates transient overvoltages
- Selective tripping possible

**Disadvantages**
- Costly point-of-fault damage
- Cannot operate with a ground fault
- Ground-fault Arc-Flash hazard
- Increased Arc-Flash risk

RESISTANCE-GROUNDED SYSTEM

**Advantages**
- Reduced point-of-fault damage and Arc-Flash risk
- Eliminates transient overvoltages
- Simplifies ground-fault location
- Continuous operation with a ground fault
- Selective tripping possible
- No ground-fault Arc-Flash hazard

**Disadvantages**
- Failure of the neutral-grounding resistor renders current-sensing ground-fault protection inoperative
Convert Solidly Grounded to Resistance-Grounded Systems

Resistance grounding protects a system against Arc-Flash Hazards caused by ground faults and provides a method for continuous operation or an orderly shutdown procedure. (Ground faults are estimated to be 98% of all electrical faults.) Since the neutral point of the power source is available, the solid connection between neutral and ground is replaced with a grounding resistor. This resistor limits ground fault current to a predetermined value, typically 5 A for 480 V systems (the system capacitive charging current is usually less than 3 A). By limiting the ground-fault current to 5 A or less, there are no Arc-Flash Hazards associated with ground faults. This allows for continuous operation during the first ground fault.

During a ground fault on a resistance-grounded (RG) system, a voltage shift occurs (the same shift experienced on ungrounded systems). The faulted phase collapses to ~0 V, the non-faulted phases rise to line-to-line voltage with respect to ground, and the neutral point rises to line-to-neutral voltage with respect to ground.

Figure 2

Design Note 1: An NGR conversion for a solidly grounded system requires a neutral connection to the existing power system, typically at the main transformer or switchgear. See Figure 2.

Design Note 2: The voltage shift requires equipment to be fully rated at line-to-line voltage with respect to ground. This may require TVSSs, VFDs, meters, etc. to be reconfigured or replaced.

Design Note 3: The voltage shift also restricts neutral distribution. The neutral typically cannot be distributed due to its potential rise during ground faults. Single-phase line-to-neutral-voltage loads must be served by a 1:1 isolation transformer or converted to line-to-line loads.

Design Note 4: The resistor let-through current must be greater than the system capacitive charging current (see Section I).

Design Note 5: Protection, coordination, and annunciation systems depend on the integrity of the NGR. Monitoring with an SE-330 or SE-325 NGR Monitor is recommended.
### IEEE Device Numbers

