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Innovation in electric power.

High Resistance Grounding Instruction Manual

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Caution

Disconnect electrical sources, power supplies, 480 volt neutral, etc. before adjusting, servicing, replacing parts or any other act that requires physical contact with any electrical components or wiring of this equipment. This work requires qualified personnel.

Instructions

1. Introduction

   A. There are several methods of grounding but the most common methods are ungrounded, solid ground, low resistance grounding, and high resistance grounding (HRG). Among these methods HRG provides the best performance. HRG is a method of inserting resistance between the transformer neutral and ground. This resistance functions as a fault current limiting device. For HRG's the common current level is 10A or less but can range up to 25A. The advantages of high resistance grounding are:

      i. Immunity to transient overvoltages.
      ii. Equipment protection against fault damage.
      iii. Continued protection after first ground fault.
      iv. Reduced frequency of faults.
      v. And of course, most importantly, is the safety of personnel.

   B. Out of all of the grounding methods high resistance grounding has been shown to provide the best possible results for the advantages mentioned above for 480V systems.

2. Description

   A. Functions

      i. The HRG unit is designed specifically for providing a high resistance ground from the neutral tap on a Wye (277V line to neutral) transformer. Along with the current limiting resistors additional functions have been provided for the convenience of the operator such as:

         1. A red "Normal" and green "Ground Fault", indicating lights.
         2. Remote undervoltage and ground fault alarm capability.
         3. Pulsing contactor system designed to allow the user to quickly locate the fault.
         4. A clamp-on ground-fault detector that is capable of clamping around 6" conduit (Optional).
         5. Disconnect switch to disconnect the HRG from the rest of the power system.
         6. Test button to check the ground fault circuit.
         7. Reset button to return system to normal operating conditions.
         8. Capability of setting the allowable ground-fault current to three different settings.

ii. Control functions are powered by a single-phase 120 volt external power source.

B. Enclosure

i. The enclosure is a NEMA 3R enclosure with 24" stands designed specifically for floor-mounting.

3. Installation

A. Receiving

i. Once received the HRG unit shall be carefully unloaded and moved by overhead crane or forklift. A preliminary inspection of the unit should be performed to ensure equipment was handled properly during shipment. If any damage has been detected contact the carrier immediately to file a claim. Before any installation work is started, check bill of materials and check that all necessary hardware is available. Then review inoLECT, LLC provided drawing for the HRG unit to ensure a general knowledge of the equipment operations and functions. Drawing includes arrangement, wiring, and schematic diagram.

B. Storage

i. If the unit is to be stored for some length of time it should be stored in an area that is clean and dry with moderate temperatures. If the unit must be stored in a damp area then it should be covered and heated to prevent condensation of moisture in the unit. Additionally, the space heaters in the unit must also be turned on.

C. Mounting

i. The HRG unit shall be floor mounted in an indoor or outdoor location. The desired mounting location must be level and strong enough to prevent future sagging due to the weight of the equipment. Sufficient height should also be considered to allow conduit entry through the side/bottom of the unit. The purchaser is responsible for anchoring the unit to the floor with anchors of suitable strength.

D. Grounding

i. The HRG unit enclosure must be properly grounded before making any power connections. It is important that proper grounding to the HRG unit be made to protect the operator from injury when ground faults or other abnormal occurrences take place and to insure that all parts of

the equipment, other than live parts, are at ground potential. The connection between the HRG unit ground and the station ground must be made in accordance to National Electrical Code.

E. Primary Wiring and Control Wiring

i. The location of the primary wiring termination point and the control cables are referenced in the drawing provided.
ii. The XO bushing, only, of the transformer to be protected shall be used for the primary cable connection.
iii. One single-phase 120 volt source and its respective neutral shall be used for the controls of the HRG unit. The connections of this wiring is referenced in the drawing provided.
iv. The routing of wiring, conduit, and connections shall be in accordance to the National Electrical Code.

F. Adjustments

i. The HRG unit shall be provided to the user with all adjustments made. Please do not make any adjustments without first consulting with a qualified inoLECT, LLC engineer.

G. Placing in Service

i. After all proper connections have been made and secured and the unit has been completely secured power the HRG as follows:
    1. Close the disconnect switch (DS) on the back panel of the HRG unit.
    2. Close the circuit on the external single-phase 120 volt control power source.
    3. Close the circuit breaker (BKR) on the back panel of the HRG unit.

4. Operation

A. When the HRG unit has been installed, control power is present, and normal operating conditions exist the green "Normal" operation lamp will be the only one illuminated.

B. As mentioned earlier when the first ground fault occurs the power system will still operate normally. It is recommended that faults are cleared as soon as possible to prevent damage to HRG unit and /or a second ground fault. When a ground fault occurs, the impedance of the resistors will limit the current across the grounding resistors which will be sensed by the meter relay (MR). After a 5 second time delay, controlled by the delay timer (DT) to allow any

unnecessary operation on system transients to pass, the delay timer (DT) will close its contacts illuminating the red "Ground Fault" light.

C. To locate the ground fault simply turn the "Selector Switch" (S1) to the "ON" position to enable the recycle timer (RT). The function of this relay is to enable and disable the pulsing contactor (PC) resulting in varying the resistance to ground and therefore current to ground for 2 second intervals. A ground fault clamp ammeter (optional item) can then be used to locate the fault as follows:

   i. Using the ground fault clamp ammeter clamp around 3 phase circuits in conduit or cabling until the amperage variance (pulsing) is detected on ground fault clamp ammeter. To further continue to move the ammeter clamp physically along circuit until fault is located.
   ii. If the ground fault is in the wiring once the clamp passes the physical location of the fault the pulsing will not be detected.
   iii. If the ground fault is in a load device (motor, etc.) further testing of the de-energized load device will reveal grounding.
   iv. Once the fault has been located be sure to return the "Selector Switch" (S1) to the "OFF" position. After the fault has been removed from the line push the "Reset" button to return the HRG unit to normal operating conditions.

D. Proper preventive maintenance checks should be performed on a regular basis on every HRG unit. To perform these checks see the following:

   i. Push "Test" pushbutton with "Selector Switch" (S1) in the "ON". This will simulate a ground fault and perform verification of recycle timer (RT), pulsing contactor (PC), delay timer (DT), "Ground Fault" light.
   ii. Push "Test" pushbutton with "Selector Switch" (S1) in the "OFF". This will simulate a ground fault and perform verification of "Ground Fault" light.
   iii. Once these checks have been performed push the "Reset" button to return the HRG unit to normal operating conditions.

Component Data

Neutral Grounding Resistor

POWEROHM RESISTOR, INC.

5713 13TH STREET

KATY, TX 77493

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR NEUTRAL GROUNDING RESISTORS

IMPORTANT: READ INSTRUCTIONS THROUGHLY BEFORE UNPACKING

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR POWEROHM NEUTRAL GROUNDING RESISTORS

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SHIPPING

After the final inspection, Powerohm Neutral Grounding Resistors are securely fastened, in an upright position, onto a wooden skid. In some cases, additional bracing and/or banding is added to insure a safe shipment. The units are then completely wrapped with plastic to protect the finish and keep the outer surface free of dirt and moisture. Depending on certain criteria, units are shipped either "open" or crated. All crates are constructed with 1" thick lumber. The finished package is easily handled with a forklift or hand truck.

All crates are clearly marked with the correct shipping information and requested customer marks. A copy of the packing list is securely fastened to the package in clear view.

NOTE: Each unit is provided with a copy of the certified test report (the originals are kept on file at the factory).

Normally, all crates are loaded by forklift into the enclosed van of a common carrier. At this point, it is the responsibility of the carrier to provide proper handling to the destination.

RECEIVING

Upon receipt, the crated unit should be unloaded and inspected immediately to insure that proper handling was practiced during transit. Report any apparent damage to the crate that could have harmed the contents.

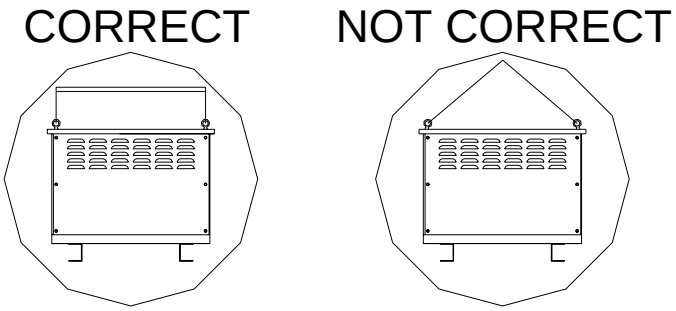
NOTE: Great care is taken to properly package your resistor, therefore, it is recommended that the unit remains crated until it reaches the job site.

All packaged neutral grounding resistors are suitable for prolonged storage. Always store the unit in the upright position (as shipped). Setting the crate on its side or top will likely cause damage to the resistor. Avoid stacking anything on top of the crate.

INSTALLATION

When ready for installation at the jobsite, uncrate the resistor using care not to damage the enclosure finish and/or external bushings. Next, remove the bolts which fasten the resistor enclosure to the skid.

It is recommended that a hoisting device be used to lift the unit with the aid of the eyebolts on the top of the enclosure. When using the eyebolts provided with Powerohm Resistors Inc. neutral grounding resistors located at the top of the enclosure, lifting must incorporate use of a spreading device to ensure a safe lift. Not utilizing a spreader while lifting the unit causes the eyebolts to be pulled at various angles resulting in roof damage. See examples below:



If a hoisting device is not available, a forklift can be used, provided the forks rest against the top of the mounting channels located on the bottom of the enclosure. Avoid resting the forks against the screened center.

NOTE: Do not remove the enclosure covers before lifting the resistor unit.

Powerohm Neutral Grounding Resistors can be mounted on a concrete pad, support stand or directly on top of the transformer (if the units size and weight will permit). Always mount the unit in the upright position. The unit should be bolted to the mounting surface using the 5/8" diameter holes provided at each corner of the mounting channels. Expansion type anchors are recommended for concrete pad mounting.

If the enclosure has an elevating stand, secure the stand to it's mounting surface before mounting the enclosure. Never lift the enclosure with the elevating stand attached.

NOTE: The enclosure should always be securely grounded to prevent a shock hazard to personnel or wildlife.

INSPECTION

After the resistor has been securely mounted, remove the front cover (the front cover can be identified by the Powerohm nameplate). Note: If the unit has external bushings mounted on the front cover, remove the back cover only. When installing the front or back cover, **DO NOT EXCEED 20 IN.-LBS WHEN TIGHTENING THE 1/4-20 COVER HARDWARE** (exceeding this torque value will damage the 1/4-20 threaded inserts).

After removing the cover, remove all packing material and banding, if any, used to support the insulators and resistor banks during shipment.

NOTE: Failure to remove packing material from the inside of the enclosure may result in fire hazard and/or resistor failure.

With the packing material removed, carefully inspect the inside of the unit for broken insulators, bushings and other parts that may have been damaged during shipment.

NOTE: If any damaged parts are found, contact the factory immediately. Energizing the unit may damage the resistor and create a shock hazard to personnel.

Finally, check all electrical connections to ensure tightness.

NEUTRAL CONNECTION

The neutral lead from the transformer or generator may be connected one of three ways depending upon the specific design (refer to the supplied drawing for terminal location):

1. The connection is made directly to a top or side mounted entrance bushing. The bushing may have an eyebolt connector (accepts bare cable), a copper stud connector (requires customer supplied lug) or a NEMA two or four hole pad type connector (requires customer supplied lug).

2. The connection is made directly to an internal terminal via rigid conduit entering from the bottom through enclosure knockouts. The terminal consists of a firmly supported stainless steel conductor (normally a Nema 2-hole pad). Cable termination will require a customer supplied compression type lug (that accepts up to 4/0 cable). The neutral terminal is tagged for easy identification. Location and termination of the conduit is the customer's responsibility.

3. The connection is made directly to the primary terminal of the current transformer which is mounted inside the enclosure. This terminal will be tagged "neutral" and requires a customer supplied lug and bolt. The other primary terminal of the current transformer has been factory wired to the resistive element. The neutral lead usually enters from the bottom through conduit. Sometimes the current transformer is factory wired to a top mounted entrance bushing in which case the connection is the same as the first example above.

NOTE: The factory supplied drawing identifies the neutral and ground connection.

In all cases, the neutral terminal is tagged for easy identification and the proper connection is shown schematically on the drawing.

Check all electrical connections to ensure tightness.

GROUND CONNECTION

The ground lead from the resistive element to ground may be connected one of two ways:

1. The connection is made directly to a top or side mounted entrance bushing. The bushing may have an eyebolt connector (accepts bare cable), a copper stud connector (requires customer supplied lug) or a NEMA two or four hole pad type connector (also requires customer supplied lug).

2. The connection is made directly to an internal terminal via rigid conduit entering from the bottom through enclosure knockouts. The terminal consists of a firmly supported stainless steel conductor (normally a Nema 2-hole pad). Cable termination will require a customer supplied compression type lug (that accepts up to 4/0 cable). The ground terminal is tagged for easy identification. Location and termination of the conduit is the customer's responsibility. Please note if a window type current transformer is present the ground cable must pass through the window of the current transformer and connect to the ground terminal (as identified above).

NOTE: The factory supplied drawing identifies the neutral and ground connection.

In all cases, the ground connection is tagged for easy identification and the proper connection is shown schematically on the drawing.

Check all electrical connections to ensure tightness.

ACCESSORIES

Neutral grounding resistors may come equipped with accessories such as ground fault sensing devices. If applicable please follow the instructions below when connecting this type of equipment.

1. If a sensing resistor is present both neutral and ground terminals come pre-wired by the factory. However signal leads must be field wired to the appropriate terminals on the ground fault monitoring device (see owner's manual).

2. If a current transformer is present the ground cable must pass through the window of the current transformer and connect to the ground terminal (as identified in step 2 of the ground connection section). In addition, the current transformer secondaries (X1 and X2) must be field wired to the appropriate terminals on the ground fault monitoring device (see owner's manual).

NOTE: The factory supplied drawing identifies these connections.

In all cases, both the neutral and ground connections are tagged for easy identification and proper connection is shown schematically on the drawing.

Check all electrical connections to ensure tightness.

MAINTENANCE

Normally, no maintenance is necessary on a neutral grounding resistor. However, periodic inspections for damage are needed to ensure that the resistor is still capable of protecting the system. Damage may occur from lightning, storms, earthquakes, wildlife, overloads or extended service life. Basically, it is necessary to ensure that the resistive element has not burned open and that the element (including the incoming bushing) is still properly isolated from ground.

The following procedure is recommended for periodic field inspections.

1. De-energize the system being grounded and break the connection between the system neutral and the grounding resistor. An isolation switch is some times available to break this connection. These precautions are recommended to prevent a shock hazard to maintenance personnel and to prevent the system from being operated without proper grounding.

2. Remove the front cover (which is on the same side as the nameplate) and the rear cover. This will allow for a visual inspection of all internal components.

3. Carefully check for cracked insulators or bushings. A Meggar or Hi-Pot test is the most reliable method of ensuring that the porcelain insulation is still providing the necessary electrical isolation.

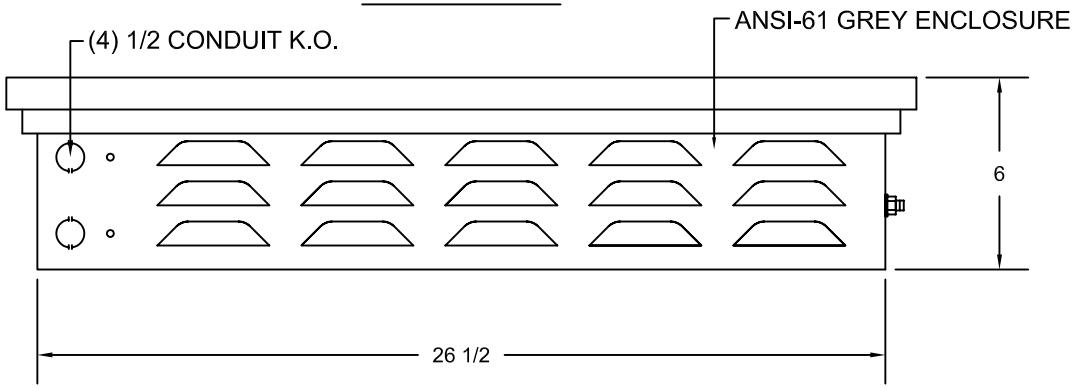
4. Check the resistive element for continuity. An ohmmeter reading made between the neutral and the ground side of the resistor should be within 10% of the nameplate value. If the resistance of the element is more than 15% off from the nameplate value, the resistors should be replaced.

5. Check all internal connections for tightness. Check wiring for signs of damage from heat or overloads.

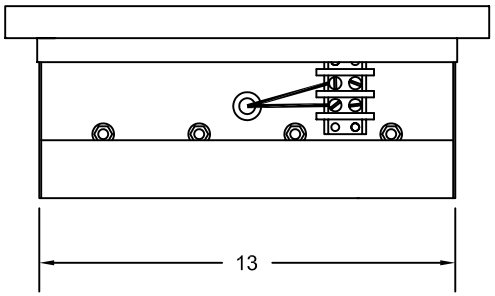
6. Check the enclosure for signs of damage from weather or rodents. Replace all covers removed during inspection and check the mounting bolts for tightness.

SYSTEM VOLTAGE: 480
L-N VOLTAGE: 277
INITIAL AMPS: 5
OHMS AT 25°C: 55.4
MAX. TEMP. RISE: 375°C

FRONT VIEW



LEFT SIDE VIEW

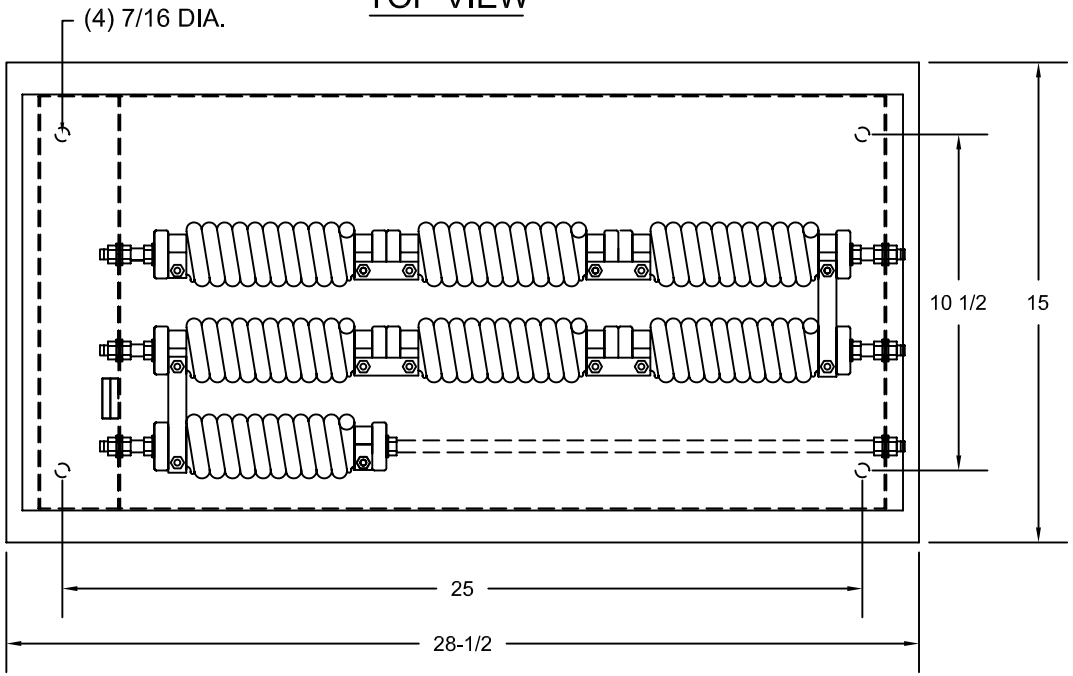


CAUTION-HOT SURFACE!

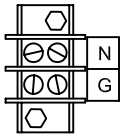
CONTACT MAY RESULT IN BURN INJURY.

ALLOW RESISTOR TO COOL BEFORE SERVICING

TOP VIEW



SCHEMATIC



WIRE N & G TO TERMINAL BLOCK (2800-2) WITH #10 HIGH TEMP.

TAP DATA

STEPS	OHMS
N - G	55.4

NAME PLATE DATA

POWEROHM RESISTORS, INC.
KATY, TEXAS
(800) 838-4694
MADE IN USA

NEUTRAL GROUNDING RESISTOR

SYSTEM VOLTAGE	480	L-N VOLTAGE	277
OHMS AT 25°C	55.4	AMPS	5
MAX. TIME ON	CONT.	TEMP. RISE	375°C
DATA LINE	NR277-5F23B10A1Y		
DRAWING NO.		SERIAL NO.	

UNIT IS FOR OUTDOOR USE. ACCESS CONNECTIONS THROUGH FRONT COVER. NAMEPLATE & CSA WARNING PLATE ARE LOCATED ON THE FRONT COVER. TOP AND REMOVABLE COVERS ARE GASKETED.

CAUTION: WHEN MOUNTING ON OR OVER A COMBUSTIBLE SURFACE, A FLOOR PLATE OF AT LEAST 1.43 mm GALVANIZED OR 1.6 mm UNCOATED STEEL EXTENDED AT LEAST 150 mm BEYOND THE EQUIPMENT ON ALL SIDES MUST BE INSTALLED.

GENERAL NOTES:

A. UNLESS OTHERWISE NOTED:
   1. ALL DIMENSIONS ARE IN INCHES.
B. FINISH: ANSI-61 GREY.

POWEROHM RESISTORS, INC.
5713 13TH STREET
KATY, TEXAS 77493
PHONE: (800) 838-4694

TEXT: NEUTRAL GROUNDING RESISTOR

DWG. NO.	REV.	SHEET
NR277-5F23B10A1Y	0	1 of 1

DRAWN BY	CHCK'D BY	DATE	SIZE
JWW	BDC	01/26/09	A

Enclosure, Back Panel, and Stand

Hinged Cover Type 3R Medium Enclosures

Application

Designed for use as a wiring box and junction box. Enclosure provides protection in outdoor installations against rain, sleet, and snow, or indoors against dripping water.

Construction

- 16 gauge or 14 gauge galvanized steel
- Drip shield top and seam-free sides, front, and back protect from rain, snow, or sleet
- 16 gauge galvanized steel continuous hinge has stainless steel pin
- Cover fastened securely with captive plated steel screws
- Hasp and staple provided for padlocking
- No gasketing or knockouts
- Collar studs provided for mounting optional panels

Finish

ANSI 61 gray polyester powder paint finish inside and out over galvanized steel. Optional solid panels are white.