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Master Element</td>
</tr>
<tr>
<td>2</td>
<td>Time Delay Starting or Closing Relay</td>
</tr>
<tr>
<td>3</td>
<td>Checking or Interlocking Relay</td>
</tr>
<tr>
<td>4</td>
<td>Master Contactor</td>
</tr>
<tr>
<td>5</td>
<td>Stopping Device</td>
</tr>
<tr>
<td>6</td>
<td>Starting Circuit Breaker</td>
</tr>
<tr>
<td>7</td>
<td>Rate of Change Relay</td>
</tr>
<tr>
<td>8</td>
<td>Control Power Disconnecting Device</td>
</tr>
<tr>
<td>9</td>
<td>Reversing Device</td>
</tr>
<tr>
<td>10</td>
<td>Unit Sequence Switch</td>
</tr>
<tr>
<td>11</td>
<td>Multi-function Device</td>
</tr>
<tr>
<td>12</td>
<td>Overspeed Device</td>
</tr>
<tr>
<td>13</td>
<td>Synchronous-speed Device</td>
</tr>
<tr>
<td>14</td>
<td>Underspeed Device</td>
</tr>
<tr>
<td>15</td>
<td>Speed - or Frequency, Matching Device</td>
</tr>
<tr>
<td>16</td>
<td>Data Communications Device</td>
</tr>
<tr>
<td>17</td>
<td>Shunting or Discharge Switch</td>
</tr>
<tr>
<td>18</td>
<td>Accelerating or Decelerating Device</td>
</tr>
<tr>
<td>19</td>
<td>Starting to Running Transition Contactor</td>
</tr>
<tr>
<td>20</td>
<td>Electrically Operated Valve</td>
</tr>
<tr>
<td>21</td>
<td>Distance Relay</td>
</tr>
<tr>
<td>22</td>
<td>Equalizer Circuit Breaker</td>
</tr>
<tr>
<td>23</td>
<td>Temperature Control Device</td>
</tr>
<tr>
<td>24</td>
<td>Volts Per Hertz Relay</td>
</tr>
<tr>
<td>25</td>
<td>Synchronizing or Synchronism-Check Device</td>
</tr>
<tr>
<td>26</td>
<td>Apparatus Thermal Device</td>
</tr>
<tr>
<td>27</td>
<td>Undervoltage Relay</td>
</tr>
<tr>
<td>28</td>
<td>Flame Detector</td>
</tr>
<tr>
<td>29</td>
<td>Isolating Contactor or Switch</td>
</tr>
<tr>
<td>30</td>
<td>Annunciator Relay</td>
</tr>
<tr>
<td>31</td>
<td>Separate Excitation Device</td>
</tr>
<tr>
<td>32</td>
<td>Directional Power Relay</td>
</tr>
<tr>
<td>33</td>
<td>Position Switch</td>
</tr>
<tr>
<td>34</td>
<td>Master Sequence Device</td>
</tr>
<tr>
<td>35</td>
<td>Brush-Operating or Slip-Ring Short-Circuiting Device</td>
</tr>
<tr>
<td>36</td>
<td>Polarity or Polarizing Voltage Devices</td>
</tr>
<tr>
<td>37</td>
<td>Undercurrent or Underpower Relay</td>
</tr>
<tr>
<td>38</td>
<td>Bearing Protective Device</td>
</tr>
<tr>
<td>39</td>
<td>Mechanical Condition Monitor</td>
</tr>
<tr>
<td>40</td>
<td>Field (over/under excitation) Relay</td>
</tr>
<tr>
<td>41</td>
<td>Field Circuit Breaker</td>
</tr>
<tr>
<td>42</td>
<td>Running Circuit Breaker</td>
</tr>
<tr>
<td>43</td>
<td>Manual Transfer or Selector Device</td>
</tr>
<tr>
<td>44</td>
<td>Unit Sequence Starting Relay</td>
</tr>
<tr>
<td>45</td>
<td>Abnormal Atmospheric Condition Monitor</td>
</tr>
<tr>
<td>46</td>
<td>Reverse-phase or Phase-Balance Current Relay</td>
</tr>
<tr>
<td>47</td>
<td>Phase-Sequence or Phase-Balance Voltage Relay</td>
</tr>
<tr>
<td>48</td>
<td>Incomplete Sequence Relay</td>
</tr>
<tr>
<td>49</td>
<td>Machine or Transformer, Thermal Relay</td>
</tr>
<tr>
<td>50</td>
<td>Instantaneous Overcurrent Relay</td>
</tr>
<tr>
<td>51</td>
<td>AC Inverse Time Overcurrent Relay</td>
</tr>
<tr>
<td>52</td>
<td>AC Circuit Breaker</td>
</tr>
<tr>
<td>53</td>
<td>Exciter or DC Generator Relay</td>
</tr>
<tr>
<td>54</td>
<td>Turning Gear Engaging Device</td>
</tr>
<tr>
<td>55</td>
<td>Power Factor Relay</td>
</tr>
<tr>
<td>56</td>
<td>Field Application Relay</td>
</tr>
<tr>
<td>57</td>
<td>Short-Circuiting or Grounding (Earthing) Device</td>
</tr>
<tr>
<td>58</td>
<td>Rectification Failure Relay</td>
</tr>
<tr>
<td>59</td>
<td>Overvoltage Relay</td>
</tr>
<tr>
<td>60</td>
<td>Voltage or Current Balance Relay</td>
</tr>
<tr>
<td>61</td>
<td>Density Switch or Sensor</td>
</tr>
<tr>
<td>62</td>
<td>Time-Delay Stopping or Opening Relay</td>
</tr>
<tr>
<td>63</td>
<td>Pressure Switch</td>
</tr>
<tr>
<td>64</td>
<td>Ground (Earth) Detector Relay</td>
</tr>
<tr>
<td>65</td>
<td>Governor</td>
</tr>
<tr>
<td>66</td>
<td>Notching or Jogging Device</td>
</tr>
<tr>
<td>67</td>
<td>AC Directional Overcurrent Relay</td>
</tr>
<tr>
<td>68</td>
<td>Blocking or “Out-of-Step” Relay</td>
</tr>
<tr>
<td>69</td>
<td>Permissive Control Device</td>
</tr>
<tr>
<td>70</td>
<td>Rheostat</td>
</tr>
<tr>
<td>71</td>
<td>Liquid Level Switch</td>
</tr>
<tr>
<td>72</td>
<td>DC Circuit Breaker</td>
</tr>
<tr>
<td>73</td>
<td>Load-Resistor Contactor</td>
</tr>
<tr>
<td>74</td>
<td>Alarm Relay</td>
</tr>
<tr>
<td>75</td>
<td>Position Changing Mechanism</td>
</tr>
<tr>
<td>76</td>
<td>DC Overcurrent Relay</td>
</tr>
<tr>
<td>77</td>
<td>Telemetering Device</td>
</tr>
<tr>
<td>78</td>
<td>Phase-Angle Measuring Relay</td>
</tr>
<tr>
<td>79</td>
<td>AC Reclosing Relay</td>
</tr>
<tr>
<td>80</td>
<td>Flow Switch</td>
</tr>
<tr>
<td>81</td>
<td>Frequency Relay</td>
</tr>
<tr>
<td>82</td>
<td>DC Reclosing Relay</td>
</tr>
<tr>
<td>83</td>
<td>Automatic Selective Control or Transfer Relay</td>
</tr>
<tr>
<td>84</td>
<td>Operating Mechanism</td>
</tr>
<tr>
<td>85</td>
<td>Communications, Carrier or Pilot-Wire Relay</td>
</tr>
<tr>
<td>86</td>
<td>Lockout Relay</td>
</tr>
<tr>
<td>87</td>
<td>Differential Protective Relay</td>
</tr>
<tr>
<td>88</td>
<td>Auxiliary Motor or Motor Generator</td>
</tr>
<tr>
<td>89</td>
<td>Line Switch</td>
</tr>
<tr>
<td>90</td>
<td>Regulating Device</td>
</tr>
<tr>
<td>91</td>
<td>Voltage Directional Relay</td>
</tr>
<tr>
<td>92</td>
<td>Voltage and Power Directional Relay</td>
</tr>
<tr>
<td>93</td>
<td>Field Changing Contactor</td>
</tr>
<tr>
<td>94</td>
<td>Tripping or Trip-Free Relay</td>
</tr>
</tbody>
</table>

### ANSI Device Numbers

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFD</td>
<td>Arc Flash Detector</td>
</tr>
<tr>
<td>CLK</td>
<td>Clock or Timing Source</td>
</tr>
<tr>
<td>DDR</td>
<td>Dynamic Disturbance Recorder</td>
</tr>
<tr>
<td>DFR</td>
<td>Digital Fault Recorder</td>
</tr>
<tr>
<td>ENV</td>
<td>Environmental Data</td>
</tr>
<tr>
<td>HIZ</td>
<td>High Impedance Fault Detector</td>
</tr>
<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
</tr>
<tr>
<td>HST</td>
<td>Historian</td>
</tr>
<tr>
<td>LGC</td>
<td>Scheme Logic</td>
</tr>
<tr>
<td>MET</td>
<td>Substation Metering</td>
</tr>
<tr>
<td>PDC</td>
<td>Phasor Data Concentrator</td>
</tr>
<tr>
<td>PMU</td>
<td>Phasor Measurement Unit</td>
</tr>
<tr>
<td>PQM</td>
<td>Power Quality Monitor</td>
</tr>
<tr>
<td>RIO</td>
<td>Remote Input/Output Device</td>
</tr>
<tr>
<td>RTU</td>
<td>Remote Terminal Unit/Data Concentrator</td>
</tr>
<tr>
<td>SER</td>
<td>Sequence of Events Recorder</td>
</tr>
<tr>
<td>TCM</td>
<td>Trip Circuit Breaker</td>
</tr>
<tr>
<td>SOTF</td>
<td>Switch On To Fault</td>
</tr>
</tbody>
</table>

### Typical Suffixes

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Alarm/Auxiliary Power</td>
</tr>
<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>B</td>
<td>Battery/Blower/Bus</td>
</tr>
<tr>
<td>BT</td>
<td>Bus Tie</td>
</tr>
<tr>
<td>C</td>
<td>Capacitor/Condenser/Compensator/Carrier Current/Case/Compressor</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>E</td>
<td>Exciter</td>
</tr>
<tr>
<td>F</td>
<td>Feeder/Field/Filament/Filter/Fan</td>
</tr>
<tr>
<td>G</td>
<td>Generator/Ground</td>
</tr>
<tr>
<td>M</td>
<td>Motor/Metering</td>
</tr>
<tr>
<td>N</td>
<td>Network/Neutral</td>
</tr>
<tr>
<td>P</td>
<td>Pump/Phase Comparison</td>
</tr>
<tr>
<td>R</td>
<td>Reactor/Rectifier/Room</td>
</tr>
<tr>
<td>S</td>
<td>Synchronizing/Secondary/Stainer/Sump/Suction (Valve)</td>
</tr>
<tr>
<td>T</td>
<td>Transformer/Thyratron</td>
</tr>
<tr>
<td>TH</td>
<td>Transformer (High-voltage Side)</td>
</tr>
<tr>
<td>TL</td>
<td>Transformer (Low-voltage Side)</td>
</tr>
<tr>
<td>TT</td>
<td>Transformer (Tertiary-voltage Side)</td>
</tr>
<tr>
<td>U</td>
<td>Unit</td>
</tr>
</tbody>
</table>

Note: Descriptions per IEEE Std C37.2-1996

*Suffix N is preferred when the device is connected in the residual of a polyphase circuit, is connected across broken delta, or is internally derived from the polyphase current or voltage quantities. The suffix G is preferred when the measured quantity is in the path of ground or, in the case of ground fault detectors, is the current flowing to ground.
Appendix
Dimensional Drawings

DIMENSIONAL DRAWINGS

Figure 1

Figure 2

Figure 3

601; 601-CS-D-P1; 777; 777-ACCUPOWER; 777-KW/HP-P2; 77C; 77C-KW/HP

RS485MS-2W; COM 4-20

CIO-120-DN-P; CIO-DN-P; CIO-EN; CIO-MB; CIO-120-MB; CIO-777-PR

Measurements: inches (millimeters)
### Figure 4

![Diagram of RM1000]

Measurements: inches (millimeters)

- 4.544 [115.417]
- 3.819 [91.922]
- 2.5 [63.5]
- 0.9 [22.86]

#6 MOUNTING SCREWS PROVIDED

PANEL 0.062 - 0.100 THICK [1.574 - 2.54]

### Figure 5

![Diagram of RM2000]

Measurements: inches (millimeters)

- 5.97 [151.51]
- 1.02 [25.98]
- 0.99 [25.15]
- 6.37 [161.67]
Appendix
Dimensional Drawings

DIMENSIONAL DRAWINGS

Figure 6

DIMENSIONS

inches [millimeters]

Figure 7

DIMENSIONS

inches [millimeters]

Figure 8

DIMENSIONS

inches [millimeters]

Measurements: inches (millimeters)

ACBC-120; ALT; ALT-XXX-X-SW; ISS-101; PC-XXX-LLC; 201-100-SLD; 201A; 201A-AU; 201A-9; 201-XXX-SP; 201-XXX-DPDT; 201-XXX-SP-DPDT

© 2023 Littelfuse, Inc.

529 Littelfuse.com/relayscontrols
Figure 9

Informer; Informer-MS

DIMENSIONS:

- 5.50 in [139.7 mm]
- 3.6 in [91.44 mm]
- 1.125 in [28.57 mm]

Figure 10

FRONT

- 0.65 in [16.51 mm]
- 0.65 in [16.51 mm]
- 3.0 in [76.2 mm]
- 3.5 in [88.9 mm]

SIDE

- 0.65 in [16.51 mm]
- 2.084 in [52.933 mm]

BOTTOM

- 2.35 in [59.69 mm]
- 2.084 in [52.933 mm]

460; 460-15-100-XXX; 460-XXX-SP; ISS-100; ISS-102; PC-102

Figure 11

Measurements: inches (millimeters)
CT; ESD52233; ESDDR; FS100 (medium power); FS200; FS300; KRD3; KRDB; KRDR; KD; KRDM; KRDR; KRD; KRDP; KRPS; KSD1; KSD2; KSD3; KSDB; KSDR; KSDS; KSDU; KSPD; KSPS; KSPU; KVM; T2D120A15M; TA; TAC1; TDU; TDB; TDU; TDS; TL; TMV8000; TS1; TS2; TS41165; TS6; TSA141300; TSB; TSD1; TSD2; TSD4115S; TSD6; TSD7; TSD94110SB; TSDB; TSDR; TSDS; TSS; TSU2000