Industry Standards

UL 50, File No. E27567, Type 3R
NEMA/EEMAC Type 3R
cUL CSA C22.2 No. 94, File No. E27525, Type 3R
IEC 60529, IP32

Accessories

Corrosion Inhibitors
Electric Heater
Grounding Device
Lock Kit (Keylock) for Type 12
Panel Support Kit
Panels (see Table)
Rack Mounting Angle Kit
Terminal Kit Assembly
Touch-Up Paint (ATPPY61)
Window Kit

Standard Sizes Hinged Cover Type 3R Medium Enclosures

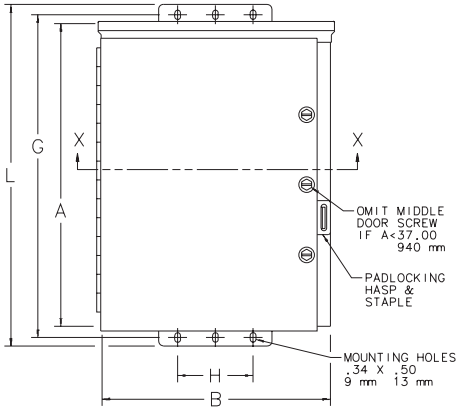
Enclosure Catalog Number	Enclosure Size A x B x C	* Panel Catalog Number	** Perforated Panel Catalog No.	Panel Size D x E	Mounting G x H	Overall L
A16R126HCR	16.00 x 12.00 x 6.00 (406 x 305 x 152)	A16P12	A16P12PP	13.00 x 9.00 (330 x 229)	17.00 x 5.00 (432 x 127)	18.00 (457)
A16R166HCR	16.00 x 16.00 x 6.00 (406 x 406 x 152)	A16P16	A16P16PP	13.00 x 13.00 (330 x 330)	17.00 x 13.00 (432 x 330)	18.00 (457)
A18R186HCR	18.00 x 18.00 x 6.00 (457 x 457 x 152)	A18P18	A18P18PP	15.00 X 15.00 (381 x 381)	19.00 X 13.00 (483 x 330)	20.00 (508)
A20R166HCR	20.00 x 16.00 x 6.00 (508 x 406 x 152)	A20P16	A20P16PP	17.00 x 13.00 (432 x 330)	21.00 x 13.00 (533 x 330)	22.00 (559)
A20R208HCR	20.00 x 20.00 x 8.00 (508 x 508 x 203)	A20P20	A20P20PP	17.00 x 17.00 (432 x 432)	21.00 x 13.00 (533 x 330)	22.00 (559)
A24R208HCR	24.00 x 20.00 x 8.00 (610 x 508 x 203)	A24P20	A24P20PP	21.00 x 17.00 (533 x 432)	25.00 x 13.00 (635 x 330)	26.00 (660)
A24R248HCR	24.00 x 24.00 x 8.00 (610 x 610 x 203)	A24P24	† A24P24PP	21.00 x 21.00 (533 x 533)	25.00 x 13.00 (635 x 330)	26.00 (660)
A30R248HCR	30.00 x 24.00 x 8.00 (762 x 610 x 203)	A30P24	† A30P24PP	27.00 x 21.00 (686 x 533)	31.00 x 13.00 (787 x 330)	32.00 (813)
A30R308HCR	30.00 x 30.00 x 8.00 (752 x 752 x 203)	A30P30	† A30P30PP	27.00 x 27.00 (686 x 686)	31.00 x 27.00 (787 X 686)	32.00 (813)
A18R1810HCR	18.00 x 18.00 x 10.00 (457 x 457 x 254)	A18P18	A18P18PP	15.00 x 15.00 (381 x 381)	19.00 x 13.00 (483 x 330)	20.00 (508)
A24R2410HCR	24.00 x 24.00 x 10.00 (610 x 610 x 254)	A24P24	† A24P24PP	21.00 x 21.00 (533 x 533)	25.00 x 13.00 (635 x 330)	26.00 (660)
A30R2410HCR	30.00 x 24.00 x 10.00 (762 x 610 x 254)	A30P24	† A30P24PP	27.00 x 21.00 (686 x 533)	31.00 x 13.00 (787 x 330)	32.00 (813)
A36R3610HCR	36.00 x 36.00 x 10.00 (914 x 914 x 254)	A36P36	† A36P36PP	33.00 x 33.00 (838 x 838)	37.00 x 30.00 (940 x 762)	38.00 (965)
A30R3012HCR	30.00 x 30.00 x 12.00 (762 x 762 x 305)	A30P30	† A30P30PP	27.00 x 27.00 (686 x 686)	31.00 x 27.00 (787 x 686)	32.00 (813)
A36R2412HCR	36.00 x 24.00 x 12.00 (914 x 610 x 305)	A36P24	† A36P24PP	33.00 x 21.00 (838 x 533)	37.00 x 13.00 (940 x 330)	38.00 (965)

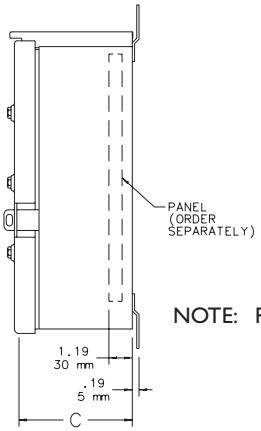
Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.
* Panels must be ordered separately. Optional aluminum panels are available for most sizes. See General Accessories.
** Purchase perforated panels separately. See page 7.30.
† Flanged on all four sides.

 ©2003 Hoffman Enclosures Inc.

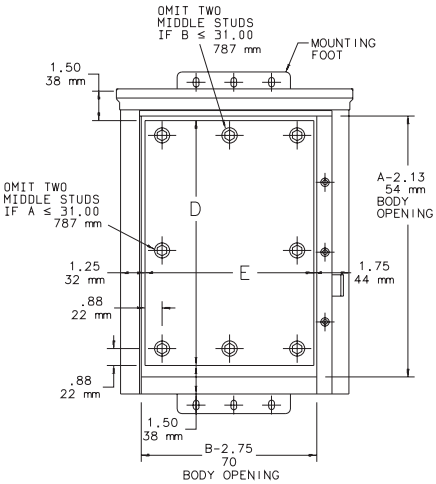
Standard Sizes Hinged Cover Type 3R Medium Enclosures (Cont.)

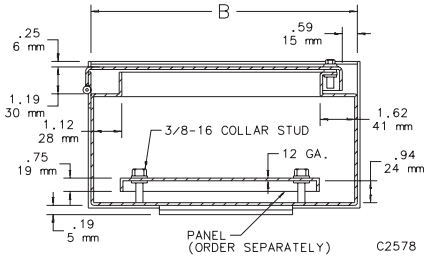
Enclosure Catalog Number	Enclosure Size A x B x C	* Panel Catalog Number	** Perforated Panel Catalog No.	Panel Size D x E	Mounting G x H	Overall L
A36R3012HCR	36.00 x 30.00 x 12.00 (914 x 914 x 305)	A36P30	† A36P30PP	33.00 x 27.00 (838 x 686)	37.00 x 27.00 (940 x 686)	38.00 (965)
A42R3012HCR	42.00 x 30.00 x 12.00 (1067 x 914 x 305)	A42P30	—	39.00 x 27.00 (991 x 686)	43.00 x 27.00 (1092 x 686)	44.00 (1118)
A36R3612HCR	36.00 x 36.00 x 12.00 (914 x 914 x 305)	A36P36	† A36P36PP	33.00 x 33.00 (838 x 838)	37.00 x 27.00 (940 x 686)	38.00 (965)
A42R3612HCR	42.00 x 36.00 x 12.00 (1067 x 914 x 305)	A42P36	—	39.00 x 33.00 (991 x 838)	43.00 x 27.00 (1092 x 686)	44.00 (1118)
A48R3612HCR	48.00 x 36.00 x 12.00 (1219 x 914 x 305)	A48P36	—	45.00 x 33.00 (1143 x 838)	49.00 x 27.00 (1245 x 686)	50.00 (1270)
A60R3612HCR	60.00 x 36.00 x 12.00 (1524 x 914 x 305)	A60P36	—	57.00 x 33.00 (1448 x 838)	61.00 x 27.00 (1549 x 686)	62.00 (1575)
A30R3016HCR	30.00 x 30.00 x 16.00 (762 x 762 x 406)	A30P30	† A30P30PP	27.00 x 27.00 (686 x 686)	31.00 x 27.00 (787 x 686)	32.00 (813)
A48R3616HCR	48.00 X 36.00 X 16.00 (1219 X 914 X 406)	A48P36	—	45.00 X 33.00 (1143 X 838)	49.00 X 27.00 (1245 X 686)	50.00 (1270)





NOTE: Panels have flanges along two sides when the side dimension is more than 21.00 inches (533mm). Panels A24P20 and A24P24 have flanges on all four sides.





SECTION X-X

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Panels

Panels for Type 3R, 4, 4X, 12 and 13 Enclosures

Steel panels are 12 gauge and have a white finish. Larger panels have flanges on two sides or four sides (see table). Some larger steel panels are 10 gauge and include extra holes for panel lifting (see table). Aluminum panels are 5052-H32 aluminum alloy. Larger panels have flanges on four sides (see table). Aluminum panels are protected on one side with a plastic film. Stainless steel panels are Type 316 stainless steel. Panel mounting hardware is furnished with all enclosures which accept these panels.

Steel Panel Catalog Number	Zinc-Plated Panel Catalog Number	Panel Thickness (ga.) or Flange Thickness ("T")	Aluminum Panel Catalog Number	Panel Thickness ("T")	Stainless Steel Panel Catalog Number	Panel Thickness (ga.)	Panel Size D x E inch	(millimeter)	Number of Holes	Edge Flanges
A12DLP12		12 ga.	—	—	—	—	9.00 x 9.00	(229 x 229)	4	None
A16P12	A16P12G	12 ga.	A16P12AL	0.10 (3)	A16P12SS6	12 ga.	13.00 x 9.00	(330 x 229)	4	None
A20P12		12 ga.	—	—	—	—	17.00 x 9.00	(432 x 229)	4	None
A16P16		12 ga.	A16P16AL	0.10 (3)	A16P16SS6	12 ga.	13.00 x 13.00	(330 x 330)	4	None
A20P16	A20P16G	12 ga.	A20P16AL	0.10 (3)	A20P16SS6	12 ga.	17.00 x 13.00	(432 x 330)	4	None
A24P16		12 ga.	—	—	A24P16SS6	12 ga.	21.00 x 13.00	(533 x 330)	4	None
A30P16		0.75 (19)	—	—	—	—	27.00 x 13.00	(686 x 330)	4	2
A20P20		12 ga.	A20P20AL	0.75 (19)	A20P20SS6	12 ga.	17.00 x 17.00	(432 x 432)	4	None*
A24P20	A24P20G	0.75 (19)	A24P20AL	0.75 (19)	A24P20SS6	12 ga.	21.00 x 17.00	(533 x 432)	4	2*
A30P20		0.75 (19)	—	—	A30P20SS6	12 ga.	27.00 x 17.00	(686 x 432)	4	2
A12P24		12ga.	—	—	—	—	9.00 x 21.00	(229 x 533)	4	None
A24P24	A24P24G	0.75 (19)	A24P24AL	0.75 (19)	A24P24SS6	12 ga.	21.00 x 21.00	(533 x 533)	4	2*
A30P24	A30P24G	0.75 (19)	A30P24AL	0.75 (19)	A30P24SS6	12 ga.	27.00 x 21.00	(686 x 533)	4	2*
A36P24		0.75 (19)	A36P24AL	0.75 (19)	A36P24SS6	12 ga.	33.00 x 21.00	(838 x 533)	6	2*
A42P24		0.75 (19)	—	—	—	—	39.00 x 21.00	(991 x 533)	6	2
A48P24		0.75 (19)	—	—	—	—	45.00 x 21.00	(1143 x 533)	6	2
A30P30		0.75 (19)	—	—	A30P30SS6	12 ga.	27.00 x 27.00	(686 x 686)	4	4
A36P30	A36P30G	0.75 (19)	A36P30AL	0.75 (19)	A36P30SS6	12 ga.	33.00 x 27.00	(838 x 686)	6	4
A40P30	A40P30G	0.75 (19)	—	—	—	—	37.00 x 29.00	(940 x 737)	4***	4
A42P30		0.75 (19)	—	—	A42P30SS6	12 ga.	39.00 x 27.00	(991 x 686)	6	4
A48P30		0.75 (19)	—	—	—	—	45.00 x 27.00	(1143 x 686)	6	4
A60P30		0.75 (19)	—	—	—	—	57.00 x 27.00	(1448 x 686)	6	4
A36P36		0.75 (19)	—	—	A36P36SS6	12 ga.	33.00 x 33.00	(838 x 838)	8	4
A42P36		0.75 (19)	—	—	A42P36SS6	12 ga.	39.00 x 33.00	(991 x 838)	8	4
A48P36	A48P36G	0.75 (19)	A48P36AL	0.75 (19)	A48P36SS6	12 ga.	45.00 x 33.00	(1143 x 838)	8	4
A60P36	A60P36G	0.75 (19)	A60P36AL	0.75 (19)	A60P36SS6	12 ga.	57.00 x 33.00	(1448 x 838)	8	4
A72P36		0.75 (19)	—	—	—	—	69.00 x 33.00	(1753 x 838)	8	4
A42P42		0.75 (219)	—	—	—	—	39.00 x 39.00	(991 x 991)	8	4
A48P42		0.75 (19)	—	—	—	—	45.00 x 39.00	(1143 x 991)	8	4
A54P42		0.75 (19)	—	—	—	—	50.00 x 38.00	(1270 x 965)	8	4
† A60BFP42		0.88 (22)	—	—	—	—	56.00 x 38.00	(1422 x 965)	10**	4
† A48P48		0.88 (22)	—	—	—	—	44.00 x 44.00	(1118 x 1118)	8	4
† A60P48		0.88 (22)	—	—	—	—	56.00 x 44.00	(1422 x 1118)	12**	4
† A60P60		0.88 (22)	—	—	—	—	56.00 x 56.00	(1422 x 1422)	10**	4
† A72P60		0.88 (22)	—	—	—	—	68.00 x 56.00	(1727 x 1422)	12**	4
† A72P72		0.88 (22)	—	—	—	—	68.00 x 68.00	(1727 x 1727)	10**	4

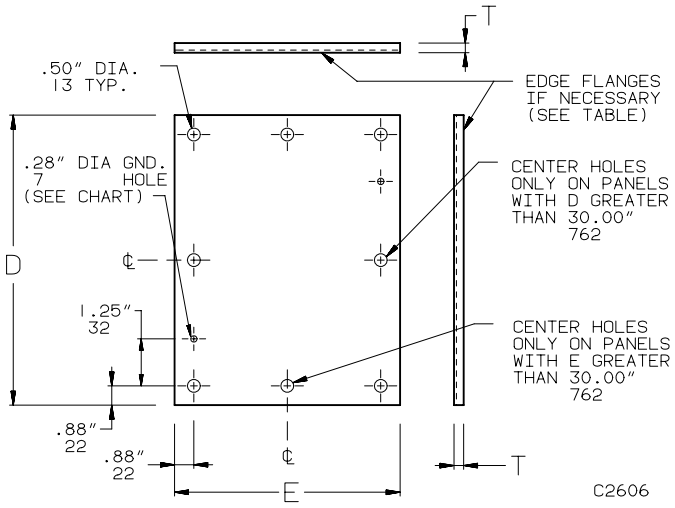
Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.

* Aluminum panels have four flanges.

** Extra holes are for panel lifting.

*** This panel is an exception to the illustration note regarding center holes on dimension "D".

† Panels are 10 gauge steel.



Additional panels are shown starting on page 12.63.

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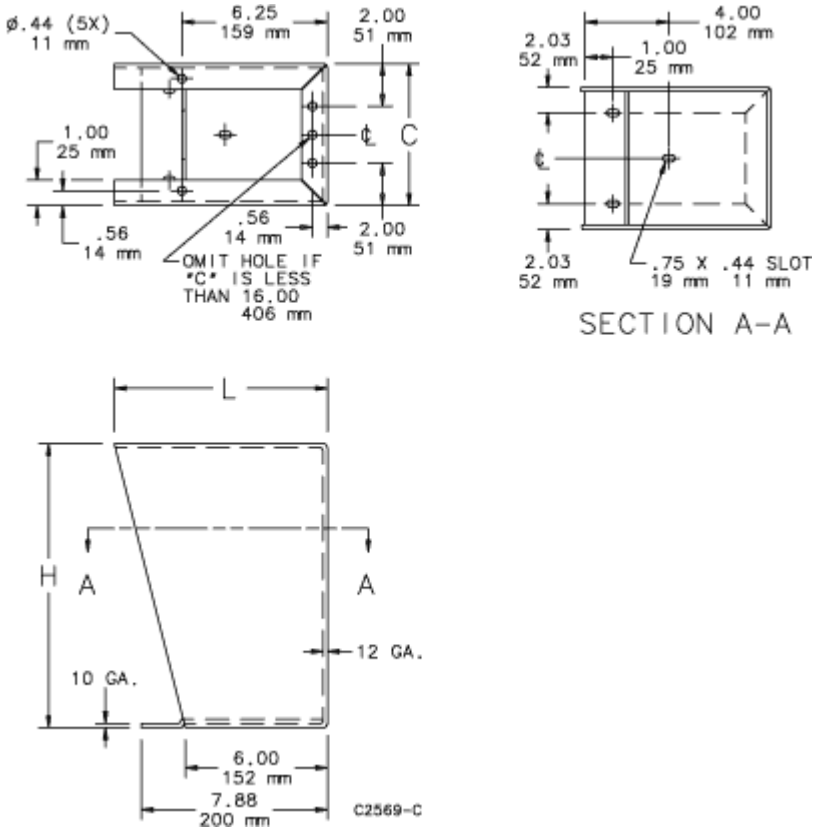
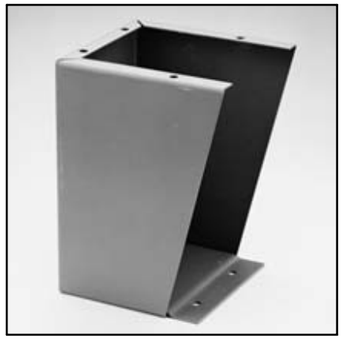
Catalog Number	Sizes	Material	Height, H (inch)	Height, H (mm)	Width, C (inch)	Width, C (mm)	L (inch)	L (mm)
AFK2416	(mm)	Steel	24.00	610	16.06	408	10.23	260





Hoffman®
A Pentair Company

Floor Stand Kit

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(763) 422–2211
www.hoffmanonline.com

Pentair Electronic Packaging
170 Commerce Drive
Warwick, RI 02886
(401) 732–3770
www.pentair–ep.com

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Circuito Comercial Plaza Satélite
Ciudad Satélite,
Naucalpan, México C.P. 53100
011–52–55–5393–8263

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75334 Straubenhardt
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44 (01442) 240471 www.schroff.co.uk

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Bjoernerudveien 24
1266 Oslo
47 022 76 33 60

⚠WARNING

To avoid electric shock, do not energize any circuits before all internal and external electrical and mechanical clearances are checked to assure that all assembled equipment functions safely and properly.

INSTALLATION INSTRUCTION:

1. Check the depth of the floor stand (”C” dimension) to verify it matches the enclosure depth dimension.
2. Anchor six 3/8 inch diameter studs (not provided with kit) securely in the floor as shown in figure 1.
3. Drill the appropriate hole pattern in the bottom of the enclosure as shown in figure 2.
4. Bolt the floor stand to the enclosure as shown in figure 3 using the 3/8–16x.75 hex head screws, washers, and nuts provided. Firmly tighten all fasteners.
5. Position the enclosure and attached floor stands over the anchored floor studs, extending the studs through the base holes in the floor stands.
6. Secure the floor stands to the anchored floor studs with 3/8 inch nuts and lockwashers or with 3/8 inch locknuts and washers (not provided with kit). Firmly tighten all fasteners.

This accessory maintains UL/CSA Type 12,4,4X when installed per these instructions.
This accessory is covered by UL file E61997 and CSA file LR42186.

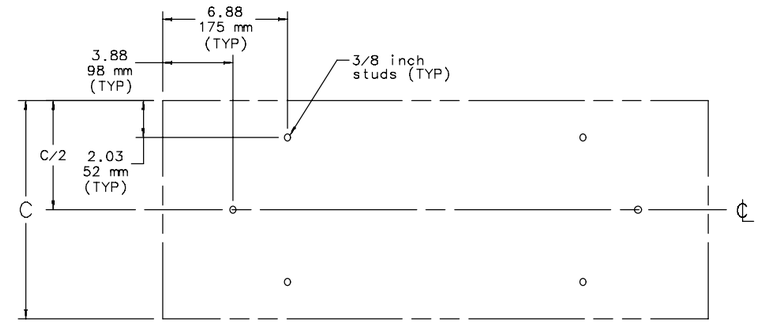


Figure 1 – Floor Stud Hole Pattern

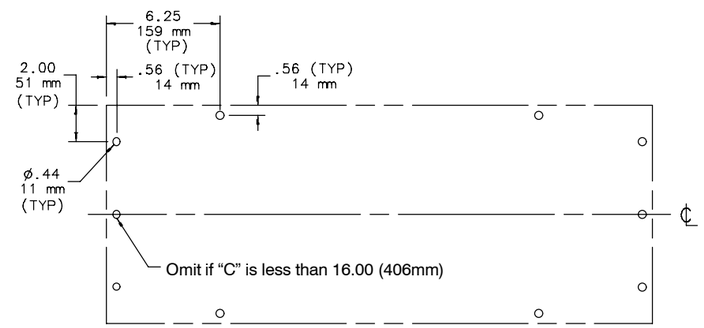


Figure 2 – Enclosure Bottom Hole Pattern

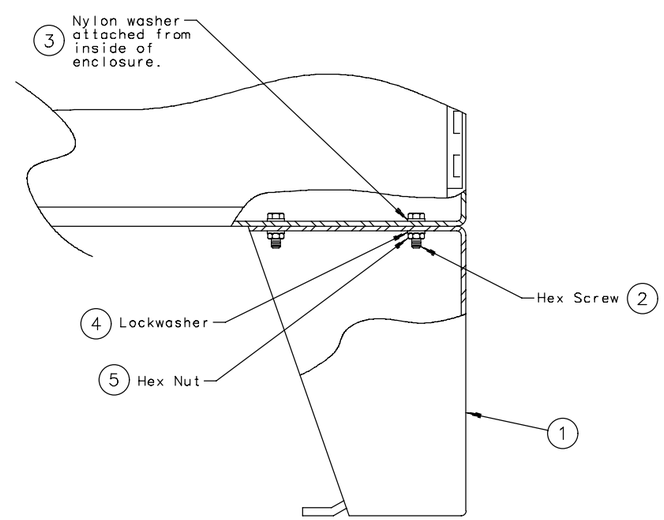
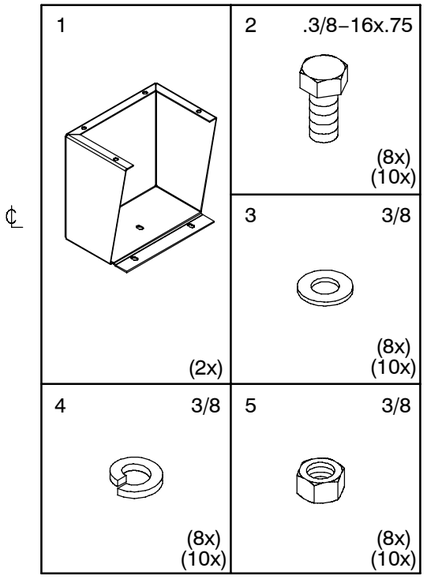


Figure 3



Catalog Number	“C”
AFK0608 AFK1208 AFK1208SS AFK1808 AFK2408	8.06
AFK0610 AFK1210 AFK1210SS AFK1810 AFK2410 AFK2410SS	10.06
AFK0612 AFK1212 AFK1212SS AFK1812 AFK2412 AFK2412SS AFK1224SS	12.06
AFK1216 AFK1216SS AFK1816 AFK2416	16.06
AFK1220	20.06
AFK0618 AFK1218 AFK1218SS	18.06

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Digital Voltmeter (MR)

800Plus

Universal Digital Meter

INSTRUCTION MANUAL

YOKOGAWA
Yokogawa Corporation of America

2 Dart Rd., Newnan, GA 30265
Phone: 770-251-8700 Fax: 770-251-2088
http://www.yca.com

ORDERING GUIDE

8 ... 800Plus

Display Color

1 ..... DPM with green LED
2 ..... DPM with red LED
3 .. Extended DPM/green LED
4 ..... Extended DPM/red LED

Note: Extended versions add rate of change and linearization of non-linear input signal capabilities. Not available for thermocouple or RTD inputs

Power

0 ..... 85 to 264Vac, 90 to 370Vdc
1 ..... 9 to 37 Vdc, 8 to 28 Vac

Setpoint Output

0 ..... None
1 ..... Dual 10 A relays
2 ..... Solid state relays

Analog Output

0 ..... None
1 ..... 0 to 20 mA, 0 to 10 Vdc

Digital Interface

0 ..... None
1 ..... RS-232
2 ..... RS-485
3 ..... BCD

Input Type

DC Volts

DCV1 ..... 200.00 mV
DCV2 ..... 2.0000 V
DCV3 ..... 20.000 V
DCV4 ..... 200.00 V
DCV5 ..... 660.0 V

DC Amperes

DCA1 ..... 2.0000 mA
DCA2 ..... 20.000 mA
DCA3 ..... 200.00 mA
DCA4 ..... 5.000 A

100 Ohm Platinum RTD's

P385C ..... -202 to 850°C
P385F ..... -331 to 1562°F
P392C ..... -202 to 850°C
P392F ..... -331 to 1562°F

Thermocouples

JC ..... -210 to 760°C
JF ..... -347 to 1400°F
KC ..... -244 to 1372°C
KF ..... -408 to 2501°F
TC ..... -257 to 400°C
TF ..... -430 to 752°F
EC ..... -240 to 1000°C
EF ..... -400 to 1830°F
NC ..... -244 to 1372°C
NF ..... -408 to 2501°F
SC ..... -46 to 1768°C
SF ..... -51 to 3214°F
RC ..... -45 to 1768°C
RF ..... -49 to 3213°F

Process Signals
(4 to 20 mA, 0 to 5 V, etc.)

P ... 4 to 20 mA=0 to 100.00
P1 ..... Custom Scaling

Specify minimum input signal and displayed reading and maximum input signal and displayed reading.

Strain Gauges, Potentiometers (4-wire ratio)

SG .. 0 to 200mV=0 to 100.00
SG1 ..... Custom Scaling

Specify minimum input signal and displayed reading and maximum input signal and displayed reading. Full scale input 200mV to 20V. 10 Vdc excitation.

RMS Volts

RMV1 ..... 200.00 mV
RMV2 ..... 2.0000 V
RMV3 ..... 20.000 V
RMV4 ..... 200.00 V
RMV5 ..... 660.0 V

RMS Amperes

RMA1 ..... 2.0000 mA
RMA2 ..... 20.000 mA
RMA3 ..... 200.00 mA
RMA4 ..... 5.000 A

Load Cells (6-wire ratio)

WM1 ..... -99,999 to +99,999.
Specify minimum input signal and displayed reading and maximum input signal and displayed reading. Full scale input 20 mV to 500 mV. 10 Vdc excitation.

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1. INTRODUCTION

This series of panel instruments is a versatile, cost effective solution to a wide variety of monitoring and control applications. These instruments are easily set to produce an accurate display of temperature, pressure, flow, weight, voltage or current. Front panel push-button or RS-232/RS-485 setup allows the user to customize the unit for a specific application. Digital scaling of zero and span provides direct readout in engineering units. Concurrent Slope (Pat 5,262,780) is a new method of analog-to-digital conversion that provides 60 conversions per second (50 for 50 Hz operation) while integrating over a full cycle of the line for maximum noise rejection. Self calibration cycles reduce the average reading rate to 56 per second (47 for 50 Hz). This fast read rate provides an accurate display of peak signal input and quick response in control applications. The adaptive auto filter automatically supplies a time constant compatible with the signal noise level. This ensures stable displayed readings and outputs while responding rapidly to changes of the input signal that exceed a selected threshold value. Selective security lockout of the front panel setup protects against accidental changes to the meter. The instrument uses a lightweight, high-efficiency switching power supply operating from AC or DC voltages. The meter can be powered worldwide without changes to the supply. An optional low voltage supply operates on 9 to 37 Vdc from batteries or 8 to 28 Vac from sources such as 400 Hz aircraft power. Both supplies have isolated 5, 10, and 24 Vdc excitation outputs to power transducers. The NEMA 4 (IP65) 1/8 DIN case is made of high impact, 94V-0 UL-rated plastic. Mounting is from the front of the panel and requires less than 110 mm behind the panel. All wiring is by removable plugs conforming to IEC950 safety standards. All output options are isolated from meter and power ground by 250 Vac minimum.

The extended DPM is capable of linearizing a nonlinear input signal such as a thermistor, gallons of liquid in a irregularly shaped tank, or altitude. Up to 240 points may be linearized by a computer program that stores the parameters via RS232 into permanent nonvolatile memory. The meter is also capable of measuring rate of change. The level of a tank is measured and the difference between readings determines the flow rate in or out of the tank.

The dual setpoints have two form C (10 A @ 250 Vac) relays or solid state relay outputs for alarm and control capabilities. Either setpoint may be latching or nonlatching and separately configured to be energized above or below the setpoint, as deviation alarms, or in a fail-safe mode. Additionally, outputs may also be selected to operate from the filtered signal to reduce relay chatter or from the unfiltered signal for fast response. Snubber circuits, programmable relay switching time delay and selectable hysteresis extend relay contact life.

Isolation of the 4 to 20 mA and 0 to +10 V analog outputs eliminates ground loop problems. The output may be scaled by front panel push-buttons or RS-232/RS-485. For thermocouples and RTD's, the output is linearized. The 4 to 20 mA output will drive up to an 600 Ohm load with 12 V compliance

The meter offers RS232 or RS485 bidirectional communications or parallel, 3-state BCD output to interface with computers, PLC's or other digital devices. IBM PC compatible software is available for programming the unit by the RS232 and RS-485 interfaces.

2. RECEIVING AND UNPACKING

Your meter was carefully tested and inspected prior to shipment. Should the meter be damaged in shipment, notify the freight carrier immediately. In the event the meter is not configured as ordered or the unit is inoperable, return the unit to the place of purchase for repair or replacement. Please include a detailed description of the problem.

3. SAFETY CONSIDERATIONS

Warning ⚠ : The use of this equipment in a manner other than specified may impair the protection of the device and subject the user to a hazard.

Visually inspect the unit for signs of damage. If the unit is damaged, do not attempt to operate.

This unit must be powered with AC (mains) from 85 to 264 Vac (90 to 370 Vdc) with the high voltage power supply option or 8 to 28 Vac (9 to 37 Vdc) with the low voltage power supply option. Verify that the proper power option is installed for the power to be used.

This meter has no AC (mains) switch; it will be in operation as soon as power is connected.

Caution: The 85 to 264 Vac (90 to 370 Vdc) mains connector (J1 Pins 1-3) is color coded Light Blue to differentiate it from other input and output connectors. The 8 to 28 Vac (9 to 37 Vdc) mains connector is not color coded because these voltages are not considered hazardous.

Do not make signal wiring changes or connections when power is applied to the instrument. Make signal connections before power is applied and, if reconnection is required, disconnect the AC (mains) power before such wiring is attempted.

To prevent electrical or fire hazard, do not expose the instrument to excessive moisture.

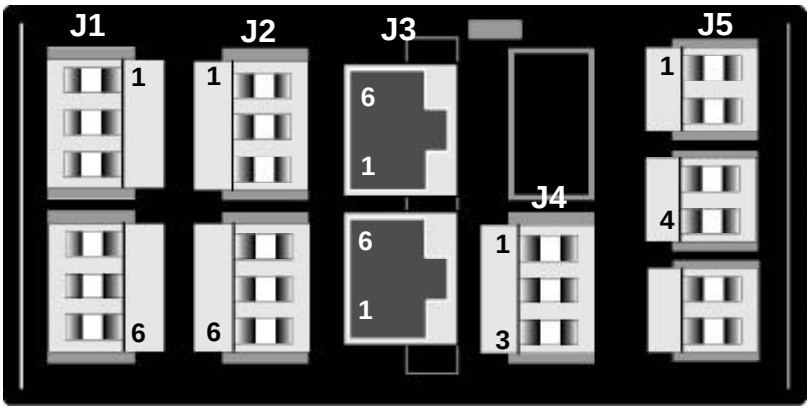
Do not operate the instrument in the presence of flammable gases or fumes; such an environment constitutes a definite safety hazard. This meter is designed to be mounted in a metal panel.

Verify the panel cutout dimensions and mount according to instructions.

4. CONNECTOR WIRING INFORMATION

4.1 CONNECTOR LOCATION

The connectors are the screw terminals that plug into the mating jack mounted on the printed circuit board. P3 is either a 6 conductor phone plug for RS-232 and RS-485 or a 30 pin, mass termination, edge connector for parallel BCD.



4.2 J1 - POWER AND DIGITAL CONTROLS

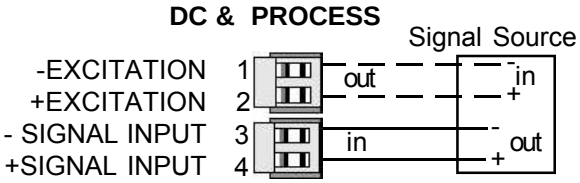
AC HI (+DC HI)	1
AC LO (DC RET)	2
EARTH GROUND	3
DIGITAL INPUT B (+5V OUT)*	4
DIGITAL INPUT A*	5
DIGITAL GROUND	6

*Note: Non-isolated digital control inputs A and B are menu selectable for Tare, Peak Display, Hold, or Reset and external control of decimal points.

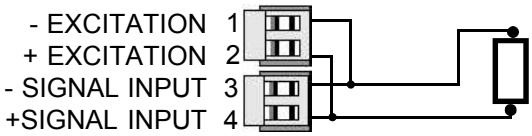
Digital Input B selected - Jumper "**h**"
+5V Output selected - Jumper "**g**"

4.3 J5 - SIGNAL INPUT

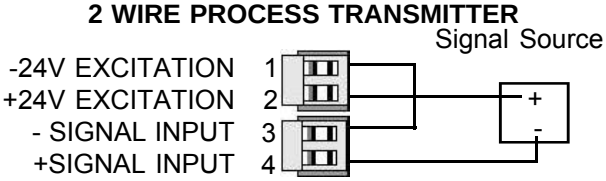
DC & PROCESS



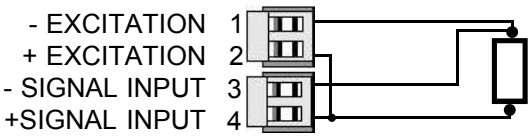
RTD (2-WIRE)



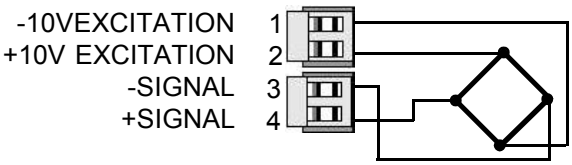
2 WIRE PROCESS TRANSMITTER



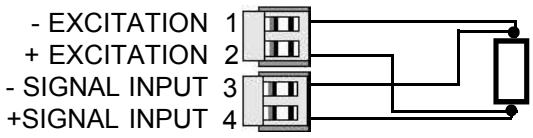
RTD (3-WIRE)



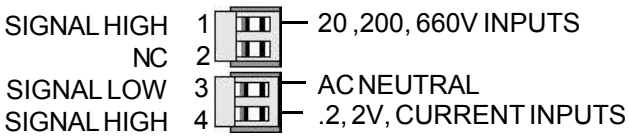
STRAIN GAUGE



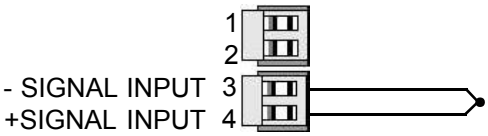
RTD (4-WIRE)



AC (TRUE RMS)

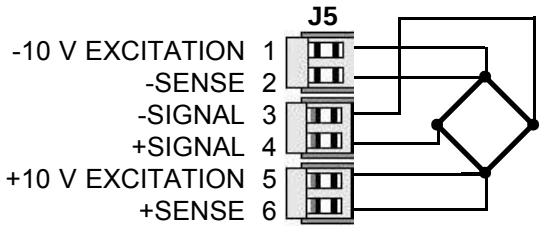


THERMOCOUPLE

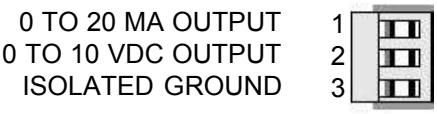


4.3 J5 - SIGNAL INPUT (CONTINUED)

LOAD CELL METER

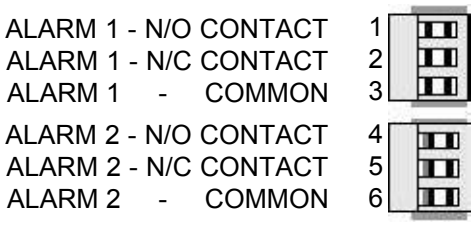


4.4 J4 - ANALOG OUTPUT

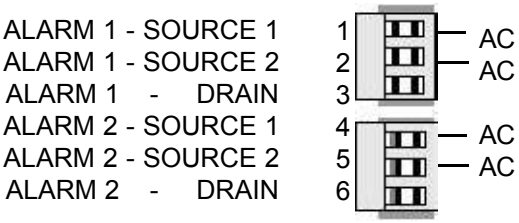


4.5 J 2 - DUAL SETPOINT CONTROLLER

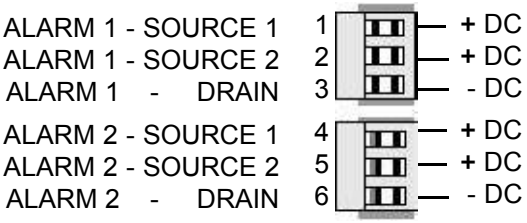
RELAY OUTPUTS



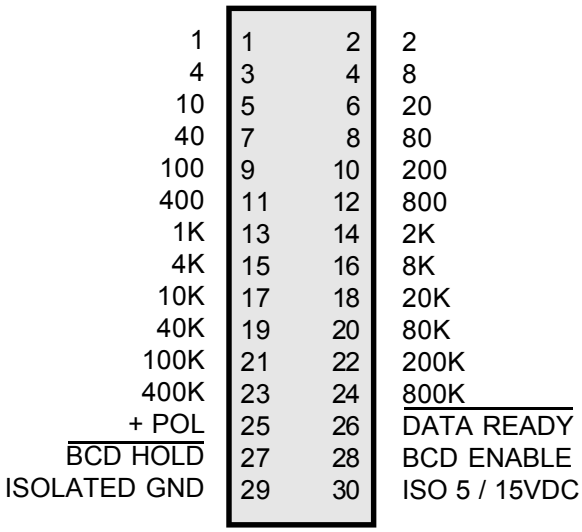
SOLID STATE RELAY OUTPUTS
Switching AC 125Vac @120 ma max.



SOLID STATE RELAY OUTPUTS
Switching DC 125Vdc @240 ma max.

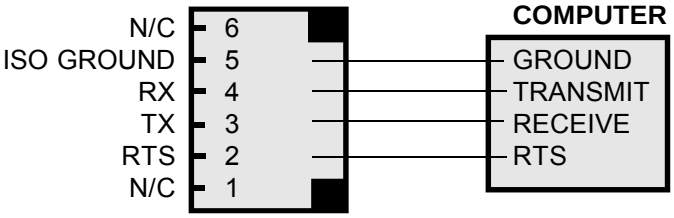


BCD OUTPUT

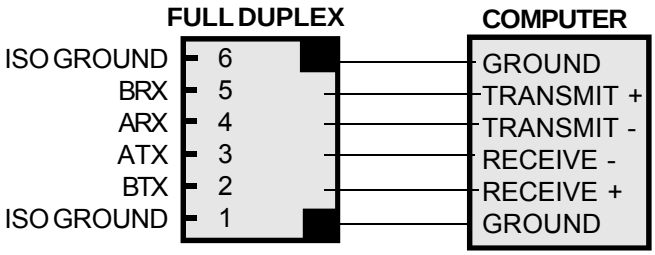


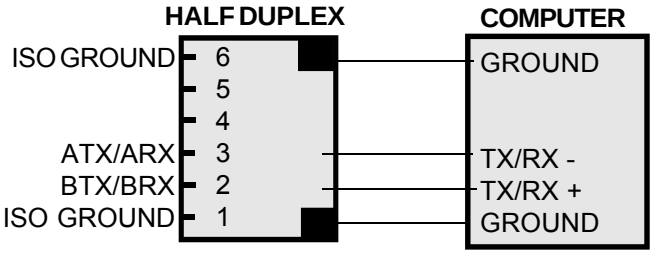
4.6 J3 DIGITAL INTERFACE

RS - 232 INTERFACE - J3A



RS - 485 INTERFACE - J3A & J3B





5. MECHANICAL ASSEMBLY

5.1 REMOVING THE REAR PANEL

To remove the rear panel, first remove any connectors that are installed. Press down on both rear panel retaining tab releases(see Fig. 5.1) and pull the top of the rear panel away from the case. The bottom of the rear panel will now lift out.

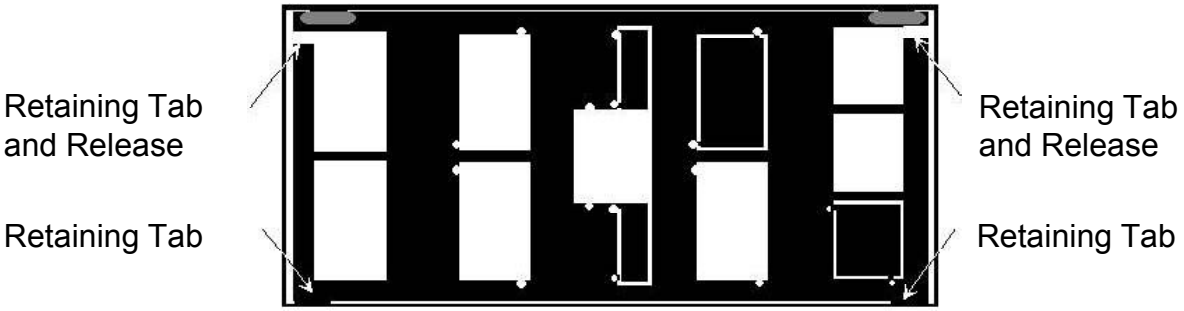
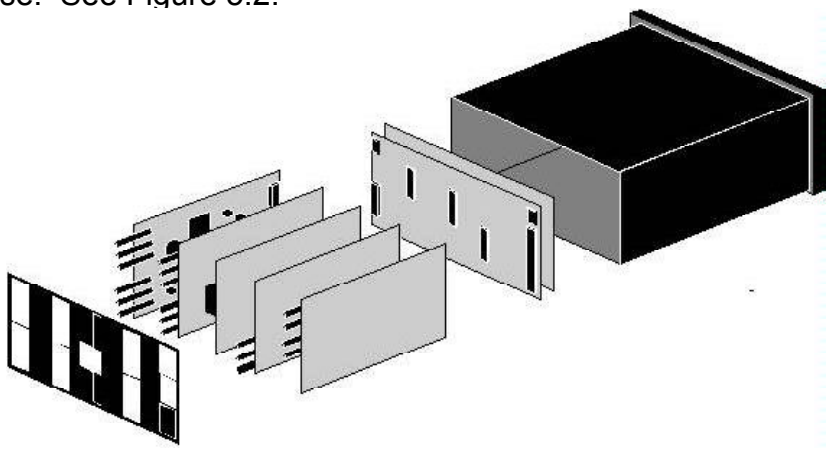


Figure 5.1

5.2 Removing the meter from the case

After removing the rear panel, the meter can be taken out of the case by carefully grasping the power supply board and signal conditioner board at the connectors and sliding the unit out the back of the case. See Figure 5.2.

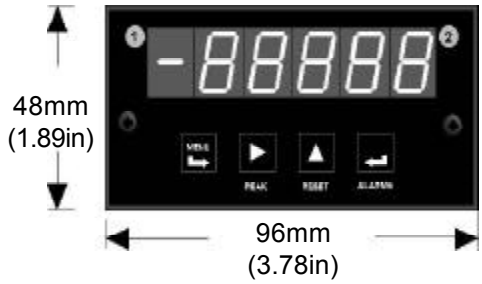


5.3 REASSEMBLING THE METER

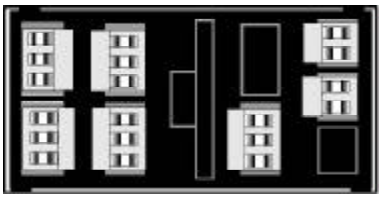
Reverse the preceding procedures to reinstall the meter in the case. After the meter is in the case, insert the bottom tabs on the rear panel into the case first. Care must be taken to ensure the printed circuit boards are properly aligned by the board retaining pins on the inside of the rear panel.

6. PANEL MOUNTING

Ensure the O-ring is in place. Turn the two mounting screws counterclockwise until the space between the mounting pawl and the bezel is greater than the panel thickness. Insert the meter in the panel cutout. Turn the mounting screws clockwise until the meter is securely mounted in the panel. Do not overtighten the mounting screws.

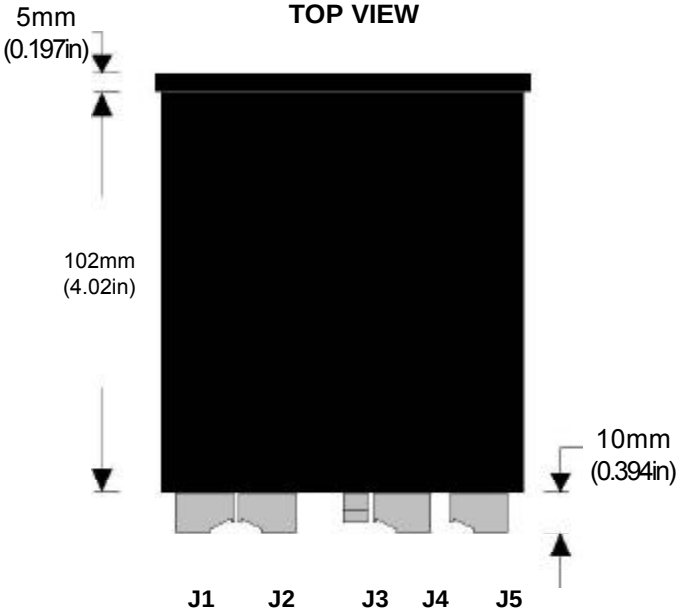


FRONT VIEW

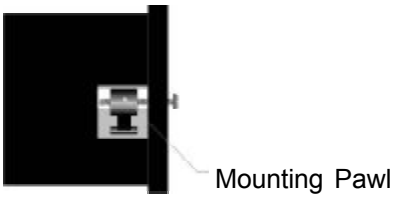


REAR VIEW

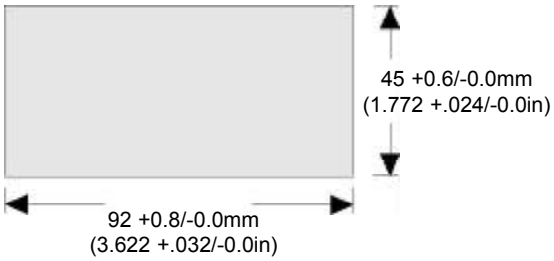
TOP VIEW



SIDE VIEW

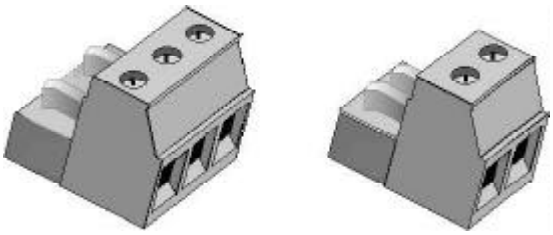


PANEL CUTOUT



7. CONNECTORS

The meter uses UL/VDE rated screw terminal connections that plug into the mating PC jack.