FA; FS; FSU1000*; PHS*; PTHF4900DK*; SIR1; SIR2; SLR1*; TH1; THC; TCR9; THD12410.5S; THD2; THD32420A; THD7; THDB; THDS; THS

*If unit is rated @ 1A, see Figure 16

APPENDIX – DIMENSIONAL DRAWINGS

Figure 16

Figure 17

Figure 18

Figure 19

Figure 20

Figure 21

Figure 22

Figure 23

Figure 24

Figure 25

Figure 26

Figure 27

APPENDIX – DIMENSIONAL DRAWINGS

CT; ESD52233; ESDDR; FS100 (medium power); FS200; FS300; KRD3; KRDB; KRDR; KD; KRDM; KRDR; KRD; KRDP; KRPS; KSD1; KSD2; KSD3; KSDB; KSDR; KSDS; KSDU; KSPD; KSPS; KSPU; KVM; T2D120A15M; TA; TAC1; TDU; TDB; TDU; TDS; TL; TMV8000; TS1; TS2; TS41165; TS6; TSA141300; TSB; TSD1; TSD2; TSD4115S; TSD6; TSD7; TSD94110SB; TSDB; TSDR; TSDS; TSS; TSU2000

FA; FS; FSU1000*; PHS*; PTHF4900DK*; SIR1; SIR2; SLR1*; TH1; THC; TCR9; THD12410.5S; THD2; THD32420A; THD7; THDB; THDS; THS

*If unit is rated @ 1A, see Figure 16

Measurements: inches (millimeters)
Appendix
Dimensional Drawings

DIMENSIONAL DRAWINGS

Appendix
Dimensional Drawings

Measurements: inches (millimeters)

© 2023 Littelfuse, Inc.
Appendix
Dimensional Drawings

DIMENSIONAL DRAWINGS

Measurements: inches (millimeters)

**Figure 39**

**Figure 40**

**Figure 41**

**Figure 42**

**Figure 43**

**Figure 44**

**Figure 45**

**Figure 46**

**Figure 47**

APPENDIX – DIMENSIONAL DRAWINGS

APPENDIX – DIMENSIONAL DRAWINGS

KEY

<table>
<thead>
<tr>
<th>MODEL NUMBERS ENDING IN:</th>
<th>N</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>0.440” (11.176 mm)</td>
<td>0.250” (6.350 mm)</td>
</tr>
<tr>
<td>X</td>
<td>3.620” (91.948 mm)</td>
<td>3.500” (88.900 mm)</td>
</tr>
<tr>
<td>Y</td>
<td>2.120” (53.848 mm)</td>
<td>2.500” (63.500 mm)</td>
</tr>
<tr>
<td>Z</td>
<td>0.190” (4.826 mm)</td>
<td>0.250” (6.350 mm)</td>
</tr>
</tbody>
</table>

MSM

LLC8

LLC1

NS = Nylon Standoffs

PCR

NPT = National Pipe Thread
Appendix
Dimensional Drawings

DIMENSIONAL DRAWINGS

Figure 48

Measurements: inches

Figure 49

NOTES:
1. DIMENSIONS IN MILLIMETERS (INCHES).
2. MOUNTING SCREWS: M4 OR 8-32.
3. OVERALL HEIGHT WHEN MOUNTED ON DIN EN50022 35-mm x 75-mm TOP-HAT RAIL.

Measurements: inches (millimeters)
Figure 50

Measurements: inches (millimeters)

MP8000

- Width: 4.08 (103.63)
- Height: 3.10 (78.74)
- Depth: 2.50 (63.50)
- Diameter: 0.63 (16.00)

Dimensions indicate the size and layout of the MP8000 component, providing a clear visual representation for design and installation purposes.
## Index

### ALPHANUMERIC INDEX

<table>
<thead>
<tr>
<th>102A Series</th>
<th>pg 198</th>
</tr>
</thead>
<tbody>
<tr>
<td>111-Insider-P / 231-Insider-P</td>
<td>101</td>
</tr>
<tr>
<td>111P / 233P / 233P-1.5 Series</td>
<td>106</td>
</tr>
<tr>
<td>201-100-SLD</td>
<td>136</td>
</tr>
<tr>
<td>201-XXX-DPDT Series</td>
<td>204</td>
</tr>
<tr>
<td>201-XXX-SP Series</td>
<td>190</td>
</tr>
<tr>
<td>201-XXX-SP-DPDT Series</td>
<td>192</td>
</tr>
<tr>
<td>201A Series</td>
<td>200</td>
</tr>
<tr>
<td>201A-AU Series</td>
<td>202</td>
</tr>
<tr>
<td>202 Series</td>
<td>206</td>
</tr>
<tr>
<td>202-200-SP Series</td>
<td>194</td>
</tr>
<tr>
<td>232-Insider</td>
<td>104</td>
</tr>
<tr>
<td>234-P</td>
<td>108</td>
</tr>
<tr>
<td>235P</td>
<td>110</td>
</tr>
<tr>
<td>250A Series</td>
<td>208</td>
</tr>
<tr>
<td>350 Series</td>
<td>210</td>
</tr>
<tr>
<td>355 Series</td>
<td>212</td>
</tr>
<tr>
<td>455 Series</td>
<td>214</td>
</tr>
<tr>
<td>460 Series</td>
<td>216</td>
</tr>
<tr>
<td>460-15-100-LLS</td>
<td>137</td>
</tr>
<tr>
<td>460-15-100-SLD</td>
<td>139</td>
</tr>
<tr>
<td>460-XXX-SP Series</td>
<td>196</td>
</tr>
<tr>
<td>50R Series</td>
<td>188</td>
</tr>
<tr>
<td>50R-400-ALT</td>
<td>159</td>
</tr>
<tr>
<td>601 Series</td>
<td>218</td>
</tr>
<tr>
<td>601-CS-D-P1</td>
<td>220</td>
</tr>
<tr>
<td>777 Series</td>
<td>114</td>
</tr>
<tr>
<td>777-P2</td>
<td>114</td>
</tr>
<tr>
<td>777-AccuPower</td>
<td>123</td>
</tr>
<tr>
<td>777-KW / HP-P2 Series</td>
<td>120</td>
</tr>
<tr>
<td>777 / 77C Series</td>
<td>118</td>
</tr>
<tr>
<td>77C-KW/HP Series</td>
<td>125</td>
</tr>
<tr>
<td>A0220</td>
<td>80, 473</td>
</tr>
<tr>
<td>AC / DC Earthed System</td>
<td>48</td>
</tr>
<tr>
<td>ACBC-120</td>
<td>130</td>
</tr>
<tr>
<td>Accessories</td>
<td>467</td>
</tr>
<tr>
<td>AC System Monitors / Load Sensors</td>
<td>22, 167</td>
</tr>
<tr>
<td>AF0100</td>
<td>79</td>
</tr>
<tr>
<td>AF0500</td>
<td>77</td>
</tr>
<tr>
<td>Alarm Control / Battery Charger</td>
<td>21, 130</td>
</tr>
<tr>
<td>ALT Series</td>
<td>153</td>
</tr>
<tr>
<td>ALT-J00X-1-SW / ALT-J00X-3-SW Series</td>
<td>155</td>
</tr>
<tr>
<td>Alternating Relays</td>
<td>20, 153</td>
</tr>
<tr>
<td>ANSI Device Numbers</td>
<td>506</td>
</tr>
<tr>
<td>Appendix – Dimensional Drawings</td>
<td>507</td>
</tr>
</tbody>
</table>

| Arc-Flash Protection | pg 14, 73 |
| ARP Series          | 157      |
| ASQU / ASTU Series  | 270      |
| Brackets & Clips    | 486      |
| CIO-777-PR          | 259      |
| CIO-DN-P / CIO-120-DN-P | 257    |
| CIO-EN              | 260      |
| CIO-MB / CIO-120-MB | 255      |
| COM 4-20            | 261      |
| Communication Adapters & Modules | 253, 476 |
| CP5 Series          | 168      |
| CT Application      | 502      |
| CT Selection Guide  | 479      |
| CT Series           | 426      |
| Current Monitoring / Load Sensing Relays | 24    |
| Current Monitoring Relays & Transducers | 167    |
| Current Transformers | 480      |
| Current Transformers Sizing Chart | 482    |
| D0920               | 74       |
| DCSA Series (w / LCSC10T12) | 185    |
| Dedicated Timers    | 28, 262  |
| Dimensional Drawings | 507    |
| DIN-Rail & Mounting Adapters | 485    |
| DLMU Series         | 224      |
| DSQU / DSTU Series  | 272      |
| ECS Series          | 175      |
| ECSW Series         | 178      |
| EL3100              | 44       |
| EL731               | 48       |
| Electrical Accessories | 469    |
| Enclosures & Watertight Covers | 487    |
| ERD3425A            | 391      |
| ERDI Series         | 362      |
| ERDM Series         | 275      |
| ESDS2233            | 422      |
| ESDR Series         | 393      |
| FA / FS Series      | 455      |
| FB Series           | 457      |
| FB9L                | 461      |
| Feeder Protection   | 14, 69   |
| Find the Right Product for Your Application | 2    |
| Flashers            | 39, 439  |
| Flashers, Beacon Tower | 41      |
| Flashers, Photo Control | 41     |
| Flashers & Tower Lighting Controls | 39, 439 |