8. FRONT PANEL SETUP KEYS

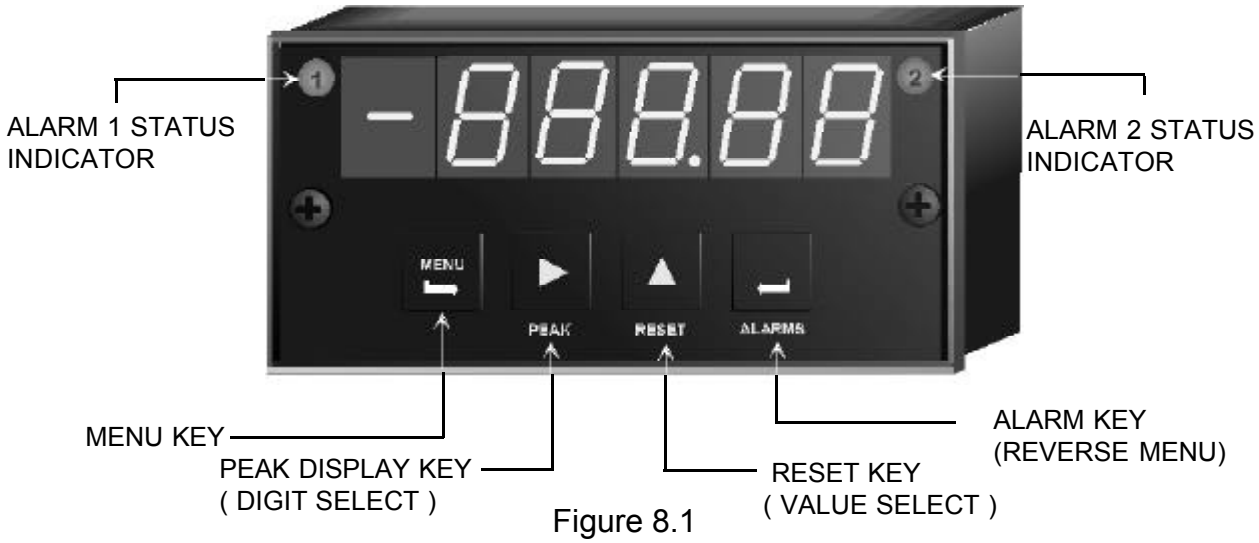


Figure 8.1

MENU KEY

The menu key steps through the various meter parameters that may be selected. These menu items may be “locked out” from front panel selection by software and hardware.

PEAK DISPLAY KEY (DIGIT SELECT)

In the **Operating Mode**, pressing the Peak Display Key causes the peak value of the input signal to be displayed. Pressing the key again returns the display to the present value. In the **Menu Mode** , the Digit Select Key (Peak Display Key) is used to select input type and decimal point or to select one of the five display digits for programming. In the main menu, pressing the Digit Select Key causes the value or code that is stored for that menu item to be displayed and the left hand digit flashes. Each time the key is pressed, the next digit to the right will flash. The value of the flashing digit may be changed using the Value Select Key. In the **Alarm Mode**, pressing the Digit Select Key causes the most significant digit of the displayed setpoint value to flash. Digits are then selected the same as in the Menu Mode.

RESET KEY (VALUE SELECT)

In the **Operating Mode**, holding the Reset Key depressed and pressing any other key causes a reset to occur. The Menu Key resets all meter functions, the Alarm Key resets any alarm conditions and the Peak Display Key resets the peak value to present value. In the **Menu Mode** or **Alarm Mode**, the Value Select Key (Reset Key) sets the value of the flashing digit. Each time the key is pressed, the value increases by one. Holding the key down causes the digit to automatically step through the numbers.

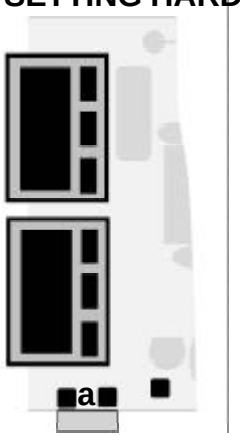
ALARM KEY (REVERSE MENU)

In the **Operating Mode**, pressing the Alarm Key displays the setpoint of Alarm 1 and then Alarm 2. These values may be changed using the Digit Select Key and the Value Select Key. In the **Menu Mode**, pressing the Alarm Key steps the display backward through the menu.

9. SETTING MENU LOCKOUTS

For security and ease of operation, any or all program menu items may be disabled. Each function to be disabled is set to "1" in the menu items, " Loc 1"," Loc 2" or "Loc 3". These lockout menu items may in turn be "locked-out" by installing an internal hardware shorting jumper. With the jumper installed, the operator has access only to enabled menu items.

9.1 SETTING HARDWARE LOCKOUT JUMPER



Power Supply Board
Figure 9.1

Lockout Jumper

To access the jumper, remove the rear panel per Section 5.1. Remove jumper "a" located on the lower portion of the power supply board next to the input connectors (see figure at left) to enable the software lockouts. Replace the jumper to disable software lockouts.

Jumper Removed - Loc 1,2 and 3 are displayed as menu items and allow other menu items to be locked out or enabled.

Jumper Installed - Loc1, 2 and 3 are not displayed on program menu

9.2 SETTING SOFTWARE LOCKOUTS

When setting up the meter, it may be necessary to enable some of the menu items. Any digit set to "1" in Loc 1, Loc 2 or Loc 3 indicates that item is locked out. By setting the digit to "0", the item will appear in the menu. Be sure to reset the lockout bit to "1" after selection if you do not want the value changed by the operator.

Note: The hardware lockout jumper must be removed to access Loc 1, 2 and 3 (see section 9.1)

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
Loc 1	11111	00000 1 2 3 4 5
Press the ↵ key until Loc 1 is displayed.	Press ▶ to display status and select left digit. Press ▶ again to select another digit. Selected digit will flash. "1" indicates the menu item is disabled. "0" indicates the item is enabled.	Press ▲ to select "0" or "1" for flashing digit 1 - Input type selection 2 - Meter setup, configuration & decimal pt. 3 - Filter selection 4 -Scale or Lo, Hi Input 5 - Offset or Lo, Hi Reading

MENU KEY ➥	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
Loc 2	1111	0000 2 3 4 5
Press the ➥ key until Loc 2 is displayed.	Press ▶ to display status and select left digit. Press ▶ again to select another digit. Selected digit will flash. "1" indicates the menu item is disabled. "0" indicates the item is enabled.	Press ▲ to select "0" or "1" for flashing digit 2 - Alarm Setup 3 - Alarm setpoint value programming 4 - Analog output scaling 5 - Serial interface setup
Loc 3	1111	0000 2 3 4 5
Press the ➥ key until Loc 3 is displayed. Lockout 3 controls the operation of the front panel push-buttons when the meter is in the normal mode of operation.	Press ▶ to display status and select left digit. Press ▶ again to select another digit. Selected digit will flash. "1" indicates the menu item is disabled. "0" indicates the item is enabled.	Press ▲ to select "0" or "1" for flashing digit 2 - View peak value 3 - View alarm setpoints 4 - Reset (peak and latched alarms) 5 - Reset (meter reset)

10. SETUP MENU

MENU KEY ➥	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
	INPUT SIGNAL SCALING METHOD	
Lo in Low signal input value (not available for tC & rtd)	**0.021** Set the input signal to zero or a known low value	**0.021** Press the ▲ key to store the low signal input.
Hi In High Signal Input Value	**20.094** Set the input signal to a known high value	**20.094** Press the ▲ key to store the high signal input.
Lo rd Set Low Displayed Reading for Low Signal Input	**0**.0000 **0.0**000 **0.00**00 **0.000**0 **0.0000** Select digit. Digit will flash	**0.000** Select 0 through 9 for flashing digit. Decimal point location is fixed by dEC.Pt.
Hi rd Set High Displayed Reading for High Signal Input	**0**.0000 **0.0**000 **0.00**00 **0.000**0 **0.0000** Select digit. Digit will flash	**0.000** Select 0 through 9 for flashing digit. Decimal point location is fixed by dEC.Pt.

MENU KEY ➥	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲

TEMPERATURE SIGNAL CONDITIONER

InPut Input signal type	**tC** Thermocouple Note: Display = K	**J°F** **J°C** **K°F** **K°C** **t°F** **t°C** **E°F** **E°C** **S°F** **S°C** **r°F** **r°C** **n°F** **n°C** Types J, K, T, E, N, S, R in °C or °F
	rtd Pt 100 Ohm RTD	**4d °F** **4d °C** DIN 4-wire **4A °F** **4A °C** ANSI 4-wire **3d °F** **3d °C** DIN 3-wire **3A °F** **3A °C** ANSI 3-wire **2d °F** **2d °C** DIN 2-wire **2A °F** **2A °C** ANSI 2-wire **Short** Compensation for 2-wire lead resistance

DC SIGNAL CONDITIONER

dC U DC Volts	**0.2U** **2.0U** **20.0U** **200.0U** **660.0U** 0.2, 2, 20, 200, 660 V FS
dC A DC Amperes	**2.0a** **20.0a** **200.0a** **5.0A** 2 , 20, 200 mA, 5 A FS
rAtio Strain Gauge	**0.2U** **2.0U** **20.0U** 0.2, 2, 20 V FS

TRUE RMS SIGNAL CONDITIONER

AC U AC Volts	**0.2U** **2.0U** **20.0U** **200.0U** **660.0U** 0.2, 2, 20, 200, 660 V FS
AC A AC Amperes	**2.0a** **20.0a** **200.0a** **5.0A** 2 , 20, 200 mA, 5 A FS

MENU KEY ➥	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲

LOAD CELL SIGNAL CONDITIONER

InPut Input signal type (continued)	**Strn** Load cells	**20.0** **50.0** **100.0** **250.0** **500.0** 20, 50, 100, 250, 500 mV FS
	dC u DC millivolts	**20.0** **50.0** **100.0** **250.0** **500.0** 20, 50, 100, 250, 500 mV FS
SEtuP Meter Setup	**00000** Display selection	**0** 4 1/2 digits (0.1 Degree) **1** Remote display **2** 4 1/2 digits [meter counts by 10] (.01 Degree) **3** 3 1/2 digits (1 Degree)
	00000 Line frequency	**0** 60 Hz **1** 50 Hz
	00000 Serial start & stop characters (Set through serial port).	**0** Null start, <cr> stop **1** Special start and stop characters.
	00000 Method of scaling meter	**0** Scale factor and offset **1** Coordinates of 2 points
	00000 Rear connector inputs A & B (negative true logic, 0V = true, +5V = false) * A and B both low = function reset A & B Logic levels for 6 & 7	**0** A: Reset B:Meter Hold **1** A: Function Reset B:Peak Display **2** * A: Meter Hold B: Peak Display **3** * A: Meter Hold B: Tare **4** * A: Peak Display B: Tare **5** A: Tare B: Reset **6** External Decimal Pts.1 **7** External Decimal Pts.2

A	B	DP1	DP2
1	1	XXXXX	XXXX.X
0	1	XXXX.X	XXX.XX
1	0	XXX.XX	XX.XXX
0	0	XX.XXX	X.XXXX

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
ConFG Meter Configuration	**0**0000 Operates as a rate of change meter **Extended version only**	**0** Not rate of change **1** Rate x 0.1 **2** Rate x 1 **3** Rate x 10 **4** Rate x 100 **5** Rate x 1000 **6** Rate x 10000
	0**0**000 Selection of scaling by reading input signal or by Setup selection	**0** Use setup scaling method **1** Scale by reading input
	00**0**00 Selects between continuous (unlatched) data or single value (latched) of RS232 data when RTS is high or open	**0** Unlatched **1** Latched
	000**0**0 RS485 interface operates in the full duplex or half duplex mode	**0** Full duplex mode **1** Half duplex mode
	0000**0** Scaling for nonlinear input **Extended version only**	**0** Linear input **1** Custom curve
FiLtr Filtering	**0**0000 Alarm filtering	**0** Output is unfiltered **1** Output is filtered
	0**0**000 Peak display filtering	**0** Peak of unfiltered signal **1** Peak of filtered signal
	00**0**00 Display filtering	**0** Batch average, 16 rdgs **1** Display filtered signal

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
FiLtr Filtering (continued)	00000 Adaptive filter response	0 Low threshold level 1 High threshold level
	00000 Input signal filtering	0 Autofilter 1 Batch avg, 16 rdgs. 2 Moving avg, .08 sec. 3 Moving avg, .15 sec. 4 Moving avg, .3 sec. 5 Moving avg, .6 sec. 6 Moving avg, 1.2 sec. 7 Moving avg, 2.4 sec. 8 Moving avg, 4.8 sec. 9 Moving avg, 9.6 sec. A Unfiltered
dEc.Pt Decimal point selection	d.dddd	d.dddd dd.ddd ddd.dd dddd.d ddddd. .ddddd
(Scale and Offset selected) **SCALE** Scale factor multiplier (not available for tC)	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	Select 0 through 9 for flashing digit and decimal point location when decimal point is flashing
OFFSt Offset or Zero Value	0.0000 0.0000 0.0000 0.0000 0.0000	Select 0 through 9 for flashing digit. Decimal point location is fixed by dEC.Pt selection
(coordinates of 2 pts method) **Lo in** Low signal input value (not available for tC & rtd)	0.0000 0.0000 0.0000 0.0000 0.0000	Select 0 through 9 for flashing digit. Decimal point location is fixed by input range chosen.
Lo rd Low Displayed Reading at Low Signal Input	0.0000 0.0000 0.0000 0.0000 0.0000	Select 0 through 9 for flashing digit. Decimal point location is fixed by dEC.Pt selection
Hi In High Signal Input Value	0.0000 0.0000 0.0000 0.0000 0.0000	Select 0 through 9 for flashing digit. Decimal point location determined by input range chosen.

MENU KEY ➥	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
Hi rd High Displayed Reading at High Signal Input	0.0000 0.0000 0.0000 0.0000 0.0000	Select 0 through 9 for flashing digit. Decimal location is fixed by dEC.Pt selection.
rd0 In (custom curve only) Corrects for zero errors	04.000 Value set to actual voltage or current input at zero	Select 0 through 9 for flashing digit.
ALSEt Alarm Operation Setup (Only enabled if relay output is installed).	00000 Relay state when alarm is active	0 Relay 1 on, Relay 2 on 1 Relay 1 off Relay 2 on 2 Relay 1 on, Relay 2 off 3 Relay 1 off, Relay 2 off
	00000 Alarm latching or nonlatching	0 Alarm 1 nonlatching, Alarm 2 nonlatching 1 Alarm 1 latching, Alarm 2 nonlatching 2 Alarm 1 nonlatching, Alarm 2 latching 3 Alarm 1 latching, Alarm 2 latching
	00000 Alarm status	0 AL1 active high AL2 active high 1 AL1 active low AL2 active high 2 AL1 disabled AL2 active high 3 AL1 active high AL2 active low 4 AL1 active low AL2 active low 5 AL1 disabled AL2 active low 6 AL1 active high AL2 disabled 7 AL1 active low AL2 disabled 8 AL1 disabled AL2 disabled

MENU KEY ➥	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
ALSEt (continued) Alarm Operation Setup	00000 Selection of Hysteresis mode or Band Deviation mode of alarms.	0 AL1 Band deviation AL2 Band deviation 1 AL1 Hysteresis AL2 Band deviation 2 AL1 Band deviation AL2 Hysteresis 3 AL1 Hysteresis AL2 Hysteresis 4 No deviation or hysteresis in menu
	00000 Number of readings in the alarm zone to cause an alarm	0 After 1 reading 1 After 2 readings 2 After 4 readings 3 After 8 readings 4 After 16 readings 5 After 32 readings 6 After 64 readings 7 After 128 readings
dEU1H Amount of deviation or hysteresis - Alarm 1 (Only enabled if relay output is installed).	00000 00000 00000 00000 00000 When the deviation value is >0, the alarms operate above and below setpoint by the value entered.	Select 0 through 9 for flashing digit.
dEU2b Amount of deviation or hysteresis - Alarm 2 (Only enabled if relay output is installed).	00000 00000 00000 00000 00000 When the deviation value is >0, the alarms operate above and below setpoint by the value entered.	Select 0 through 9 for flashing digit.
An Set Setup of analog output. (Only enabled if analog output board is installed).	00 Calibrated output is current or voltage.	0 Current output 1 Voltage output
	00 Analog output filtering	0 Analog output unfiltered 1 Analog output filtered

MENU KEY ➥	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
(if analog output installed) **An Lo** Displayed value for 0 voltage or current output	0.0000 0.0000 0.0000 0.0000 0.0000	Select 0 through 9 for flashing digit. Decimal point location fixed by dEC.Pt selection.
An Hi Displayed value for 10 volts or 20 mA output	0.0000 0.0000 0.0000 0.0000 0.0000	Select 0 through 9 for flashing digit. Decimal fixed by DEC.Pt selection.
(if serial interface is installed) **Ser 1** Serial interface setup Fixed Parameters No parity 8-bit word 1 stop bit	000 Output filtering	0 Send unfiltered signal 1 Send filtered signal
	000 Baud rate	0 300 baud 1 600 baud 2 1200 baud 3 2400 baud 4 4800 baud 5 9600 baud 6 19200 baud
	000 Digital output rate (in seconds)	60 Hz / 50 Hz 0 Line frequency 1 .28 sec / .34 sec 2 .57 sec / .68 sec 3 1.1 sec / 1.4 sec 4 2.3 sec / 2.7 sec 5 4.5 sec / 5.4 sec 6 9.1 sec / 10.9 sec 7 18.1 sec / 21.8 sec 8 36.3 sec / 43.5 sec 9 72.5 sec / 87 sec
Ser 2 Serial interface setup	0000 Line Feed	0 None after carriage rtn 1 LF after carriage return
	0000 Alarm data transmitted with meter readings	0 No alarm data 1 Alarm data with reading
	0000 Control of digital output	0 Continuous output 1 Output on RS-232 / RS-485 command only

MENU KEY ➥	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
Ser 2 (continued) Serial interface setup	**0000** Meter address for RS-232/RS-485 communication (digit display, address number of meter) **Note:** Addresses 1 through 15 are denoted by 1 through 9 and A through F. Addresses 16 through 31 use the same character followed by a decimal point.	**Meter# / Display** 1 / 1 2 / 2 3 / 3 4 / 4 5 / 5 6 / 6 7 / 7 8 / 8 9 / 9 10 / a 11 / b 12 / C 13 / d 14 / E 15 / F 16 / 0. 17 / 1. 18 / 2. 19 / 3. 20 / 4. 21 / 5. 22 / 6. 23 / 7. 24 / 8. 25 / 9. 26 / A. 27 / b. 28 / C. 29 / d 30 / E. 31 / F.
Loc 1 Lockout of Menu Items (Lockout jumper must be removed to access Loc 1, 2, 3. See Figure 9.1)	**00000** Input type selection	**0** Enabled **1** Disabled
	00000 Meter setup, configuration and decimal point selection.	**0** Enabled **1** Disabled
	00000 Filter	**0** Enabled **1** Disabled

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
Loc 1 (continued) Lockout of Menu Items (Lockout jumper must be removed to access Loc 1, 2, 3. See Figure 9.1)	00000 Scale or Lo, Hi Input	0 Enabled 1 Disabled
	00000 Offset or Lo, Hi Reading	0 Enabled 1 Disabled
Loc 2 Lockout of Front Panel Keys (Lockout jumper must be removed to access Loc 1, 2, 3. See Figure 9.1)	0000 Alarm Setup	0 Enabled 1 Disabled
	0000 Alarm setpoint programming	0 Enabled 1 Disabled
	0000 Analog output scaling	0 Enabled 1 Disabled
	0000 Serial interface setup	0 Enabled 1 Disabled
Loc 3 Lockout of Front Panel Keys (Lockout jumper must be removed to access Loc 1, 2, 3. See Figure 9.1)	0000 View peak value pushbutton	0 Enabled 1 Disabled
	0000 View alarm setpoints pushbutton	0 Enabled 1 Disabled
	0000 Reset pushbutton (peak and latched alarms)	0 Enabled 1 Disabled
	0000 Reset pushbutton (meter reset)	0 Enabled 1 Disabled

11. DC VOLTS & AMPS

This section is designed to provide basic meter setup instructions when a direct readout of voltage or current is required. When an external shunt is used to monitor current, the setup for process signals, section 12, should be used. Some menu items, such as leading zero blanking, display filtering, etc., are not discussed in this section and have been set to the most commonly used values. Should these items require change, refer to section 10 for selection information. For configuration of optional boards, see the appropriate section elsewhere in the manual.

11.1 RANGE JUMPER SELECTIONS

Voltage

Input	Jumpers Required
200mV	E, b
2V	E, a
20V	F, g, b
200V	F, g, a
660V	F, h, a

Current

Input	Jumpers Required
2mA	D, h, b
20mA	C, h, b
200mA	B, h, b
5A	A, h, b

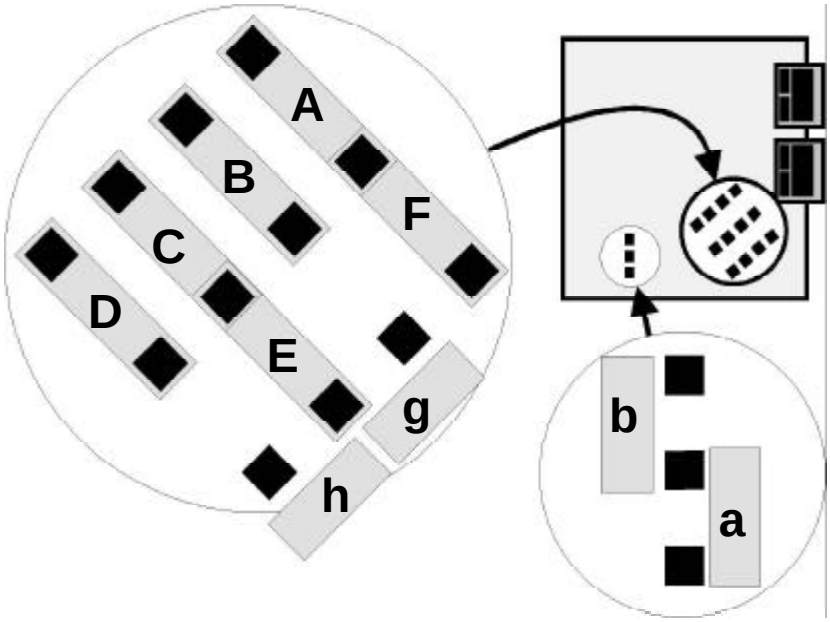


Figure 11.1 DC Signal Conditioner

Notes 1. See Section 22 to select 5,10 or 24Vdc excitation.
2. Jumpers designated by capital letters require 5mm (0.2in) jumpers. Jumpers designated by lower case letters require 2.5mm (0.1 in) jumpers.
3. Spare jumpers should be stored on single unused jumper posts not associated with capital letter designations

11.2 MENU SELECTION

Whenever the scale factor is 1.0 and offset is zero, the meter displays a direct readout of the signal input in (milli)volts or (milli)amperes. In the following example, the meter is configured for a full scale display of 0 to 20V or 0 to 20mA equals 0 to 20.000. Other ranges follow the same setup format. Note that the decimal point selection does not affect the displayed value. A full scale value of 20000 may be displayed as 20.000 milliamps or 20000 microamps. During setup, it may be necessary to enable some menu items that are locked out. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
InPut Press the ↵ key to display InPut (Input type selection). **Note:** Selection of input type & range must match jumper selection in Section 11.1	dC U Press ▶ until dC U (dc Volts) is displayed dC A or dC A (DC Amps) is displayed.	20.0U Press ▲ to select 0.2V, 2.0V, 20.0V, 200.0V, 660.0V 20.0a or 2.0a, 20.0a, 200.0a (milliamps) or 5.0A (Amps)
SEtuP Press the ↵ key to display SEtuP. (Basic setup) See Section 9, Page 10 for detailed description of selections for digits 1 through 5.	30001 1 2 3 4 5 Press ▶ to display status and select left digit. Press ▶ again to select another digit. Selected digit will flash.	00000 1 2 3 4 5 Press ▲ to select value for flashing digit. Digit 1: "0"= 20,000 cts. full scale "3"=2,000 cts. full scale Digit 4: "0" = scale and offset method
dEc.Pt Press the ↵ key to display dEcPt (Decimal point)	d.dddd Press ▶ to display location of decimal point.	dd.ddd Press ▲ to change decimal point location.
SCALE Press the ↵ key to display SCALE (Scale factor).	005.00 Press ▶ to display value and select left digit. Press again to select another digit.	1.0000 Use ▲ to set digit values. Set value and decimal to 1.0 (1.0000, 01.000, etc)
OFFSt Press the ↵ key to display OFFSt (Zero offset).	01.250 Press ▶ to display value and select left digit. Press again to select another digit.	00.000 Use ▲ to set digit values. Set value to 00.000. Decimal point is fixed by Dec.Pt.
rESEt	20.000	

Press the ↵ key. Continue to press ↵ (or ↵ and ▲ simultaneously) until rESEt is displayed. The meter will now go to the operating mode and display the value of the input signal.

12. PROCESS SIGNAL INPUTS

This section provides basic meter setup instructions for a direct readout in engineering units such as psi, rpm, etc. The signal input may come from a transducer or other voltage or current source. Some menu items, such as leading zero blanking, display filtering, etc., are not discussed in this section and have been set to the most commonly used values. Should these items require change, refer to section 10 for selection information. For configuration of optional boards, see the appropriate section elsewhere in the manual.

12.1 RANGE JUMPER SELECTIONS

Voltage

Input	Jumpers Required
200mV	E, b
2V	E, a
20V	F, g, b
200V	F, g, a
660V	F, h, a

Current

Input	Jumpers Required
2mA	D, h, b
20mA	C, h, b
200mA	B, h, b
5A	A, h, b

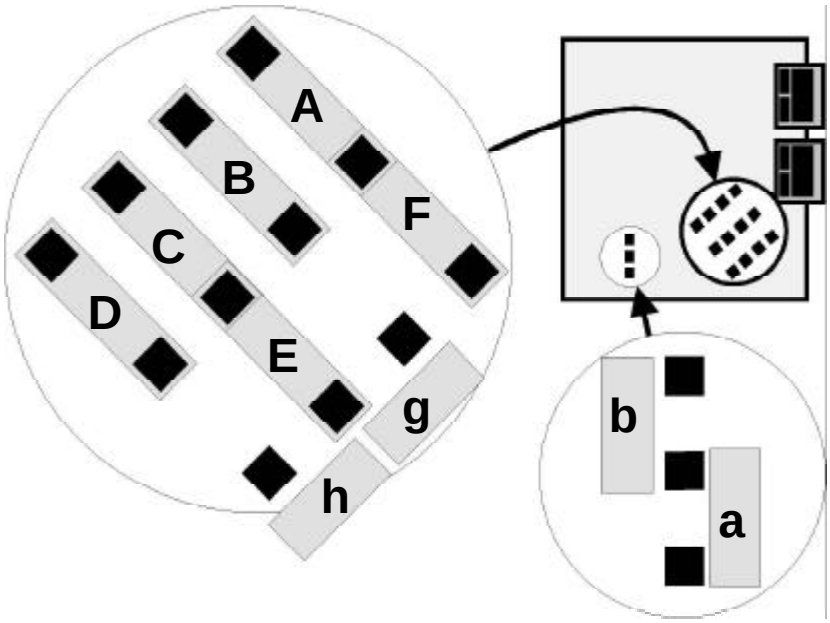


Figure 12.1 DC Signal Conditioner

Notes
1. See Section 22 to select 5, 10 or 24Vdc excitation.
2. Jumpers designated by capital letters require 5mm (0.2in) jumpers. Jumpers designated by lower case letters require 2.5mm (0.1 in) jumpers.
3. Spare jumpers should be stored on single unused jumper posts <u>not</u> associated with capital letter designations

12.2 MENU SELECTION

Display in engineering units is most easily programmed using the coordinates of 2 points. There are two methods. The first is to enter the 4 values (low signal input, desired reading at the low signal input, high signal input, and desired reading at the high signal input) directly via the front panel pushbuttons or the RS232 interface. The second method is to have the meter read the signal input at a known low value and store that reading as the low in and read a known high signal value and store that value as high in. The low and high known values are entered as the lo rd and hi rd. An example of using the reading the input method of coordinates of 2 points is shown for the load cell meter, Section 17. Selecting the reading method (menu item "config" digit 2 set to 1) overides either method of scaling selected in "setup". The following example is the 2 coordinate method of directly entering the 4 values.

To set up the range using coordinates of 2 points, values for low signal input, low display, high signal input and high display are entered. The following example uses this scaling method. Signal input is 4 to 20mA and displayed value is 000.00 (at 4mA) to 100.00 (at 20mA). When setting up the meter, it may be necessary to enable some menu items. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
InPut Press the ↵ key to display InPut (Input type selection). **Note:** Selection of input type & range must match jumper selection in Section 12.1.	dC A Press ▶ until dC A (DC Amperes) is displayed. (dC U if voltage input).	20.0a Press ▲ to select 2.0a, 20.0a, 200.0a (milliamps) or 5.0A (Amps). (.20U, 2.0U, 20.0U, 200.0U or 660.0U if voltage input)
SEtuP Press the ↵ key to display SEtuP. (Basic setup) See Section 9, Page 10 for detailed description of selections for digits 1 through 5.	30000 1 2 3 4 5 Press ▶ to display status and select left digit. Press ▶ again to select another digit. Selected digit will flash.	00010 1 2 3 4 5 Press ▲ to select value for flashing digit. Digit 1: "0"= 20,000 cts "3"=2,000 cts Digit 4: "0"=scale & offset "1"=2- coordinate
dEc.Pt Press the ↵ key to display dEcPt (Decimal point).	d.dddd Press ▶ to display decimal point location	ddd.dd Press ▲ to change decimal point location.
Lo in Press the ↵ key to display Lo in (Low signal input value).	00.000 Press ▶ to display value and select left digit. Press ▶ again to select another digit.. Dec pt. fixed by input range	04.000 Use ▲ to set digit values and set to 04.000 (4 mA). Most significant digit may be set to 0 thru 9 and -0 thru -9.
Lo rd Press the ↵ key to display Lo rd (Desired meter reading at low signal input).	000.00 Press ▶ to display value and select left digit. Press ▶ again to select another digit. Decimal point set by Dec.Pt.	000.00 Use ▲ to set digit values and set to 000.00 .
Hi In Press the ↵ key to display Hi in (High signal input value).	00.000 Press ▶ to display value and select left digit. Press ▶ again to select another digit. Dec pt. fixed by input range	20.000 Use ▲ to set digit values and set to 20.000 (20 mA).

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
Hi rd	000.00	100.00
Press the ↵ key to display Hi rd (Desired meter reading at high signal input).	Press ▶ to display value and select left digit. Press ▶ again to select another digit. Decimal point set by Dec.Pt.	Use ▲ to set digit values and set to 000.00 .
rESEt	100.00	

Press the ↵ key. Continue to press ↵ (or ↵ and ▲ simultaneously) until rESEt is displayed. The meter will now go to the operating mode and display the value of the input signal.

13. THERMOCOUPLES

13.1 RANGE JUMPER SELECTIONS

Thermocouple Type

Type	Jumpers Required
J, K, E, N T, R, S	e f

Open Thermocouple

Open TC Indication	Jumpers Required
Upscale Downscale	c d

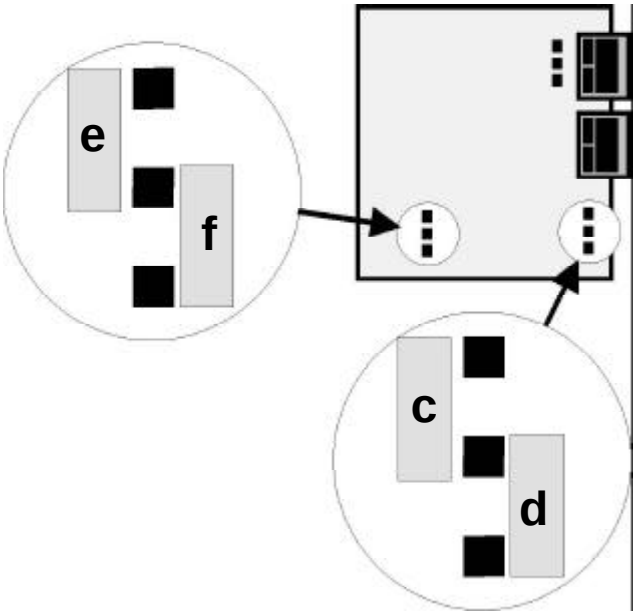


Figure 13.1 Temperature Signal Conditioner

13.2 MENU SELECTION

Thermocouple type and Celsius or Fahrenheit scale are selected by input type. However, Kelvin or Rankine may be displayed by entering the appropriate offset to the selected scale. Although 0.01 degree resolution may be selected, it is not recommended for use with thermocouples. When setting up the meter, it may be necessary to enable some of the menu items. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
InPut Press the ↵ key to display InPut (Input type selection). **Note:** Selection of input type & range must match jumper selection in Section 13.1.	tC Press ▶ to display input selected. Press ▶ again until tC (thermocouple) is displayed.	J °C Press ▲ to select thermocouple type J, K, T, E, R, S and °C or °F scale (J°F, J°C, K°F, K°C, t°F, t°C, E°F, E°C, r°F, r°C, S°F, S°C)
SEtuP Press the ↵ key to display SEtuP. (Basic setup) See Section 9, Page 10 for detailed description of selections for digits 1 through 5.	30000 Press ▶ to display status and select left digit. Press ▶ again to select another digit. Selected digit will flash.	00000 1 2 3 4 5 Press ▲ to select value for flashing digit. Digit 1: "0"= 0.1 degree resolution "3"=1 degree resolution
OFFSt Press the ↵ key to display OFFSt (Zero offset).	0000.0 Press ▶ to display value and select left digit. Press ▶ again to select another digit.	0000.0 Use ▲ to set digit values and set to 000.00 for °F and °C or 0273.2 set value to 273.2 if °C is selected to display in °Kelvin and 459.7 if °F is selected to display in ° Rankine.

rESEt 451.9

Press the ↵ key. Continue to press ↵ (or ↵ and ▲ simultaneously) until rESEt is displayed. The meter will now go to the operating mode and display the value of the input signal.

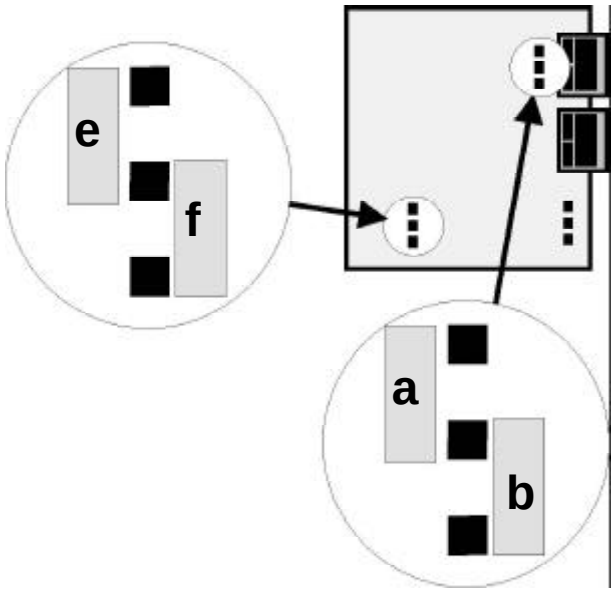
14. Pt100 RTD'S

14.1 RANGE JUMPER SELECTION

All RTD Types

Jumpers Required 2-,4-wire
b, e

Jumpers Required 3--wire
a, e



Note: See Section 22 to select 10 Vdc excitation.

Figure 14.1 Temperature Signal Conditioner

14.2 2-WIRE RTD LEAD COMPENSATION

This section describes how to remove the error caused by lead resistance in a 2-wire RTD. Ambient temperature changes will cause some error in the readings; the higher the lead resistance, the greater the error. When performing this procedure, the leads should be shorted together as close as possible to the RTD. This step is not necessary when using 3- or 4-wire RTD's since lead resistance compensation is automatic in the meter. When setting up the meter, it may be necessary to enable some of the menu items. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
InPut Press the ↵ key to display InPut (Input type selection).	rtd Press ▶ to display input selected. Press ▶ again until rtd is displayed.	Short Press ▲ to select short.
rESEt	1.4	

Press the ↵ key until rESEt is displayed. Short the input leads at the RTD sensor. Press the ▶ key to store value. Set up for RTD per section 14.3

14.3 MENU SELECTIONS

The following example is setup for a 4-wire DIN RTD. When setting up the meter, it may be necessary to enable some of the menu items. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
InPut Press the ↵ key to display InPut (Input type selection). **Note:** Selection of input type & range must match jumper selection in Section 14.1.	rtd Press ▶ until rtd (resistance temperature detector) is displayed	4d °C Press ▲ to select rtd type (4d°F, 4d°C, 4A°F, 4A°C, 3d°F, 3d°C, 3A°F, 3A°C, 2d°F, 2d°C, 2A°F, 2A°C) Number = # of leads Letter = Din or ANSI RTD
SEtuP Press the ↵ key to display SEtuP. (Basic setup) See Section 9, Page 10 for detailed description of selections for digits 1 through 5.	30000 Press ▶ to display status and select left digit. Press ▶ again to select another digit. Selected digit will flash.	00000 1 2 3 4 5 Press ▲ to select value for flashing digit. Digit 1: "0"= 0.1 degree resolution "2" = 0.01 degree resolution "3"=1 degree resolution
SCALE Press the ↵ key to display SCALE. Divide 100 by resistance of RTD at 0° C to calculate scale factor.	005.00 Press ▶ to display value and select left digit. Press again to select another digit.	.99706 Use ▲ to set digit values. Set value and decimal to calculated scale factor.
OFFSt Press the ↵ key to display OFFSt (Zero offset).	0000.0 Press ▶ to display value and select left digit. Press ▶ again to select another digit.	0000.0 Use ▲ to set digit values and set to 0.0 for °F and °C or 0273.2 set value to 273.2 if °C is selected to display in °Kelvin and 459.7 if °F is selected to display in ° Rankine.
rESEt	85.00	

Press the ↵ key. Continue to press ↵ (or ↵ and ▲ simultaneously) until rESEt is displayed. The meter will go to the operating mode and display the value of the input signal.

15. 1 RANGE JUMPER SELECTIONS

Voltage

Input	Jumpers Required
200mV	E, b
2V	E, a
20V	F, g, b

Notes

1. See Section 22 to select 10V
   removejumpers for externa
tion.
2. Jumpers designated by lowe
   letters require 2.5mm (0.1 in) ju
3. Spare jumpers should be sto
   single unused jumper posts.

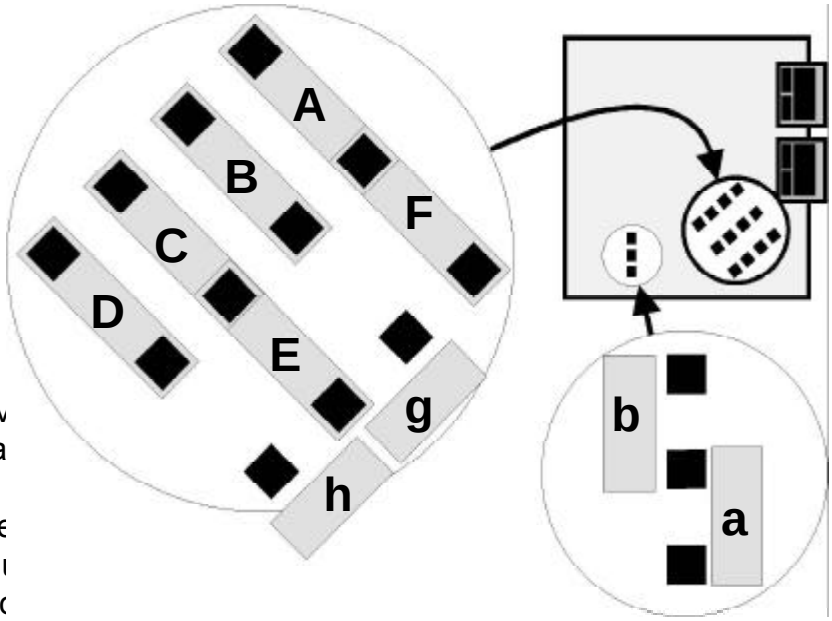


Figure 15. 1 DC Signal Conditioner

15. 2 MENU SELECTION

Display in engineering units is most easily programmed using the coordinates of 2 points. There are two methods. The first is to enter the 4 values (low signal input, desired reading at the low signal input, high signal input, and desired reading at the high signal input) directly via the front panel pushbuttons or the RS232 interface. The second method is to have the meter read the signal input at a known low value and store that reading as the low in and read a known high signal value and store that value as high in. The low and high known values are entered as the lo rd and hi rd. An example of using the reading the input method of coordinates of 2 points is shown for the load cell meter, Section 17. Selecting the reading method (menu item "config" digit 2 set to 1) overides either method of scaling selected in "setup". To set up the range using coordinates of 2 points, values for low signal input, low display, high signal input and high display are entered. The following example uses this scaling method. Signal input is 0 to 20mV and displayed value is 000.00 (at 0mV) to 100.00 (at 20mV). When setting up the meter, it may be necessary to enable some menu items. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
InPut	rAtio	0.2U
Press the ↵ key to display InPut. **Note:** Range selection must match jumper selection in Section 15. 1 .	Press ▶ until rAtio (Ratiometric operation) is displayed.	Press ▲ to select 0.2U, 2.0U or 20.0U (200mV, 2V or 20Vdc).

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
SEtuP Press the ↵ key to display SEtuP. (Basic setup). See Section 9, Page 10 for detailed description of selections for digits 1 through 5.	30000 Press ▶ to display status. Press ▶ again to select another digit. Selected digit will flash.	00010 1 2 3 4 5 Press ▲ to select value. Digit 1:"0"= 20,000 cts. FS "2"=LSD fixed zero "3"=2,000 cts. FS Digit 4: "1" for 2 point scaling
dEc.Pt Press the ↵ key to display dEcPt (Decimal point).	d.dddd Press ▶ to display decimal point location.	ddd.dd Press ▲ to select decimal point location.
Lo in Press the ↵ key to display Lo in (Low signal input value).	.00000 Press ▶ to display value. Press ▶ again to select another digit. **Note:** Decimal point is fixed by input range selection.	.00000 Use ▲ to set digit values and set to .00000 (0mV). **Note:** Most significant digit may be set to 0 thru 9 and -0 thru -9.
Lo rd Press the ↵ key to display Lo rd (Desired meter reading at low signal input).	000.00 Press ▶ to display value. **Note:** Decimal point is fixed by dEcPt selection.	000.00 Use ▲ to set digit values and set to 000.00
Hi In Press the ↵ key to display Hi in (High signal input value).	.00000 Press ▶ to display value. **Note:** Decimal point is fixed by input range selection.	.02000 Use ▲ to set digit values and set to .02000 (20mV)
Hi rd Press the ↵ key to display Hi rd (Desired meter reading at high signal input).	000.00 Press ▶ to display value. **Note:** Decimal point is fixed by dEcPt selection.	100.00 Use ▲ to set digit values and set to 100.00
rESEt	100.00	

Press the ↵ key. Continue to press ↵ (or ↵ and ▲ simultaneously) until rESEt is displayed. The meter will now go to the operating mode and display the value of the input signal.

16. AC (RMS) VOLTS & AMPS

This section provides basic setup instructions for true RMS voltage or current monitoring. An RMS signal conditioner is required. Some menu items, such as leading zero blanking, display filtering, etc., are not discussed in this section and have been set to the most commonly used values. Should these items require change, refer to section 10 for selection information. For configuration of optional boards, see the appropriate section elsewhere in the manual.

16. 1 RANGE JUMPER SELECTIONS

Voltage

Input	Jumpers Required AC Coupled
200mV	g, k
2V	g, j
20V	h, k
200V	h, j
660V	f, j

Current

Input	Jumpers Required AC Coupled
2mA	e, f, k
20mA	d, f, k
200mA	c, f, k
5A	a, b, f, m

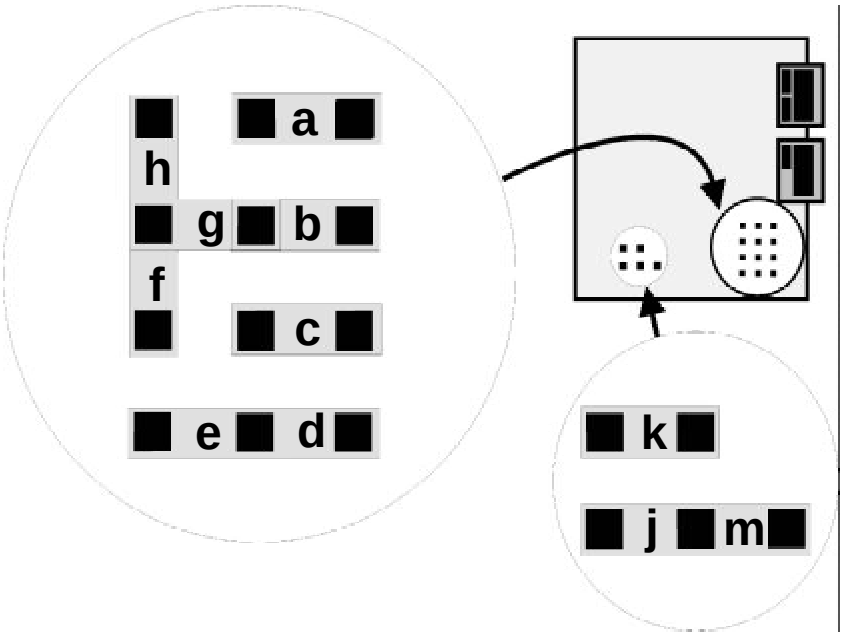


Figure 16. 1 RMS Signal Conditioner

16. 2 MENU SELECTION

Whenever the scale factor is 1.0 and offset is zero, the meter displays a direct readout of the signal input in (milli)volts or (milli)amperes. In the following example, the meter is configured for a full scale display of 0 to 20V or 0 to 20mA equals 20.000. Other ranges follow the same setup format. Note that the decimal point selection does not affect the displayed value. A full scale value of 20000 may be displayed as 20.000 Volts or 20000 millivolts. When an external shunt or current transformer is used to monitor current, the appropriate scale factor must be entered. A 5A CT input to the meter displays 20000 (2000 when 3 1/2 digit is selected). For an 800 Amp CT, divide 8000 (desired full scale display with .1 Amp resolution) by 20000 (full scale when the scale factor is 1.0) for the correct scale factor. Enter .4 as a scale factor. During setup, it may be necessary to enable some menu items that are locked out. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
InPut Press the ↵ key to display InPut (Input type selection). **Note:** Selection of input type & range must match jumper selection in Section 16. 1.	AC U Press ▶ until AC U (ac Volts) is displayed or AC A AC A (ac Amperes) is displayed.	20.0U Press ▲ to select 0.2V, 2.0V, 20.0V, 200.0V or 660.0V or 20.0a 2.0a, 20.0a, 200.0a (milliamps) or 5.0A (Amps)
SEtuP Press the ↵ key to display SEtuP. (Basic setup). See Section 9, Page 10 for detailed description of selections for digits 1 through 5.	30000 Press ▶ to display status and select left digit. Press ▶ again to select another digit. Selected digit will flash.	00000 1 2 3 4 5 Press ▲ to select value for flashing digit. Digit 1: "0"= 20,000 cts. full scale "2"=Same as "0" but LSD is fixed zero. "3"=2,000 cts. full scale Digit 4: Set to "0" for scale and offset
dEc.Pt Press the ↵ key to display dEcPt (Decimal point).	d.dddd Press to display decimal point location.	dd.ddd Press ▲ to select decimal point location.
SCALE Press the ↵ key to display SCALE (Scale factor).	005.00 Press ▶ to display value and select left digit. Press again to select another digit.	1.0000 Use ▲ to set digit values. Set value and decimal to 1.0 or appropriate multiplier for external shunts or CT's.
OFFSt Press the ↵ key to display OFFSt (Zero offset).	01.250 Press ▶ to display value and select left digit. Press again to select another digit.	00.000 Use ▲ to set digit values. Set value to 00.000. Decimal point is fixed by Dec.Pt.

rESEt 20.000

Press the ↵ key. Continue to press ↵ (or ↵ and ▲ simultaneously) until rESEt is displayed. The meter will now go to the operating mode and display the value of the input signal.