© 2023 Littelfuse, Inc.  
Littelfuse.com/relayscontrols
## ALPHANUMERIC INDEX

<table>
<thead>
<tr>
<th>Index</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPS</td>
<td>71</td>
</tr>
<tr>
<td>FPU-32</td>
<td>70</td>
</tr>
<tr>
<td>FS100 (low current) Series</td>
<td>442</td>
</tr>
<tr>
<td>FS100 (med power) Series</td>
<td>444</td>
</tr>
<tr>
<td>FS200 Series</td>
<td>446</td>
</tr>
<tr>
<td>FS300 Series</td>
<td>448</td>
</tr>
<tr>
<td>FS491</td>
<td>450</td>
</tr>
<tr>
<td>FS500 Series</td>
<td>451</td>
</tr>
<tr>
<td>FSU1000 Series</td>
<td>440</td>
</tr>
<tr>
<td>Generator Ground-Fault Relay</td>
<td>55</td>
</tr>
<tr>
<td>GFA300</td>
<td>55</td>
</tr>
<tr>
<td>Glossary of Terms</td>
<td>490</td>
</tr>
<tr>
<td>Ground Reference Modules</td>
<td>472</td>
</tr>
<tr>
<td>High-Tension Couplers</td>
<td>472</td>
</tr>
<tr>
<td>HLMU Series</td>
<td>227</td>
</tr>
<tr>
<td>HLVA6123</td>
<td>241</td>
</tr>
<tr>
<td>HRDB Series</td>
<td>315</td>
</tr>
<tr>
<td>HRDI Series</td>
<td>364</td>
</tr>
<tr>
<td>HRDM Series</td>
<td>277</td>
</tr>
<tr>
<td>HRDR Series</td>
<td>396</td>
</tr>
<tr>
<td>HRDS Series</td>
<td>337</td>
</tr>
<tr>
<td>HRPS / HRIS Series</td>
<td>317</td>
</tr>
<tr>
<td>HVS Series</td>
<td>437</td>
</tr>
<tr>
<td>HSPZA22SL</td>
<td>339</td>
</tr>
<tr>
<td>IEEE Device Numbers</td>
<td>506</td>
</tr>
<tr>
<td>Industrial Shock-Block</td>
<td>53</td>
</tr>
<tr>
<td>Informer</td>
<td>250, 475</td>
</tr>
<tr>
<td>Informer-MS</td>
<td>252, 475</td>
</tr>
<tr>
<td>Input Modules</td>
<td>473</td>
</tr>
<tr>
<td>Instrumentation &amp; Metering Transformers</td>
<td>481</td>
</tr>
<tr>
<td>Intrinsically Safe Relays/Pump Controllers</td>
<td>21, 160</td>
</tr>
<tr>
<td>Introduction to Protection Relays</td>
<td>493</td>
</tr>
<tr>
<td>ISS-100</td>
<td>160</td>
</tr>
<tr>
<td>ISS-101</td>
<td>161</td>
</tr>
<tr>
<td>ISS-102 Series</td>
<td>163</td>
</tr>
<tr>
<td>ISS-105 Series</td>
<td>165</td>
</tr>
<tr>
<td>KRD3 Series</td>
<td>398</td>
</tr>
<tr>
<td>KRD9 Series</td>
<td>388</td>
</tr>
<tr>
<td>KRDB Series</td>
<td>319</td>
</tr>
<tr>
<td>KRD1 Series</td>
<td>366</td>
</tr>
<tr>
<td>KRD Series</td>
<td>319</td>
</tr>
<tr>
<td>KRDR Series</td>
<td>400</td>
</tr>
<tr>
<td>KRDS Series</td>
<td>341</td>
</tr>
<tr>
<td>KRPD Series</td>
<td>424</td>
</tr>
<tr>
<td>KRPS Series</td>
<td>281</td>
</tr>
<tr>
<td>KSD1 Series</td>
<td>284</td>
</tr>
<tr>
<td>KSD2 Series</td>
<td>368</td>
</tr>
<tr>
<td>KSD3 Series</td>
<td>402</td>
</tr>
<tr>
<td>KSD Series</td>
<td>321</td>
</tr>
<tr>
<td>KSDR Series</td>
<td>404</td>
</tr>
<tr>
<td>KSDS Series</td>
<td>343</td>
</tr>
<tr>
<td>KSDU Series</td>
<td>286</td>
</tr>
<tr>
<td>KSPD Series</td>
<td>406</td>
</tr>
<tr>
<td>KSPS Series</td>
<td>288</td>
</tr>
<tr>
<td>KSPU Series</td>
<td>370</td>
</tr>
<tr>
<td>KVM Series</td>
<td>243</td>
</tr>
<tr>
<td>LCSC101T12</td>
<td>473</td>
</tr>
<tr>
<td>LCS101T12 / LPM Series</td>
<td>185</td>
</tr>
<tr>
<td>Liquid Level Control</td>
<td>19, 129, 478</td>
</tr>
<tr>
<td>LLC1 Series</td>
<td>141</td>
</tr>
<tr>
<td>LLC2 Series</td>
<td>143</td>
</tr>
<tr>
<td>LLC4 Series</td>
<td>145</td>
</tr>
<tr>
<td>LLC5 Series</td>
<td>147</td>
</tr>
<tr>
<td>LLC6 Series</td>
<td>149</td>
</tr>
<tr>
<td>LLC8 Series</td>
<td>151</td>
</tr>
<tr>
<td>Load Sensors</td>
<td>22</td>
</tr>
<tr>
<td>LSR-0</td>
<td>169</td>
</tr>
<tr>
<td>LSR-XXX Series</td>
<td>170</td>
</tr>
<tr>
<td>LSRU Series</td>
<td>171</td>
</tr>
<tr>
<td>LSRX / LSRX-C Series</td>
<td>173</td>
</tr>
<tr>
<td>Motor &amp; Pump Protection</td>
<td>16, 93</td>
</tr>
<tr>
<td>Motor &amp; Pump Protection with Bluetooth®</td>
<td>17, 112</td>
</tr>
<tr>
<td>Mounting Adapters &amp; Enclosures</td>
<td>483</td>
</tr>
<tr>
<td>MP8000</td>
<td>112</td>
</tr>
<tr>
<td>MP8100</td>
<td>112</td>
</tr>
<tr>
<td>MPS</td>
<td>98</td>
</tr>
<tr>
<td>MPS-469X</td>
<td>100</td>
</tr>
<tr>
<td>MPU-32</td>
<td>96</td>
</tr>
<tr>
<td>MPU-32-X69X</td>
<td>100</td>
</tr>
<tr>
<td>MSM Series</td>
<td>291</td>
</tr>
<tr>
<td>Multifunction Timers</td>
<td>262</td>
</tr>
<tr>
<td>Neutral-Grounding Resistor Chart</td>
<td>61</td>
</tr>
<tr>
<td>Neutral-Grounding Resistor Package</td>
<td>66</td>
</tr>
<tr>
<td>NGR</td>
<td>66</td>
</tr>
<tr>
<td>NGRM-ENC</td>
<td>67, 487</td>
</tr>
<tr>
<td>NGR Monitoring</td>
<td>13, 61</td>
</tr>
<tr>
<td>ORB Series</td>
<td>323</td>
</tr>
<tr>
<td>ORM Series</td>
<td>293</td>
</tr>
<tr>
<td>ORS Series</td>
<td>345</td>
</tr>
<tr>
<td>Overview</td>
<td>pg 489</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Panel Mount Adapters</td>
<td>483</td>
</tr>
<tr>
<td>Personnel Protection</td>
<td>53</td>
</tr>
<tr>
<td>PC-102 Series</td>
<td>132</td>
</tr>
<tr>
<td>PC-105</td>
<td>133</td>
</tr>
<tr>
<td>PC-XXX-LLC-CZ / PC-XXX-LLC-GM</td>
<td>134</td>
</tr>
<tr>
<td>PCR Series</td>
<td>465</td>
</tr>
<tr>
<td>PGA-1100</td>
<td>81, 469</td>
</tr>
<tr>
<td>PGA-LS10</td>
<td>473</td>
</tr>
<tr>
<td>PGA-LS20</td>
<td>473</td>
</tr>
<tr>
<td>PGA-LS30</td>
<td>473</td>
</tr>
<tr>
<td>PGR-3100</td>
<td>45</td>
</tr>
<tr>
<td>PGR-3200</td>
<td>46</td>
</tr>
<tr>
<td>PGR-4300</td>
<td>45</td>
</tr>
<tr>
<td>PGR-6100</td>
<td>94</td>
</tr>
<tr>
<td>PGR-6101-120</td>
<td>95</td>
</tr>
<tr>
<td>PGR-8800</td>
<td>75</td>
</tr>
<tr>
<td>PHS Series</td>
<td>84</td>
</tr>
<tr>
<td>PLM Series</td>
<td>231</td>
</tr>
<tr>
<td>PLMU11</td>
<td>229</td>
</tr>
<tr>
<td>PLR Series</td>
<td>237</td>
</tr>
<tr>
<td>PLS Series</td>
<td>239</td>
</tr>
<tr>
<td>PRLM Series</td>
<td>295</td>
</tr>
<tr>
<td>Product Selection Guide</td>
<td>11</td>
</tr>
<tr>
<td>PRS65</td>
<td>347</td>
</tr>
<tr>
<td>PTHF4900DK</td>
<td>418</td>
</tr>
<tr>
<td>Pump Controls &amp; Liquid Level Controls</td>
<td>18, 129</td>
</tr>
<tr>
<td>Relay Application</td>
<td>494</td>
</tr>
<tr>
<td>Pump Protection</td>
<td>16, 98</td>
</tr>
<tr>
<td>Relay Software</td>
<td>468</td>
</tr>
<tr>
<td>Relay Testing Equipment</td>
<td>472</td>
</tr>
<tr>
<td>Remote Indication &amp; Meters</td>
<td>473-474</td>
</tr>
<tr>
<td>Remote Indication &amp; Monitoring</td>
<td>245, 475</td>
</tr>
<tr>
<td>Resistance-Grounded Systems</td>
<td>62, 504</td>
</tr>
<tr>
<td>Resistance-Grounding Conversion</td>
<td>503</td>
</tr>
<tr>
<td>Resistance Grounding</td>
<td>13, 61</td>
</tr>
<tr>
<td>RM1000 Series</td>
<td>246, 475</td>
</tr>
<tr>
<td>RM2000 Series</td>
<td>248, 475</td>
</tr>
<tr>
<td>RS Series</td>
<td>408</td>
</tr>
<tr>
<td>RS485MS-2W</td>
<td>254</td>
</tr>
<tr>
<td>SB6000 Series</td>
<td>53</td>
</tr>
<tr>
<td>SC3 / SC4 Series</td>
<td>453</td>
</tr>
<tr>
<td>SCR Series</td>
<td>459</td>
</tr>
<tr>
<td>SCR490D</td>
<td>458</td>
</tr>
<tr>
<td>SCR9L</td>
<td>463</td>
</tr>
<tr>
<td>SE-105 / SE-107</td>
<td>58</td>
</tr>
<tr>
<td>SE-134C / SE-135</td>
<td>pg 59</td>
</tr>
<tr>
<td>SE-325</td>
<td>62</td>
</tr>
<tr>
<td>SE-330 / SE-330HV</td>
<td>63</td>
</tr>
<tr>
<td>SE-330AU</td>
<td>65</td>
</tr>
<tr>
<td>SE-601</td>
<td>47</td>
</tr>
<tr>
<td>SE-701</td>
<td>50</td>
</tr>
<tr>
<td>SE-703</td>
<td>51</td>
</tr>
<tr>
<td>SE-704</td>
<td>52</td>
</tr>
<tr>
<td>Seal Leak Detectors</td>
<td>18, 129</td>
</tr>
<tr>
<td>Sequencing Controls</td>
<td>453</td>
</tr>
<tr>
<td>Sensing Resistors</td>
<td>474</td>
</tr>
<tr>
<td>Shock-Block GFCI</td>
<td>53</td>
</tr>
<tr>
<td>SIO-RTD-02-00</td>
<td>128</td>
</tr>
<tr>
<td>SIR Series</td>
<td>86</td>
</tr>
<tr>
<td>SLR Series</td>
<td>88</td>
</tr>
<tr>
<td>Sockets</td>
<td>488</td>
</tr>
<tr>
<td>Software</td>
<td>468</td>
</tr>
<tr>
<td>Solidly-Grounded Systems</td>
<td>43, 504</td>
</tr>
<tr>
<td>Switching Relays &amp; Controls</td>
<td>15, 83</td>
</tr>
<tr>
<td>T10 Series</td>
<td>274</td>
</tr>
<tr>
<td>T2D120A15M</td>
<td>428</td>
</tr>
<tr>
<td>TA Series</td>
<td>430</td>
</tr>
<tr>
<td>TAC1 Series</td>
<td>432</td>
</tr>
<tr>
<td>TCR9C</td>
<td>90</td>
</tr>
<tr>
<td>TCS Series</td>
<td>181</td>
</tr>
<tr>
<td>TCSA Series</td>
<td>183</td>
</tr>
<tr>
<td>TDB / T DBH / TDBL Series</td>
<td>325</td>
</tr>
<tr>
<td>TDI / TDIH / TDIL Series</td>
<td>372</td>
</tr>
<tr>
<td>TDM / TDMH / TDML Series</td>
<td>297</td>
</tr>
<tr>
<td>TDMB Series</td>
<td>420</td>
</tr>
<tr>
<td>TDR Series</td>
<td>410</td>
</tr>
<tr>
<td>TDS / TDSH / TDSL Series</td>
<td>348</td>
</tr>
<tr>
<td>TDU / TDUH / TDUL Series</td>
<td>299</td>
</tr>
<tr>
<td>TDUB Series</td>
<td>327</td>
</tr>
<tr>
<td>TDUI / TDUIH / TDUIL Series</td>
<td>374</td>
</tr>
<tr>
<td>TDUS Series</td>
<td>350</td>
</tr>
<tr>
<td>Termination &amp; Adapters</td>
<td>477</td>
</tr>
<tr>
<td>TH1 Series</td>
<td>301</td>
</tr>
<tr>
<td>THC / THS Series</td>
<td>352</td>
</tr>
<tr>
<td>THD1B410.5S</td>
<td>303</td>
</tr>
<tr>
<td>THD2 Series</td>
<td>376</td>
</tr>
<tr>
<td>THD3C42A0</td>
<td>412</td>
</tr>
<tr>
<td>THD7 Series</td>
<td>378</td>
</tr>
<tr>
<td>THDB Series</td>
<td>329</td>
</tr>
<tr>
<td>THDS Series</td>
<td>354</td>
</tr>
<tr>
<td>Time Delay Relays</td>
<td>26, 262</td>
</tr>
</tbody>
</table>
## ALPHANUMERIC INDEX