17. LOAD CELLS AND MICROVOLT INPUTS

This section provides setup instructions for use as a microvoltmeter or with load cells and strain gauges. 10 Volt excitation will power up to 4 350 Ohm load cells. Sense leads may be used to compensate for lead resistance of the excitation supply. For configuration of optional boards, see the appropriate section elsewhere in the manual.

17.1 RANGE JUMPER LOCATIONS

Input	Jumper Locations	Full Scale Display Scale factor = 1
20mV	e	20000
50mV	a	50000
100mV	b	10000
250mV	c	25000
500mV	d	50000

Notes 1. See Section 22 to select 10V excitation.
2. Jumpers are 2.5mm (0.1 in).

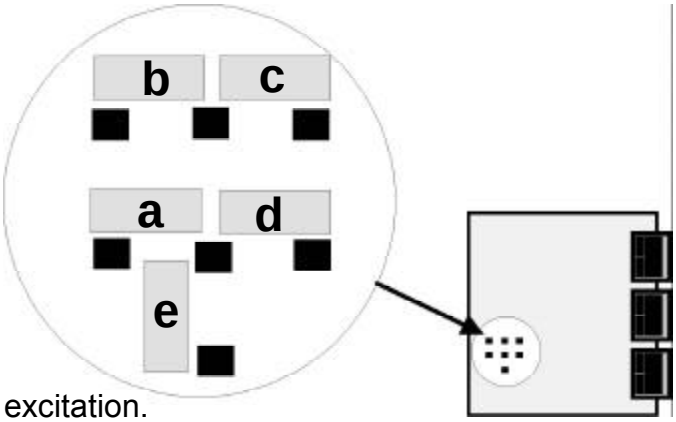


Figure 17.1 Load Cell Signal Conditioner

17.2 MENU SELECTION

To scale the meter using the reading method of coordinates of 2 points, the low signal input and high signal input are read directly by the meter and are stored as Lo in and Hi in. For example, the full scale range of a load cell is 500 pounds and has an output of 2mV/V. With 10V excitation, the full scale range of 20mV selected. The resolution is .01 pounds. With no weight on the scale, the meter should read 0.00 and with a 500 pound weight on the scale the meter should display 500.00 pounds. With no weight on the scale, press the menu key to select Lo inand press the digit select key. The meter will take readings and display the millivolt value of the input signal. Pressing the value select key will store this reading as Lo in. Press the menu key to select Hi in, place the 500 pound weight on the scale and repeat the procedure the same as for Lo in. Press the menu key to select lo rd (Low reading) and enter 000.00, then press the menu key to select Hi rd (High reading) and enter 500.00. Advantages of this method are accuracy, since reading the value corrects for any error in the transducer, and ease of recalibration. To recalibrate the meter, take readings at 0 and 500 pounds, Lo rd and Hi rd do not need to be reentered. If a 500 lb. weight was not available, the same result can be achieved by using any known weight. During setup, it may be necessary to enable some menu items. See Section 9 for further information. See Section 12, Process Meters, for an example scaling by direct entry of the input values.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
InPut	Strn	20.0
Press the ↵ key to display InPut (Input type selection).	Press ▶ until Strn (ratiometric) is displayed.	Press ▲ to select 20.0, 50.0, 100.0, 250.0 or 500.0mV

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
ConFG Press the ↵ key to display ConFG(configuration). See Section 9, Pg 13 for detailed description of digits 1 thru 5.	00000 Press ▶ to display status. Press ▶ again to select digit. Selected digit will flash.	01000 1 2 3 4 5 Press ▲ to select value. Digit 2:"1"= Reading input 2 coodinate method of scaling.
dEc.Pt Press the ↵ key to display dEcPt (Decimal point)	d.dddd Press ▶ to display decimal point location.	ddd.dd Press ▲ to change decimal point location.
rESEt Press the ↵ key. Continue to press ↵ (or ↵ and ▲ simultaneously) until rESEt is displayed. The meter will go to the operating mode and display the value of the input signal		000.29
Lo in Press the ↵ key to display Lo in (Low signal input value). Apply an input for a known low value.	000.29 Press ▶ to display input signal. Meter will momentarily blank and then display a reading.	000.29 Use ▲ to store reading as low input
Hi In Press the ↵ key to display Hi in (High signal input value). Apply an input for a known high value.	19.957 Press ▶ to display input signal. Meter will momentarily blank and then display a reading.	19.957 Use ▲ t o set digit values and set to 20.000mV.
Lo rd Press the ↵ key to display Lo rd (Desired meter reading at low signal input).	00000 Press ▶ to display value and select left digit. Press ▶ again to select another digit. Decimal point set by dEc.Pt	00000 Use ▲ to set digit values and set to 0.
Hi rd Press the ↵ key to display Hi rd (Desired meter reading at high signal input).	500.00 Press ▶ to display value and select left digit. Press ▶ again to select another digit. Decimal point set by dEc.Pt .	500.00 Use ▲ to set digit values and set to 500.00.
rESEt Press the ↵ key. Continue to press ↵ (or ↵ and ▲ simultaneously) until rESEt is displayed. The meter will go to the operating mode and display the value of the input signal.		500.00

18. DUAL ALARM OUTPUTS

18.1 OPERATING MODE MENU SELECTION

When setting up the meter, it may be necessary to enable some of the menu items. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
ALSEt Press the ↵ key until ALSEt (Alarm setup) is displayed. See Section 9, ALSEt for detailed selection information for Digits 1 through 5.	00000 Press ▶ to display status. Press ▶ again to select digit. Selected digit will flash.	20013 1 2 3 4 5 Press ▲ to select value for flashing digit **Digit 1**:Relay state in alarm **Digit 2:** Latching or non-latching output **Digit 3:** Alarm high, low, or disabled **Digit 4:** Hysteresis or deviation **Digit 5:** Time delay
dEU1b Press the ↵ key and dEU1b (Alarm 1 band deviation) or dEU1H (Alarm 1 hysteresis) is displayed if ALSEt digit 4 is not set to 4.	00000 Press ▶ to display value. Press again to select digit. Selected digit will flash.	00200 Using ▲ to select digit and ▶ to set digit value, enter deviation value for setpoint 1 Relays turn on and off at setpoint if value is zero.
dEU2H Press the ↵ key and dEU2b (Alarm 2 band deviation) or dEU2H (Alarm 2 hysteresis) is displayed if ALSEt digit 4 is not set to 4.	00000 Press ▶ to display value. Press ▶ again to select digit. Selected digit will flash.	00200 Using ▲ to select digit and ▶ to set digit value, enter deviation value for setpoint 2 Relays turn on and off at setpoint if value is zero.

18.2 NORMAL OPERATION

When deviation and hysteresis are not enabled or deviation is set to zero, the alarm energizes at and above the setpoint and deenergizes below the setpoint if high alarm is selected. The alarm energizes at and below the setpoint and deenergizes above the setpoint if low alarm is selected. The setpoint value is not displayed if the alarm is disabled.

18.3 BAND DEVIATION

When deviation is selected from the setup menu, a value is entered for the amount of deviation required. This value represents the number of counts at which the relay will be energized above and below the setpoint. For example, if the setpoint is set to 10,000 and a deviation value of 200 was entered, the relay will activate below 9800 and above 10,200.

18.4 HYSTERESIS

When hysteresis is selected from the setup menu, a value is entered for the amount of hysteresis required. This value represents the number of counts at which the relay will be energized above and deenergized below the setpoint. For example, if the setpoint is set to 10,000 and a hysteresis value of 200 was entered, the relay will activate at 10200 and deactivate at 9800.

18. 3 VIEWING AND CHANGING SETPOINTS

When viewing or changing the setpoint values, it is not necessary to enter the setup menu. This allows the meter to continue conversions and provide outputs when the setpoints are displayed.

ALARM KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
300.24 Press the ALARMS key to display Alarm 1 value.	200.00 Alarm value blinks and Alarm 1 LED indicator lights. Press ▶ to select digit.	295.00 Using ▶ to select digit and ▲ to set digit value, enter setpoint 1 value.
395.00 Press ALARMS key again to display Alarm 2 value	395.00 Alarm value blinks and Alarm 2 LED indicator lights. Press ▶ to select digit.	305.00 Using ▶ to select digit and ▲ to set digit value, enter setpoint 2 value.
300.24 Press ALARMS key again. The meter resets and then displays the present reading.		

19. ANALOG OUTPUT

The analog output option provides a 0 to 20mA and a 0 to 10Vdc linear signal derived from the displayed reading. The low signal output and high signal output may be set to equal any displayed value. Although both outputs are available, only one is calibrated to specifications. The other output is accurate to +/-1% of the displayed value typical (2%max).

19. 1 4 TO 20MA OUTPUT SCALING

The output is scaled by selecting a displayed value for the low signal output and a displayed value for the high signal output. For a current output, the low value is 0mA and the high output is 20mA. To scale a signal for 4 to 20 mA, the following procedure must be used:

1. Desired display value for 20mA - Desired display value for 4mA = Display span
2. Display span / 4 = Offset value
3. Desired display value for 4mA - Offset value = **An Lo**
4. **An Hi** = Desired display value for 20mA

19. 2 ANALOG OUTPUT SETUP SOFTWARE

The following menu items are accessible only with an Analog Output option installed and appropriate lockouts enabled. See Section 9 for further information. Setup Example: 4mA to 20mA out = 5000 counts to 15000 counts (See Section 19.1).

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
An SEt Press the ↵ key until An Set (Setup of analog output) is displayed. See Section 9, An Set for detailed selection information for Digits 1 through 6.	00 Press ▶ to display status. Press ▶ again to select digit. Selected digit will flash.	12 1 2 3 4 5 6 Press ▲ to select value for flashing digit **Digit 5:** Current or Voltage **Digit 6:** Filtering
An Lo Press the ↵ key until An Lo (Displayed value at 0mA or 0V) is displayed.	00000 Press ▶ to display value. Press ▶ again to select digit. Selected digit will flash.	02500 Press ▲ to select value for flashing digit
An Hi Press the ↵ key until An Hi (Displayed value at 20mA or 10V) is displayed.	00000 Press ▶ to display value. Press ▶ again to select digit. Selected digit will flash.	15000 Press ▲ to select value for flashing digit

20. RS-232 AND RS-485 INTERFACE

20. 1 OPERATING MODE MENU SELECTION

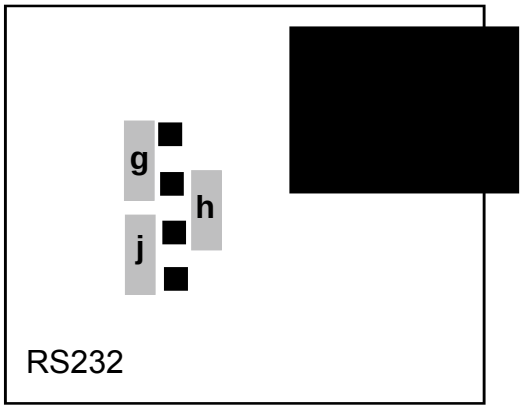
The following menu items are accessible only with an RS-232 or RS-485 option installed and appropriate lockouts enabled. See Section 10 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
SEr 1 Press the ↵ key until SEr 1 (Serial interface setup 1) is displayed.	000 1 2 3 4 5 Press ▶ to display status. Press ▶ again to select digit. Selected digit will flash. **Digit 3:** Output filtering **Digit 4:** Baud rate **Digit 5:** Output update rate	158 1 2 3 4 5 Press ▲ to select value for flashing digit **3**: "0"- Send unfiltered signal "1"- Send filtered signal **4**: "0" - "6" -300 to 19.2K baud **5:** "0"- "9"-60/sec to 1/15min
SEr 2 Press the ↵ key until SEr 2 (Serial interface setup 2) is displayed.	0000 1 2 3 4 5 Press ▶ to display status. Press ▶ again to select digit. **Digit 2:** Line feed **Digit 3:** Alarm data sent with meter readings **Digit 4:** Control of output **Digit 5:** Meter address	001E. 1 2 3 4 5 Press ▲ to select value for flashing digit **2**: "0"-no line feed "1"-<LF> after <CR> **3**: "0"-no alarm data "1"-alarm data sent **4**: "0"-continuous output "1"-output on command **5:** "1" to "F" & "0." to "F." - Meter #1 to Meter #31

15. RS-232 AND RS-485 INTERFACE

15. 1 JUMPER SELECTIONS

RS232 Interface

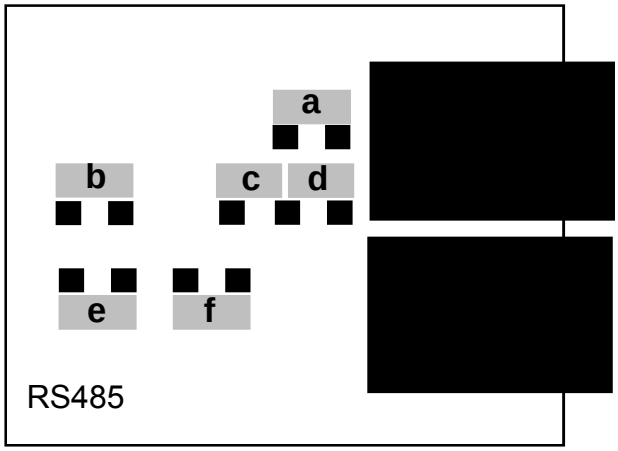


Jumper g - installed for normal operation
Jumper h - installed when used as a slave display with the RS232 output of another Laureate meter.
Jumper j - provides a pull-up resistor on the RTS line.

Note: The board is shipped standard with jumpers **g** and **j** installed

RS485 Interface

Note: Bias jumpers b and e must be installed on board for proper operation. If the outputs of more than 1 RS485 are connected together, then 1 (AND ONLY 1) RS485 board must have the jumpers installed.



Full Duplex

Jumpers b and **e** - bias jumpers installed on 1 board
Jumpers a and d - are installed with long cable runs and add 121 ohm load resistors. If multiple meters are on same line, only the last meter in the line should be jumpered.

Half Duplex

Jumpers b and **e** - bias jumpers installed on 1 board
Jumpers c and **f** - installed for half duplex operation
Jumper a - is installed with long cable runs and add a 121 ohm load resistor. If multiple meters are on same line, only the last meter in the line should be jumpered.

Note: The board is shipped standard with no jumpers installed

21. PARALLEL BCD OUTPUT

21. 1 OPERATING MODE MENU SELECTION

The following menu items are accessible only with a BCD option installed and appropriate lockouts enabled. See Section 9 for further information.

MENU KEY ↵	DIGIT SELECT KEY ▶	VALUE SELECT KEY ▲
SEr 1	0_0 1 2 3 4 5	0_0 1 2 3 4 5
Press the ↵ key until SEr 1 (Serial interface setup 1) is displayed.	Press ▶ to display status. Press ▶ again to select digit. Selected digit will flash. **Digit 3:** Output filtering **Digit 5:** Output update rate	Press ▲ to select value for flashing digit **3**: "0"-Send unfiltered signal "1"-Send filtered signal **5:** "0"-Line frequency "1" to "9" - Batch display rate (3.5/sec) to Batch display rate / 256 (1 every 15 min.)

21. 2 BCD OUTPUT LEVELS

The BCD option provides isolated, buffered, stored, 3-state parallel outputs that are selectable for either 0 to 5V logic levels (LSTTL, CMOS compatible) or 0 to 15Vdc. Selection jumpers are located on the BCD board. BCD outputs are positive true. Polarity bit is positive true for +sign.

LOGIC LEVEL	JUMPER REQUIRED
0 to 5Vdc	b
0 to 15Vdc	a

21. 3 BCD CONTROL SIGNALS

Enable — Logical 0 - All outputs go to the high impedance state
Logical 1 - BCD information is available at outputs.

$\overline{\text{BCD Hold}}$ — Logical 0 - BCD from last update prior to BCD Hold going low is stored
Logical 1- BCD information updates at selected rate.

$\overline{\text{Data Ready}}$ — Logical 0 - BCD outputs are valid
Logical 1 - BCD outputs are not valid

22. 5, 10 AND 24 VDC EXCITATION OUTPUTS

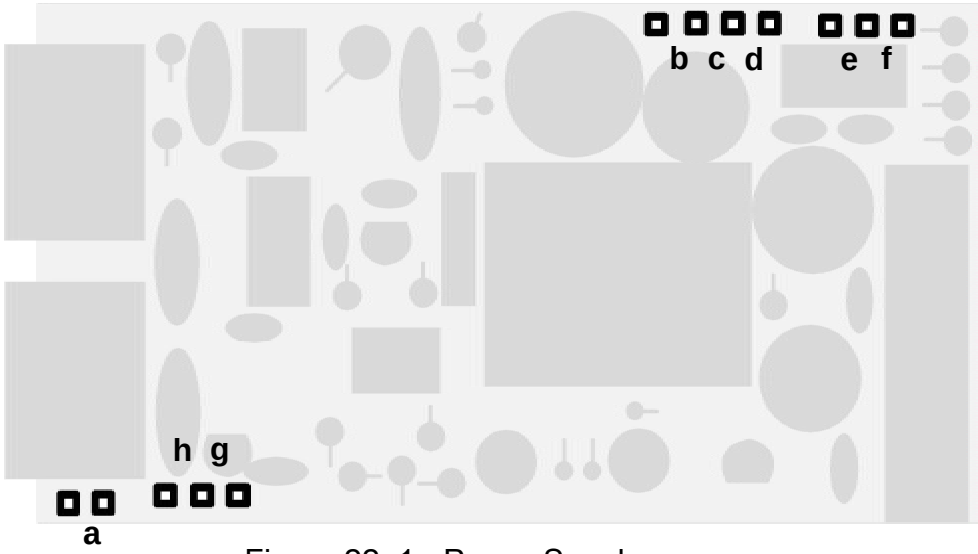
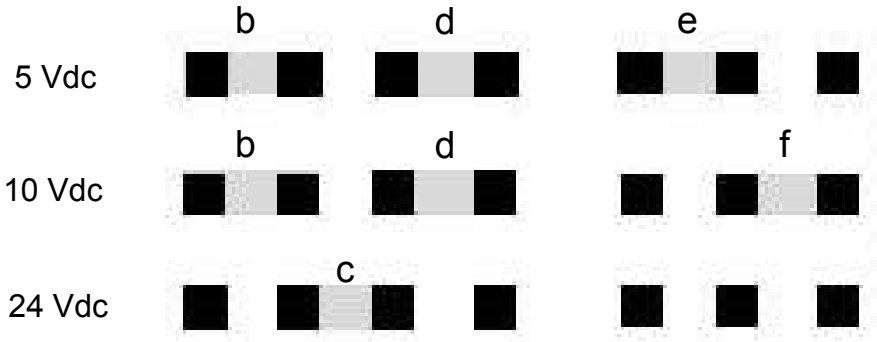


Figure 22. 1 - Power Supply

22. 1 SELECTION OF 5, 10 OR 24VDC OUTPUT

Voltage Output	Jumper Locations
5 Vdc	b, d and e
10 Vdc	b, d and f
24 Vdc	c



22. 2 SELECTION OF OTHER JUMPERS

Jumper ' **a** ' - Front panel menu lockout, locked when installed (see Section 10.1)

Jumper ' **g** ' - Provides +5V power output at P1-4 when installed
Jumper ' **h** ' - Connects "Digital Input B" to P1-4 when installed

23. DIGITAL INPUTS

23.1 FUNCTION OF DIGITAL INPUTS

$\overline{\text{Tare}}$ Logical 0 - The present display value is set to zero and stored as an offset value.
Logical 1 - The displayed value is equal to the signal input minus the tare value.

$\overline{\text{Peak Display}}$ Logical 0 - The peak value of the input signal is displayed.
Logical 1 - The present value of the input signal is displayed.

$\overline{\text{Hold}}$ Logical 0 - The meter display and outputs are held at the last reading.
Logical 1 - The display and outputs are updated normally

$\overline{\text{Reset}}$ Logical 0 - The microcomputer reads and resets the meter to nonvolatile memory values
Logical 1 - The meter display and outputs operate normally.

$\overline{\text{Function Reset}}$ Logical 0 - The microC resets peak to present value and resets alarms.
Logical 1 - The meter display and outputs operate normally.

External Decimal Points

Input A	Input B	Decimal Pts 1	Decimal Pts 2
1	1	XXXXX	XXXX.X
0	1	XXXX.X	XXX.XX
1	0	XXX.XX	XX.XXX
0	0	XX.XXX	X.XXXX

23.3 MENU SELECTIONS

MENU KEY ➥ | **DIGIT SELECT KEY** | **VALUE SELECT KEY ▲**

Press the ➥ key until SEtup (Basic meter setup) is displayed.

1 2 3 4 5

Press ▶ to display status. Press ▶ again to select digit. Selected digit will flash. **Digit 5:** digital inputs A & B at J1, Pins 5 and 4.

1 2 3 4 5

Press ▲ to select value for flashing digit

0 A: Reset B: Meter Hold
1 A: Function Reset
B: Peak display
2 A: Meter Hold B: Peak
3 A: Meter Hold B: Tare
4 A: Peak B: Tare
5 A: Tare B: Reset
6 External Decimal Pts.1
7 External Decimal Pts.2

24. CALIBRATION

All ranges of the meter have been digitally calibrated at the factory prior to shipment. The calibration equipment is certified to NIST standards. Calibration constants are stored in non-volatile memory in EEPROM on the signal conditioner. This eliminates much of the analog circuitry that causes drift and provides superior long term accuracy and stability.

Since the calibration is stored on the signal conditioner and analog output boards, all boards may be mixed and interchanged without requiring recalibration. If recalibration is required, the meter may be returned to the factory or any authorized distributor.

For the customer requiring on site calibration, an RS-232 or RS-485 option must be installed to perform the calibration. The interface card may be temporarily installed and then removed upon completion of calibration. Step-by-step instructions for calibration and the equipment required is available from the factory.

25. SPECIFICATIONS

BASIC METER

Display

Type ..... 5 LED, 7-segment, 14.2mm (.56") high digits & 3 LED indicators
Color ..... Red or green
Range .....-99999 to +99999 and -99990 to +99990

A to D Conversion

Technique (Pat.5,262,780) ..... Concurrent Slope™
Rate ..... 60/s for 60 Hz NMR, 50/s for 50 Hz NMR
Output Update Rate ..... 56/s at 60 Hz, 47/s at 50 Hz
Display Update Rate ..... 3.5/s at 60 Hz, 3/s at 50 Hz

Noise Rejection

CMV from DC to 60 Hz .....Safety-rated to 250Vac, 4.2kVp per High Voltage Test
CMR from DC to 60 Hz .....130 dB
NMR at 50/60 Hz ..... 90 dB with minimum digital filtering

External Inputs/Outputs (CMOS/TTL Levels)

$\overline{\text{Hold}}$ input ..... 0 - holds display and outputs
$\overline{\text{Peak}}$ input .....0 - displays peak value
$\overline{\text{Tare}}$ input ..... 0 - offsets input value to zero
$\overline{\text{Reset}}$ input ..... 0 - resets all meter functions
$\overline{\text{Function Reset}}$ input ..... 0 - resets peak values and alarms
Decimal Point input ..... overrides internal DP selections and controls DP position

ACCURACY

DC Volts

VOLTAGE RANGE	RESOLUTION	INPUT OHMS	ERROR AT 25°C
200.00 mV 2.0000 V 20.000 V 200.00 V 660.0 V	10 uV 100 uV 1 mV 10 mV 100 mV	1 G 1 G 1 M 1 M 1 M	.01% Full Scale +/-2 Ct.

DC Amperes

CURRENT RANGE	RESOLUTION	INPUT OHMS	ERROR AT 25°C
2.0000 mA 20.000 mA 200.00 mA 5.000 A	0.1 uA 1.0 uA 10 uA 1.0 mA	100 10 1 .01	.01% Full Scale +/-2 Ct.

Ratio

VOLTAGE RANGE	RESOLUTION	INPUT OHMS	ERROR AT 25°C
200.00 mV 2.0000 V 20.000 V	10 uV 100 uV 1 mV	1 G 1 G 1 M	.01% Full Scale +/-2 Ct.

True RMS Volts (1 to 100% Full Scale)

VOLTAGE RANGE	RESOLUTION	INPUT OHMS	ERROR AT 25°C
200.00 mV 2.0000 V 20.000 V 200.00 V 660.0 V	10 uV 100 uV 1 mV 10 mV 100 mV	22 M 22M 1 M 1 M 1 M	.1% FS +/-10 Ct. from 10 Hz to 10kHz

True RMS Amperes (1 to 100% Full Scale)

CURRENT RANGE	RESOLUTION	INPUT OHMS	ERROR AT 25°C
2.0000 mA 20.000 mA 200.00 mA 5.000A	0.1 uA 1.0 uA 10 uA .25 mA	100 10 1 .01	.1% FS +/-10 Ct. from 10 Hz to 10kHz

RTD's (.01, .1, 1.0 Degree Resolution)

PT100 TYPE	RANGE	ERROR AT 25°C
DIN .00385	-202°C to +850°C -331°F to +1562°F	.01% FS +/- 0.03°C .01% FS +/- 0.05°F
ANSI .003925	-202°C to +631°C -331°F to +1168°F	.01% FS +/- 0.04°C .01% FS +/- 0.07°F

Thermocouple
(.1, 1.0 Degree Resolution)

TC TYPE	RANGE	ERROR AT 25°C
J	-210°C to +760°C -347°F to +1400°F	.01% FS +/- 0.09°C .01% FS +/- 0.16°F
K	-244°C to +1372°C -408°F to +2501°F	.01% FS +/- 0.1°C .01% FS +/- 0.17°F
T	0°C to +400°C -257°C to 0°C +32°F to 752°F -430°F to +32°F	.01% FS +/- 0.03°C .01% FS +/- 0.2°C .01% FS +/- 0.05°F .01% FS +/- 0.36°F
E	-240°C to +1000°C -400°F to +1830°F	.01% FS +/- 0.18°C .01% FS +/- 0.32°F
N	-244°C to +1372°C -408°F to +2501°F	.01% FS +/- 0.1°C .01% FS +/- 0.17°F
S	-46°C to +1768°C -51°F to +3213°F	.01% FS +/- 0.12°C .01% FS +/- 0.22°F
R	-45°C to +1768°C -49°F to +3214°F	.01% FS +/- 0.17°C .01% FS +/- 0.31°F

Load Cell Inputs

INPUT RANGE	RESO-LUTION	OUTPUT ZERO RANGE	OUTPUT SPAN RANGE	ERROR AT 25°C
20.000 mV 50.000 mV 100.00 mV 250.00 mV 500.00 mV	1 uV 2.5 uV 5 uV 12.5 uV 25 uV	-99,999 to +99,999	0 to +/-99,999	.01%Full Scale +/-1Ct.

Span Tempco ..... 0.003% of reading/°C
Load Cell Meter only ..... 0.0015% of reading/°C
Zero Tempco ..... 0.2 uV/°C
Reference Junction ..... 0.03 degree/degree

POWER SUPPLIES

Input Voltage (std) ..... 85 to 264 Vac, 90 to 370 Vdc
Input Voltage (opt) ..... 8 to 28 Vac, 9 to 37 Vdc
Frequency ..... DC and 47 to 440 Hz
Consumption ..... 5.3 Watts max.

Excitation Power Supplies
Outputs ..... 5 Vdc, 5%, 100 mA max
10 Vdc, 5%, 120 mA max.
24 Vdc, 5%, 40 mA max.
Ripple ..... 100 mVp max.
Isolation ..... Safety-rated to 250Vac, 4.2kVp per High Voltage Test

DUAL CONTROLLER OPTION

Basic

Power ..... Provided by basic meter
Update Rate ..... 56/s at 60 Hz, 47/s at 50 Hz
Setup ..... setpoint values may be entered by front panel pushbuttons or via RS-232 or RS-485
Lockouts ..... Front panel pushbuttons control display and change of setpoints, only control display of setpoints, or are disabled.
Output Operation ..... either output may be set to operate above, below or around the setpoint, latching or non-latching or output disabled
Filtering ..... comparison to the setpoints may be either from the filtered or unfiltered input signal
Time Delay ..... selectable time delay of output status change of 1 to 128 readings
Hysteresis ..... selectable from 0 to +/- 99,999 counts

Alarm Status Indicators
Type ..... 2 red LED lamps

Relay Output

Contact Rating ..... 10 A @ 240 Vac, 8 A @ 24 Vdc
Safety Certification ..... VDE, UL, and CSA

Isolation
- Coil to Contacts ..... Safety-rated to 250Vac, 4.2kVp per High Voltage Test
- Between Open Contacts ..... withstand 4.2kVp for 1 min
- Pickup ..... 26 ms typ.
- Release ..... 22 ms typ.

Solid State Relay Output

Voltage Rating ..... 125Vac, 150 Vdc max.
Current Rating ..... 120 mAac, 240mAdc
Safety Certification ..... VDE, UL and CSA
Isolation ..... Safety-rated to 250Vac, 4.2kVp per High Voltage Test
Response to input signal ..... 17 ms typ.

ANALOG OUTPUT OPTION

Isolation ..... Safety-rated to 250Vac, 4.2kVp per High Voltage Test
Power ..... supplied by basic meter
Accuracy ..... basic meter +/-0.1% Analog Full Scale
Response Time ..... 17 ms for unfiltered input, same as basic meter for filtered input
Compliance
- 0 to 20 mA ..... 12 V (0 to 600 Ohms)
- 0 to 10 V ..... 2 mA (5 kOhms min.) load

Scaling
Reading for Zero Output ..... -99,999 to +99,999
Reading for Full Scale Output ..... -99,999 to +99,999

RS-232 / RS-485 INTERFACE OPTION

Isolation ..... Safety-rated to 250Vac, 4.2kVp per High Voltage Test
Power ..... supplied by basic meter
Type ..... full or half duplex (RS-485)
Baud Rates 300, 600, 1200, 2400, 4800, 9600, 19200
Signal Levels ..... Meet RS-232 and RS-485 standards

BCD OUTPUT OPTION

Isolation ..... Safety-rated to 250Vac, 4.2kVp per High Voltage Test
Power ..... supplied by basic meter
Type ..... 3-state, stored, parallel
Signal Levels ..... LSTTL, CMOS compatible
Controls ..... BCD Enable, $\overline{\text{Hold}}$, $\overline{\text{Data Ready}}$

ENVIRONMENTAL

Operating Temperature ..... 0°C to 55°C
Storage Temperature ..... -40°C to 85°C
Relative Humidity ..... 90% from 0°C to 40°C

WARRANTY

Laurel Electronics Inc. warrants its products against defects in materials or workmanship for a period of one year from the date of purchase.

In the event of a defect during the warranty period, the unit should be returned, freight prepaid (and all duties and taxes) by the Buyer, to the authorized Laurel distributor where the unit was purchased. The distributor, at its option, will repair or replace the defective unit. The unit will be returned to the buyer with freight charges prepaid by the distributor.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from:

1. Improper or inadequate maintenance by Buyer.
2. Unauthorized modification or misuse.
3. Operation outside the environmental specifications of the product.
4. Mishandling or abuse.

The warranty set forth above is exclusive and no other warranty, whether written or oral, is expressed or implied. Laurel specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

EXCLUSIVE REMEDIES

The remedies provided herein are Buyer's sole and exclusive remedies. In no event shall Laurel be liable for direct, indirect, incidental or consequential damages (including loss of profits) whether based on contract, tort, or any other legal theory.

800Plus

UNIVERSAL DIGITAL METERS & COUNTERS

Model Type:	800Plus Universal Digital Meter							800Plus Universal Counter		
Selector guide and price:	page 3	page 4	page 5		page 6			page 7		
Specifications	DC Volt & Amp	AC Volt & Amp	RTD Temperature	Thermocouple	Process Monitor	Strain Gauge	Load Cell	FR Counter/Timer	VF Counter/Timer	QD Quaduture Input
Display:	7-segment LED, 14.2mm, .56" high digits									
Number of digits	5 digits							6 digits		
Range	-99999 to +99999							-999999 to +999999		
LED indicators	2 status indicators							3 status indicators		
Color	*Red or Green available with all models*									
Accuracy (25°C):			ANSI	TC type K						
Full scale or reading	0.01%FS	0.1%FS	0.04°C	0.1°C	0.01%FS	0.01%FS	0.01%FS	±2ppm	0.015%	±2ppm
± number of counts	1	1	-	-	1	1	1			
Span TEMPCO	0.003% of reading/°C- except load cell(0.0015% rdg./°C) & FR(±1ppm/°C typical)									
Zero TEMPCO	0.1 counts/°C							0.001FS/°C		
Conversion:	Patented A/D conversion method (US patent no. 5,262,780)							1 / period time:		
Update rate	60/sec. @ 60Hz operation; 50/sec. @ 50 Hz operation							Gate time + 30ms + 2 periods of		
Output update rate (UDM)	56/sec. @ 60Hz operation; 47/sec. @ 50 Hz operation							the input signal (max): gate time		
Display update rate (UDM)	3.5/sec. @ 60Hz operation; 3/sec. @ 50Hz operation							selectable 0 to 199.99 seconds		
Noise rejection:	Common Mode voltage from DC to 60 Hz safety rated to 250 VAC; 4.2 kVp per high voltage test									
CMR (DC to 60 Hz)	130 dB							-		
NMR (50/60 Hz line)	90 dB with minimum filtering							-		
Case:	NEMA 4 (IP65) 1/8 DIN case made of high impact 94V-0 UL rated plastic									
Environmental:	Temperature: *Operating* 0°C~55°C, *Storage* -40°C~85°C; Relative humidity 95% at 40°C non-condensing									
Operating Power:	Frequency 47 to 440 HZ and DC, consumption 5.3 Watts maximum									
Standard	Universal power supply 85 to 264 VAC, 90 to 370 VDC									
Option	Universal power supply 8 to 28 VAC, 9 to 37 VDC									
Excitation:	Selectable with shorting jumpers on power supply printed circuit board (normal setting 10 VDC)									
Outputs	5 VDC, ±5%, 100 mA max., 10 VDC, ±5%, 120 mA max., 24 VDC, ±5%, 50 mA max.									
Isolation (power ground)	Safety rated to 250 VAC, 4.2 kV peak per high voltage test									
Dual Controller option:	Power is provided by meter, update rate is 56 / second at 60 Hz, 47 / second at 50 Hz									
Setup	Setpoint values may be entered from front panel pushbutton or via RS-232 or RS-485									
Output operation	Either may be set to operate above or below setpoint, latching or non-latching, or output disabled									
Filtering	Comparison to the setpoints may be from filtered or unfiltered input signal									
Time delay	Selectable time delay of output status change from 1 to 128 readings									
Lockouts	Pushbutton control of display and change of setpoints, or display of setpoints, or disable									
Alarm status indicators	Either of two red LED's may be set to indicate when output is on or off, or they may be disabled									
Relay output:	10 A at 240 VAC, 8 A at 24 VDC contact rating; safety certification: VDE, UL, CSA									
Isolation	*Coil to contacts :*Safety rated to 250VAC, 4.2 kV peak; *Between open contacts :* Withstand 1 kVrms									
Response to input signal	*Pick-up:* 26 milliseconds typical; *Release:* 22 milliseconds typical									
Optotransistor output:	*Voltage rating:* 30VDC; *Current rating:* 100 mA minimum at 1.2 VDC maximum									
Isolation	Safety rated to 250 VAC, 4.2 kV peak per high voltage test									
Response to input signal	17 milliseconds typical									
Analog output option:	*Power :* provided by meter, *Isolation:* Withstand 3750 Vrms, 8mm creepage									
Accuracy	Use basic meter accuracy ±0.05% of analog output full scale									
Response time	17 milliseconds for unfiltered input, same as basic meter for filtered output									
RS-232 / RS-485 option:	*Power :* provided by meter; *Isolation:* safety rated to 250 VAC, 4.2 kVp per high voltage test									
Baud rates	300, 600, 1200, 2400, 9600, 19200									
Type / Signal levels	Full duplex (RS-485) / meets RS-232 and RS-485 standards									
BCD output option:	*Power :* provided by meter; *Isolation:* safety rated to 250 VAC, 4.2 kVp per high voltage test									
Type / Signal levels	Tri-state, stored parallel / LSTTL, CMOS compatible									
Controls	BCD Enable, Hold, Data ready									

800Plus UNIVERSAL DIGITAL METER

RMS VOLTS and AMPS

Selector Guide

Model Format: ❶ – ❷ – ❸ – ❹

Insert model code from the selection below:

❶ **Basic DPM, display & power supply:**

810	Green LED display, 85~264 VAC, 90~370 VDC
811	Green LED display, 8~28 VAC, 9~37 VDC
820	Red LED display, 85~264 VAC, 90~370 VDC
821	Red LED display, 8~28 VAC, 9~37 VDC

❷ **Output options:**

00	None
01	Adjustable analog output range of 0-20 mA and 0-10 V
10	Dual Form C,10 Amp relays
11	Dual Form C,10 Amp relays & analog output 0-20 mA and 0-10 V
20	Opto-Isolated open collectors
21	Opto-Isolated open collectors & analog output 0-20 mA and 0-10 V

❸ **Digital interface options:**

0	None
1	RS-232
2	RS-485
3	BCD

❹ **AC input:**

RMV1	200.00 mVAC
RMV2	2.0000 VAC
RMV3	20.000 VAC
RMV4	200.00 VAC
RMV5	660.0 VAC
RMA1	2.000 mAAC
RMA2	20.000 mAAC
RMA3	200.00 mADC
RMA4	5.000 AAC

Ordering Example: Model 821-10-1-RMV5 has red LED display with 8~28 VAC, 9~37 VDC power, dual 10A relay outputs, RS-232 digital interface and 660.0 VAC input range.

The 800Plus Universal Digital Meter is a versatile, cost effective solution to a wide variety of monitoring and control applications. The input can be changed by the user to any of the RMS voltage or current values listed above by re-locating shorting jumpers on the plug-in signal conditioner card. No calibration equipment is required when changing ranges since they are digitally precalibrated at the factory. Rescaling is accomplished via front panel pushbuttons. Optional alarms and outputs are also front panel programmable.

Refer to product bulletin 800SP-A for complete specifications and description of all features.

YOKOGAWA

800Plus

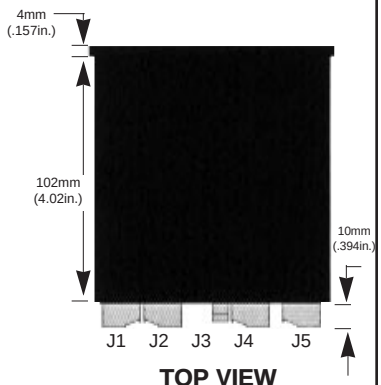
UNIVERSAL DIGITAL METER & COUNTER

Front Panel Setup Keys

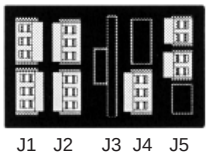
Panel Mounting and Cutout

Ensure the O-ring is in place. Turn the two mounting screws counterclockwise until the space between the mounting pawl and the bezel is greater than the panel thickness. Insert the meter in the panel cutout. Turn the mounting screws clockwise until the meter is securely mounted in the panel. Do not overtighten the mounting screws.

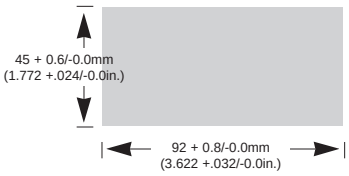
FRONT VIEW



TOP VIEW



REAR VIEW



PANEL CUTOUT

MENU KEY
The menu key steps through the various meter parameters that may be selected. These menu items may be "locked out" from front panel selection by software and hardware.

PEAK DISPLAY KEY (DIGIT SELECT)
In the Operating Mode, pressing the Peak Display Key causes the peak value of the input signal to be displayed. Pressing the key again returns the display to the present value. In Menu Mode , the Digit Select Key (Peak Display Key) is used to select input type and decimal point or to select one of the five display digits for programming. In the main menu, pressing the Digit Select Key causes the value or code that is stored for that menu item to be displayed and the left hand digit flashes. Each time the key is pressed, the next digit to the right will flash. The value of the flashing digit may be changed using the Value Select Key. In the Alarm Mode, pressing the Digit Select Key causes the most significant digit of the displayed setpoint value to flash. Digits are then selected the same as in the Menu Mode.

RESET KEY (VALUE SELECT)
In the Operating Mode, holding the Reset Key depressed and pressing any other key causes a reset to occur. The Menu Key resets all meter functions, the Alarm Key resets any alarm conditions and the Peak Display Key resets the peak value to present value. In the Menu Mode or Alarm Mode, the Value Select Key (Reset Key) sets the value of the flashing digit. Each time the key is pressed, the value increases by one. Holding the key down causes the digit to automatically step through the numbers.

ALARM KEY (REVERSE MENU)
In the Operating Mode, pressing the Alarm Key displays the set-point of Alarm 1 and then Alarm 2. These values may be changed using the Digit Select Key and the Value Select Key. In the Menu Mode, pressing the Alarm Key steps the display backward through the menu.

Connectors

The 800Plus Universal Digital Meter uses UL/VDE rated screw terminal connections that plug into the mating PC jack.

YOKOGAWA

Yokogawa Corporation of America

2 Dart Rd.
Newnan, GA 30265
800-258-2552 ext. 575
770-253-7000
FAX: 770-251-2088
www.yca.com

Represented by:

Pulsing Contactor (PC)

Definite Purpose Contactors & Starters

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50 mm DP Contactor

Compact 1-Pole with Shunt

Compact 2-Pole

50 mm DP Starter

XT Starter

Application Description

These Cutler-Hammer® ampere and horsepower rated devices from Eaton's electrical business are designed for service in applications such as Refrigeration, Air Conditioning and Resistance Heating and are manufactured to traditional Cutler-Hammer standards for quality and reliability. They are subjected to stringent quality assurance inspections and testing procedures. The life expectancy, both electrical and mechanical, will meet or exceed industry performance requirements for Definite Purpose devices.

If more detailed technical information is required — specifications, ratings, etc. — contact your local Eaton distributor or sales office.

Catalog Number Selection

Table 35-1. Definite Purpose Control Catalog Numbering System

C 25 D N A 2 15 A A 161 -84

Model
- **C** = Contactor
- **A** = Three-Phase Starter
- **B** = Single-Phase Starter

Type
- **25** = Non-reversing
- **27** = Non-reversing Starters
- **65** = Reversing

Frame Size
- **A** = Compact 1-Pole
- **B** = Compact 2-Pole
- **C** = Compact 1-Pole W/Shunt
- **D** = 15 – 50A, 2- and 3-Pole
- **E** = 25 – 40A, 4-Pole
- **F** = 60 – 75A, 2- and 3-Pole
- **G** = 90A, 2- and 3-Pole
- **H** = 120A, 2- and 3-Pole
- **K** = 200 and 300A, 3-Pole
- **L** = 360A, 3-Pole

Enclosure Type
- **N** = Open with Metal Mounting Plate
- **R** = Open with DIN Rail Mounting Adapter (2- and 3-Pole, 15 – 50A Contactors Only)
- **G** = NEMA Type 1 Enclosed

Power Terminals
- **A** = Binding Head Screw
- **B** = Binding Head Screw and Quick Connect Terminals (side by side)
- **C** = Screw/Pressure Plate ①
- **D** = Screw/Pressure Plate and Quick Connect Terminals (side by side) ①
- **E** = Box Lugs (Posidrive Setscrew)
- **F** = Box Lugs (Posidrive Setscrew) and Quick Connect Terminals (side by side)
- **G** = Binding Head Screw and Quick Connect Terminals (vertical in-line)
- **H** = Screw/Pressure Plate and Quick Connect Terminals (vertical in-line) ①
- **J** = Box Lugs (Posidrive Setscrew) and Quick Connect Terminals (vertical in-line)
- **K** = Box Lugs (Hex Socket Allen Head Setscrew)
- **L** = Box Lugs (Hex Socket Allen Head Setscrew) and Quick Connect Terminals (side by side)
- **M** = Box Lugs (Hex Socket Allen Head Setscrew) and Quick Connect Terminals (vertical in-line)

① Not available on 50A devices.

No. of Poles
- **1** = 1-Pole
- **2** = 2-Pole
- **3** = 3-Pole
- **4** = 4-Pole

Current Rating

15 = 15A	**75** = 75A
25 = 25A	**90** = 90A
30 = 30A	**120** = 120A
40 = 40A	**200** = 200A
50 = 50A	**300** = 300A
60 = 60A	**360** = 360A

Coil Selection

A = 110 – 120V AC, 50/60 Hz	**R** = 12V AC, 50/60 Hz
B = 208 – 240V AC, 50/60 Hz	**T** = 24V AC, 50/60 Hz
C = 440 – 480V AC, 50/60 Hz	**1R** = 12V DC
D = 550 – 600V AC, 50/50 Hz	**1T** = 24V DC
H = 277V AC, 60 Hz	**1W** = 48V DC
J = 220 – 240 V AC, 50/60 Hz	**1A** = 120V DC
L = 380 – 415V AC, 50 Hz	

Auxiliary Contacts (Side Mount)
- **A** = 1NO Pressure Plate
- **B** = 1NC Pressure Plate
- **C** = 1NO-1NC Pressure Plate
- **D** = 2NO Pressure Plate
- **E** = 2NC Pressure Plate
- **F** = 1NO Pressure Plate and QC
- **G** = 1NC Pressure Plate and QC
- **H** = 1NO-1NC Pressure Plate and QC
- **J** = 2NO Pressure Plate and QC
- **K** = 2NC Pressure Plate and QC
- **L** = 1NO-1NC Snap Switch QC Only
- **M** = 2NO-2NC Snap Switch QC Only

Fuse Blocks
- **161** = Class M, 600V, 30A
- **237** = Class G, 300V, 15A
- **238** = Class G, 300V, 20A
- **231** = Class G, 300V, 30A
- **232** = Class G, 300V, 60A
- **361** = Class J, 600V, 30A
- **362** = Class J, 600V, 60A
- **431** = Class T, 300V, 30A
- **432** = Class T, 300V, 60A
- **461** = Class T, 600V, 30A
- **462** = Class T, 600V, 60A
- **521** = Class H, 250V, 30A
- **522** = Class H, 250V, 60A
- **621** = Class R, 250V, 30A
- **622** = Class R, 250V, 60A

Bulk Packaging
- **Blank** = individual pkg.
- **-84** = 20 pc./pkg. (C25D_) 50 pc./pkg. (C25A_, C25B_, C25C_)
- **-86** = Rotate coil terminals 180° for 15A – 50A Contactors

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Standard 2-, 3- and 4-Pole Contactors 15 – 360A

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50 mm DP Contactor

Product Description

Cutler-Hammer® Type C25 Definite Purpose Contactors 15A through 360A, from Eaton's electrical business incorporate most competitive contactor mounting dimensions into a single baseplate. Contactors are dual-rated with inductive and resistive ratings as well as horsepower and kilowatt ratings. C25 contactors are furnished with pressure plates and quick connect terminals as standard on 15, 25 and 30A devices and with box lugs and quick-connect terminals on 40, 50, 60 and 75A. Other terminal configurations are available, see **Table 35-13**. Contactors will accept add-on auxiliary contacts — order factory assembled or as kits for field installation.