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer Function Guide</td>
<td>264</td>
</tr>
<tr>
<td>Timers, Factory-Programmable</td>
<td>26</td>
</tr>
<tr>
<td>Timers, Multifunction</td>
<td>27</td>
</tr>
<tr>
<td>Timing Function Symbols</td>
<td>264</td>
</tr>
<tr>
<td>TL Series</td>
<td>434</td>
</tr>
<tr>
<td>TMV8000/TSU2000 Series</td>
<td>305</td>
</tr>
<tr>
<td>Tower &amp; Obstruction Lighting Controls</td>
<td>39, 41, 439</td>
</tr>
<tr>
<td>Trailing Cable Protection</td>
<td>57</td>
</tr>
<tr>
<td>TRB Series</td>
<td>331</td>
</tr>
<tr>
<td>TRDU Series</td>
<td>265</td>
</tr>
<tr>
<td>TRM Series</td>
<td>307</td>
</tr>
<tr>
<td>TRS Series</td>
<td>356</td>
</tr>
<tr>
<td>TRU Series</td>
<td>268</td>
</tr>
<tr>
<td>TS1 Series</td>
<td>309</td>
</tr>
<tr>
<td>TS2/TS6 Series</td>
<td>380</td>
</tr>
<tr>
<td>TS441165</td>
<td>313</td>
</tr>
<tr>
<td>TSA141300</td>
<td>436</td>
</tr>
<tr>
<td>TSB Series</td>
<td>333</td>
</tr>
<tr>
<td>TSD1 Series</td>
<td>311</td>
</tr>
<tr>
<td>TSD2 Series</td>
<td>382</td>
</tr>
<tr>
<td>TSD3411S</td>
<td>414</td>
</tr>
<tr>
<td>TSD6 Series</td>
<td>384</td>
</tr>
<tr>
<td>TSD7 Series</td>
<td>386</td>
</tr>
<tr>
<td>TSD94110SB</td>
<td>390</td>
</tr>
<tr>
<td>TSDB Series</td>
<td>335</td>
</tr>
<tr>
<td>TSDR Series</td>
<td>416</td>
</tr>
<tr>
<td>TSDS Series</td>
<td>358</td>
</tr>
<tr>
<td>TSS Series</td>
<td>360</td>
</tr>
<tr>
<td>TVM Series</td>
<td>236</td>
</tr>
<tr>
<td>TVW Series</td>
<td>233</td>
</tr>
<tr>
<td>Typical Suffixes</td>
<td>506</td>
</tr>
<tr>
<td>Ungrounded AC Systems</td>
<td>43</td>
</tr>
<tr>
<td>Ungrounded DC System</td>
<td>47</td>
</tr>
<tr>
<td>Ungrounded System</td>
<td>504</td>
</tr>
<tr>
<td>Voltage Monitoring Relays</td>
<td>22, 167</td>
</tr>
<tr>
<td>WVM Series</td>
<td>222</td>
</tr>
</tbody>
</table>

---

**White Papers & Technical Information**

An expanded Technical Application Guide, White Papers, and a library of technical information is available online at [Littelfuse.com/TechnicalCenter](http://Littelfuse.com/TechnicalCenter). Littelfuse can help you address application and circuit protection challenges while achieving regulatory compliance.

---

**Introduction to Protection Relays and Applications**

- Lowering the Limits for Ground-Fault Protection
- The Importance of Effective Motor and Motor Circuit Protection
- Ground-Fault Protection with VFDs
- Selecting an Arc-Flash Relay
- Why NGRs Need Monitoring
- Transformer Protection

---

**Littelfuse Literature is in the App Store!**

Our free Littelfuse Catalogs and Literature App keeps our products and technical resources at your finger tips, wherever you are. Find products and technical specifications you need, quickly and easily!
Fuses and Fuse Holders Catalog (PF101N)
Littelfuse offers a complete circuit protection portfolio of industrial power fuses, including time-saving indication products for an instant visual blown-fuse identification.

POWR-GARD® Solar Catalog (PF140N)
POWR-GARD Solar Products are designed specifically for photovoltaic applications where issues such as heat, efficiency, longevity and global standards impact the choices in selecting circuit protection.

Visit Technical Resources at Littelfuse.com
Technical information is only a click away. The Littelfuse Technical Resources contains datasheets, product manuals, whitepapers, application guides, demos, online design tools, and more.

An Extension of Your Team

Technical Hotline (800-TEC-FUSE or 800-832-3873)
Littelfuse engineers are a phone call away to help identify potential issues and provide product recommendations to resolve problems.

Application and Field Support
Our experienced product and application engineers work step-by-step with customers from design to installation to determine the best solution.