The separately available snap-on mechanical interlock permits interlocking two contactors for reversing or two-speed applications.

Contactors rated 15 – 50A only are available with DIN rail mount as a factory installed option.

Standards and Certifications

- UL Recognized Components
  UL File #E-1491, Guide NLDX2
- CSA Certified Components
  File #LR353, Class 3211 04, 481301 & 122201
- IEC 60947-4-1
- EN 60947-4-1

Technical Data and Specifications

- Magnet coil:
  - Class B (C25E, F, G, H and K), 130°C
  - Class F (C25D and L), 155°C
  - Class H (C25D), 180°C (Available as factory installed option)
- Contacts: Double break
- Coil terminals: 10 – 14 AWG
- Ambient temperature: 150°F (65°C) maximum
- UL recognized, CSA certified and conform to ARI 780
- CE mark
- Terminal wire range:
  - #8–32 binding head screw: 14 – 12 AWG (one conductor-solid)
  - #8–32 screw/pressure plate:
    - 14 – 8 AWG (one conductor)
    - 14 – 8 AWG (two conductors)
  - Box lugs — 15 – 50A:
    - # 2 posidrive screw or 5/32 hex socket screw
    - Upper Level: 14 – 4 AWG (one conductor)
    - Lower Level: 14 – 6 AWG (one conductor)
  - Box lugs — 60 – 75A
    - Upper Level: 14 – 2 AWG
    - Lower Level: 14 – 6 AWG

    Note: The box lugs on the 15 – 75A device can accept two conductors per pole.
  - Box lugs — 90A: 1/0 – 14 AWG
  - Box lugs — 120A: 3/0 – 8 AWG
  - Box lugs — 200 – 300A: 350 MCM – 6 AWG
  - Box lugs — 360A: 750 MCM – 2 AWG

Table 35-8. IEC/CE Ratings (IEC 60947-4-1, EN 60947-4-1) for 15A through 50A C25D_Contactors

C25D_ Inductive Rating	AC-1 (Ic)		AC-3 (Ie)		AC-4 (Ie)		AC-8a	
	480V	600V	480V	600V	480V	600V	480V	600V
15A	20A	20A	15A	15A	15A	—	15A	15A
25A	30A	30A	25A	25A	25A	—	25A	25A
30A	40A	40A	30A	30A	30A	—	30A	30A
40A	50A	—	40A	—	40A	—	40A	—
50A	65A	65A	50A	50A	50A	—	50A	50A

Table 35-9. Contactor Torque Ratings

Contactor Size	Terminal	Wire Range	Tightening Torque
15 – 50A ①	8–32 Binding Head Screw	12 – 14 AWG	22 lb-in
	Screw/Pressure Plate	8 – 14 AWG	15 lb-in
	Box Lug	12 – 14 AWG 10 AWG 8 AWG 4 – 6 AWG	15 lb-in 25 lb-in 40 lb-in 45 lb-in
60 – 75A ②	Box Lug	10 – 14 AWG 8 AWG 3 – 6 AWG	40 lb-in 45 lb-in 50 lb-in
90A	Box Lug	1/0 – 14 AWG	60 lb-in
120A	Box Lug	8 AWG 4 – 6 AWG 3 – 1/0 AWG	40 lb-in 45 lb-in 50 lb-in
200 – 300A	Box Lug	6 – 350 MCM	200 lb-in
360A	Box Lug	2 – 750 MCM	550 lb-in

① The box lugs on the 15 – 50A device can accept 2 conductors per pole, the upper section will accept 4 – 14 AWG and the lower section will accept 6 – 14 AWG.
② The box lugs on the 60 – 75A device can accept 2 conductors per pole, the upper section will accept 3 – 14 AWG and the lower section will accept 6 – 14 AWG.

Product Selection

When Ordering Specify

- Catalog Number plus Magnet Coil Suffix, below.
- Modify Catalog Number for any options required — see Options, **Page 35-7.**
- Catalog Numbers of accessory kits required, **Page 35-7.**

Table 35-10. Catalog Numbering System

C25DND215	A	X
Incomplete Catalog Number	Magnet Coil Suffix	Option Code as necessary

Table 35-11. C25 Contactors Product Selection— Open Type

Rating, Amperes				Maximum Motor Horsepower		Maximum Motor Kilowatts		Number of Poles	Open Type with Metal Mounting Plate		Open Type with DIN Rail Adapter	
Inductive Full Load	Resistive per Pole	Line Voltage	Locked Rotor	1-Phase	3-Phase	1-Phase	3-Phase		Catalog Number ①②	Price U.S. $	Catalog Number ①②	Price U.S. $
15	20	115	90	3/4	—	0.40	—	2	C25DND215_		C25DRD215_	
		230	90	2	3	1.5	2.2	3	C25DND315_		C25DRD315_	
		460	75	—	5	—	3.7					
		575	60	—	5	—	3.7					
25	35	115	150	2	—	1.5	—	2	C25DND225_		C25DRD225_	
		230	150	3	7-1/2	2.2	5.5	3	C25DND325_		C25DRD325_	
		460	125	—	10	—	7.5	4	C25END425_		NA	
		575	100	—	10	—	7.5					
30	40	115	180	2	—	1.5	—	2	C25DND230_		C25DRD230_	
		230	180	5	10	3.7	7.5	3	C25DND330_		C25DRD330_	
		460	150	—	15	—	11	4	C25END430_		NA	
		575	120	—	15	—	11					
40	50	115	240	3	—	2.2	—	2	C25DNF240_		C25DRF240_	
		230	240	7-1/2	10	5.5	7.5	3	C25DNF340_		C25DRF340_	
		460	200	—	20	—	15	4	C25ENF440_		NA	
		575	160	—	20	—	15					
50	65	115	300	3	—	2.2	—	2	C25DNJ250_		C25DRJ250_	
		230	300	10	15	7.5	11	3	C25DNJ350_		C25DRJ350_	
		460	250	—	30	—	22					
		575	200	—	30	—	22					
60	75	115	360	5	—	3.7	—	2	C25FNF260_		NA	
		230	360	10	20	7.5	15	3	C25FNF360_			
		460	300	—	40	—	30					
		575	240	—	40	—	30					
75	90	115	450	5	—	3.7	—	2	C25FNF275_		NA	
		230	450	15	20	11	18.5	3	C25FNF375_			
		460	375	—	50	—	37					
		575	300	—	50	—	37					
90	120	115	540	7-1/2	—	5.7	—	2	C25GNF290_		NA	
		230	540	20	30	15.1	22	3	C25GNF390_			
		460	450	—	50	—	37					
		575	360	—	50	—	37					
120	140	230	720	—	—	—	—	3	C25HNE3120_		NA	
		460	720	—	—	—	—					
		575	570	—	—	—	—					
200	200	240	1200	—	—	—	—	3	C25KNE3200_		NA	
		480	1200	—	—	—	—					
		600	1000	—	—	—	—					
300	300	240	1800	—	—	—	—	3	C25KNE3300_		NA	
		480	1800	—	—	—	—					
		600	1500	—	—	—	—					
360	360	240	2320	—	—	—	—	3	C25LNE3360_		NA	
		480	2320	—	—	—	—					
		600	1900	—	—	—	—					

① Incomplete Catalog Number. Replace underscore (_) in Catalog Number with Magnet Coil Suffix from table below.
② Carton quantities including 20 individually packaged units are available for 2- and 3-pole units through 60A inductive.
③ Contactors with DC coils (only available up to 75A) include an early break NC auxiliary contact, C320KGD1. See **Page 35-34** for more details.
④ Available only for 15A through 75A contactors and 4-pole contactors.
⑤ Available through 75A.
⑥ Available through 120A.
⑦ Available 120 – 360A.
⑧ Available 15 – 90A, others 240V.
⑨ Available through 50A.

Table 35-12. Magnet Coil Selection

Voltage		Coil Suffix
60 Hertz	50 Hertz	
AC ⑪		
12 ⑤	12	R
24 ⑥	24	T
110 – 120 ⑩	110 – 120 ⑩	A
208 ⑦	—	E
208 – 240 ⑧	208 – 240	B
240 ⑨	220	J
277	—	H
—	380 – 415	L
440 – 480	440 – 480	C
550 – 600	550 – 600	D
DC ③		
12		1R
24		1T
48		1W
120		1A ④

⑩ 104 – 120V 50/60 Hz for 60A, 75A and all 4-Pole Contactors (25A – 40A).
⑪ Class H AC Coils available as option for 15A – 50A Contactor. Add **2** before AC Coil Suffix letter.

Technical Data ..... **Pages 35-5, 35-22**
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Discount Symbol **1CD-5C**

C25 Contactors

Table 35-69. Approximate Dimensions and Shipping Weights

Ampere Size	Number of Poles	Dimensions in Inches (mm)									Ship. Wt. Lbs. (kg)
		Wide A	High B	Deep C	Mounting					Side Auxiliary Contact Adder	
					D	E	F	G	H	J	
Open Type											
15 – 50	2 and 3	2.40 (61.0) ①	3.75 (95.0)	3.35 (85.0)	3.25 (83.0)	2.00 (51.0)	—	3.13 (79.0)	1.50 (38.0)	0.34 (8.6)	1.3 (.6)
25 – 40	4	2.68 (68.0) ①	3.75 (95.0)	3.38 (86.0)	3.25 (83.0)	2.00 (51.0)	1.5 (38.0)	3.13 (79.0)	1.50 (38.0)	0.50 (12.5)	2.3 (1.0)
60 – 75	2 and 3	2.63 (67.0) ①	3.75 (95.0)	3.97 (101.0)	3.25 (83.0)	2.00 (51.0)	1.5 (38.0)	3.13 (79.0)	1.50 (38.0)	0.37 (9.5)	2.8 (1.3)
90	2 and 3	3.39 (86.0)	5.12 (130.0)	4.76 (121.0)	4.44 (113.0)	2.87 (73.0)	—	—	2.50 (63.5)	0.54 (13.7)	4.0 (1.8)
120	2 and 3	4.08 (104.0)	7.17 (182.0)	5.94 (151.0)	3.00 (76.0)	6.63 (168.0)	—	—	—	0.54 (13.7)	8.5 (3.9)
200 and 300	2 and 3	7.05 (179.0)	9.11 (232.0)	7.25 (184.0)	6.00 (152.0)	8.50 (216.0)	—	—	—	—	20.0 (9.1)
360	2 and 3	7.05 (179.0)	13.12 (333.0)	7.78 (198.0)	6.00 (152.0)	12.50 (318.0)	—	—	—	—	23.0 (10.4)
Open Type — Reversing											
15 – 50	2 and 3	5.0 (127)	3.75 (95)	3.35 (85)	3.25 (83)	4.53 (118)	—	3.13 (79)	4.13 (105)	0.34 (8.6)	2.6 (1.2)
60 – 75	2 and 3	5.77 (147)	3.75 (95)	3.97 (101)	3.25 (83)	5.15 (131)	3.15 (80)	3.13 (79)	4.65 (118)	0.37 (9.5)	5.6 (2.5)
NEMA 1 Enclosed											
15 – 50	2 and 3	4.10 (104.0)	6.75 (171.0)	3.50 (89.0)	2.75 (70).0	4.88 (124.0)	—	—	—	—	3.4 (1.5)
25 – 40	4	5.62 (142.0)	9.51 (241.0)	4.81 (122.0)	4.50 (114.0)	8.00 (203.0)	—	—	—	—	5.8 (2.6)
60	2 and 3										6.3 (2.9)

① Add 0.30 inch (8 mm) to width for C25 contactors with DC coils

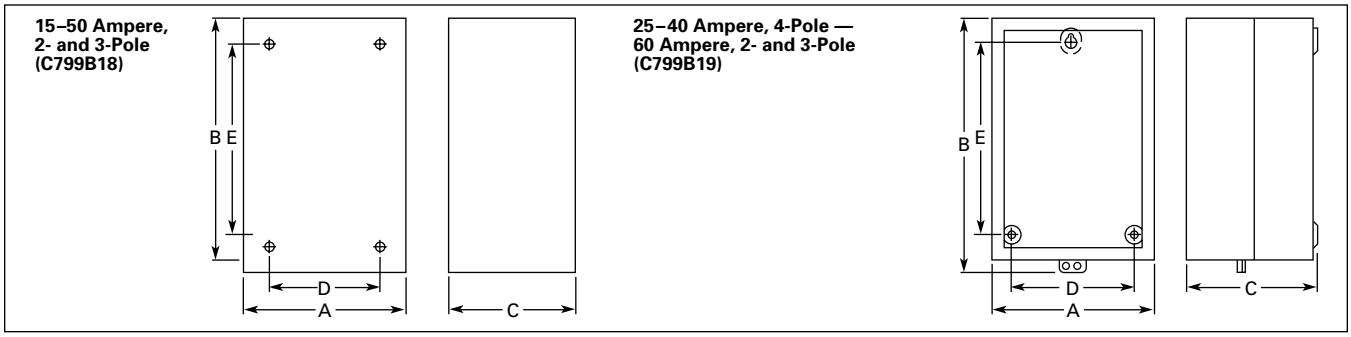

Figure 35-14. Enclosures

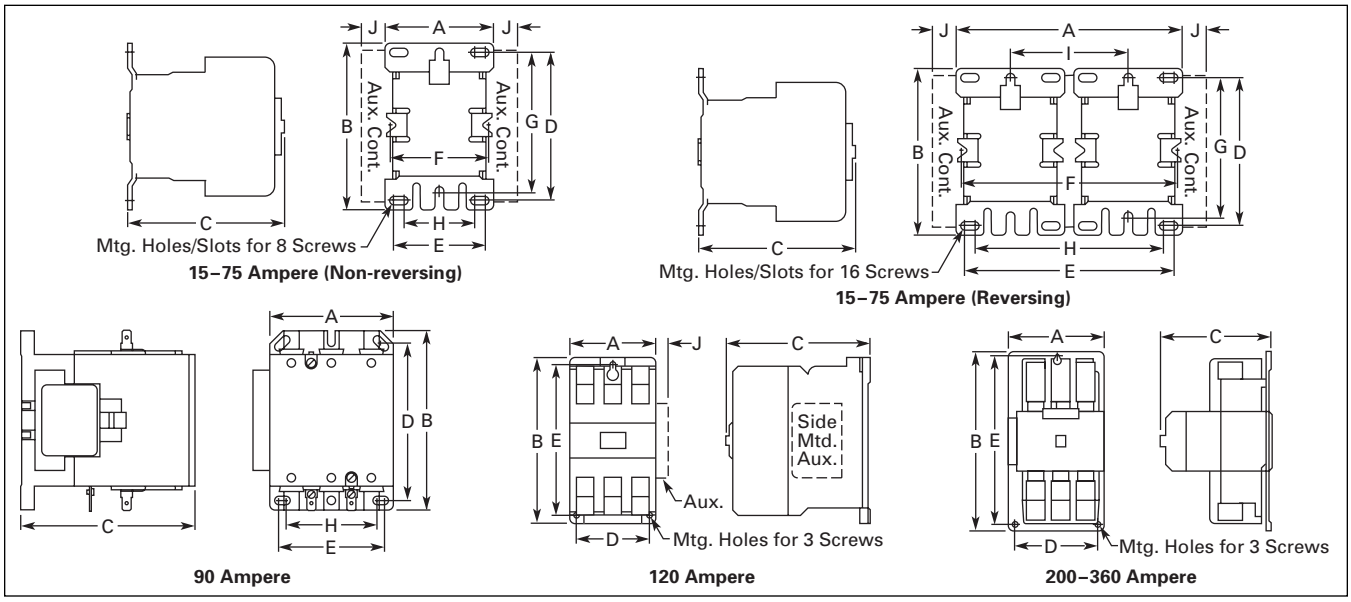

Figure 35-15. 15 – 360A, 2-, 3- and 4-Pole

Relays

- Recycle Timer (RT)
- Delay Timer (DT)
- Loss of Power (UV)
- Relay Socket

Control Relays & Timers

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Control Relays

Control Relays & Timers Comparison

Table 49-1. Selection Guide by Catalog Number Prefix

Relays	Type	Mounting	Contacts	Maximum Amperage (AC)		UL	CSA	CE	Page Number
9575H3	General Purpose	Panel Mount	Fixed	40A		X	X	X	**49-73**
AR/ARD	Machine Tool	Panel Mount	Convertible	10A		X	X		**49-90**
BF/BFD	Machine Tool	Panel Mount	Fixed	10A	X		X		**49-86**
D2PF	Full Featured Plug-In	DIN Rail/Panel Mount	Fixed	10A	X	X	X	X	**49-35**
D2PR	Standard Plug-In	DIN Rail/Panel Mount/Flange	Fixed	5A	X		X	X	**49-39**
D3PF	Full Featured Plug-In	DIN Rail/Panel Mount	Fixed	12A	X	X	X	X	**49-43**
D3PR	Standard Plug-In	DIN Rail/Panel Mount	Fixed	12A	X		X	X	**49-43**
D4PR	Standard Plug-In	DIN Rail/Panel Mount	Fixed	10A	X		X	X	**49-49**
D5PF	Full Featured Plug-In	DIN Rail/Panel Mount	Fixed	12A	X	X	X	X	**49-52**
D5PR	Standard Plug-In	DIN Rail/Panel Mount/PC Board	Fixed	15A	X		X	X	**49-52**
D7PF	Full Featured Plug-In	DIN Rail/Panel Mount	Fixed	20A	X	X	X	X	**49-62**
D7PR	Standard Plug-In	DIN Rail/Panel Mount/Flange	Fixed	15A	X		X	X	**49-56**
D8PR	Standard Plug-In	DIN Rail/Panel Mount/Flange	Fixed	30A	X		X	X	**49-67**
D9PR	Standard Plug-In	Panel Mounting	Fixed	25A	X		X		**49-71**
D12	General Purpose Mini Control	DIN Rail/Panel Mount	Fixed	6A		X	X	X	**49-75**
D15	Machine Tool	DIN Rail/Panel Mount	Fixed	10A		X	X	X	**49-82**
D26	Machine Tool	Panel or Channel Mount	Convertible	10A		X	X		**49-94**
D64	Ground Fault Relays	Panel Mount	Fixed	N/A		X	X	X	**49-111**
D65	Voltage Monitoring	DIN Rail/Panel Mount	Fixed	10A Resistive		X	X		**49-108**
D80	Timer (Pneumatic)	Panel Mount/Enclosure	Fixed	N/A		X	X		**49-105**
EZ	Intelligent Relay	DIN Rail	Fixed	8A	X		X	X	**49-14**
TR	Timer (Solid-State)	DIN Rail/Panel Mount	Fixed	10A		X	X		**49-100**
VSR	Voltage Sensing	Panel Mount/Enclosure	Fixed	2A					**49-106**
XR	Terminal Block Relay	DIN Rail	Fixed	6A, 10A	X			X	**49-4**

TR Series

TR Timing Relay

Product Description

The upgraded TR Series timing relays are designed to meet most timing requirements by offering more flexibility in range of input voltage, timing range and functionality. Use a rotary switch to choose from 20 selectable time ranges from 0.1 second to 600 hours. We offer both a power triggered and signal triggered model — each with expanded operation modes. There is a green LED to indicate when power is ON and an orange LED when output is ON.

Features

- 20 time ranges and 10 timing functions
- Time delays from 0.1 sec to 600 hrs.
- Space-saving, compact package
- High repeat accuracy of ± 0.2%
- LED indication
- Standard 8- or 11-pin and 11-blade termination
- 2 Form C DPDT delayed output contacts
- 10A Contact Rating

Standards and Certifications

c UL us Listed CSA CE TUV

Technical Data and Specifications

Table 49-167. Contact Ratings

Item	Specification
Contact Configuration	2 Form C, DPDT (Delayed Output)
Allowable Voltage/Current	240V AC, 30V DC/10A
Max. Permissible Operating Frequency	1800 cycles per hour
Rated Load — Resistive Inductive Horsepower Rating	 10A, 240V AC/30V DC 7A, 240V AC/30V DC 1/6 hp 120V AC, 1/3 hp 240V AC
Life — Electrical Mechanical	 500,000 operations min. (resistive) 50,000,000 operations minimum

Table 49-168. General Specifications

Item	Specification
Operation System	Solid-State CMOS Circuit
Time Range	0.1 sec to 600 hours
Pollution Degree	2 (IE60664-1)
Overvoltage Category	III (IE60664-1)
Rated Operational Voltage 240AC 24AC 12DC	 100 – 240V AC (50/60 Hz) 24V AC (50/60 Hz)/24V DC 12V DC
Voltage Tolerance 240AC 24AC 12DC	 85 – 264V AC (50/60 Hz) 20.4 – 26.4V AC (50/60 Hz)/21.6 – 26.4V DC 10.8 – 13.2V DC
Input OFF Voltage	Rated Voltage x 10% Minimum
Ambient Operating Temperature	-4 – 149°F (-20 – 65°C)
Reset Time	100 mS maximum
Repeat Error	± 0.2%, ± 20 mS ①
Voltage Error	± 0.2%, ± 20 mS ①
Temperature Error	± 0.5%, ± 20 mS ①
Setting Error	± 10% maximum
Insulation Resistance	100M ohm minimum (500V DC)
Dielectric Strength Between power and output terminals Between contacts of different poles Between contacts of same pole	 2000V AC, 1 minute 2000V AC, 1 minute 1000V AC, 1 minute
Vibration Resistance	10 – 55 Hz amplitude 0.5 mm; 2 hrs in each of 3 axes
Shock Resistance Operating extremes Damage limits — TRNP, TRFP TRNB, TRFB	 10G 40G (3x in each of 3 axes) 10G (3x in each of 3 axes)
Power Consumption (Approx.) 240AC 120V AC/60 Hz 240V AC/60 Hz 24AC (AC/DC) 12DC	 6.5 VA TRNP, TRNB/6.6 VA TRFP, TRFB 11.6 VA TRNP, TRNB/12.1 VA TRFP, TRFB 3.4 VA – 1.7W TRNP, TRNB/3.5 VA – 1.7W TRFP, TRFB 1.6W
Dimensions TRNP, TRFP TRNB, TRFB	 1.58H x 1.42W x 3.07D in. (40H x 36W x 77.9D mm) 1.58H x 1.42W x 2.95D in. (40H x 36W x 74.9D mm)
Weight	TRNP — 87g; TRFP — 89g; TRNB, TRFB — 85g

① For the value of the error against a preset time, whichever value is larger should apply.

Catalog Numbering System

Table 49-169. Catalog Numbering System

TR N P 240 AC

Family Type

TR

Operational Mode

N = Power Triggered
- A = ON Delay
- B = Interval
- C = Cycle (OFF first)
- D = Cycle (ON first)

F = Signal Triggered
- A = ON Delay
- B = Cycle (OFF first)
- C = Cycle (ON first)
- D = Signal ON/OFF Delay
- E = OFF Delay
- F = One-Shot

Model Type

P = Pin/Octal
B = Blade Style

Input Voltage

24AD = 24V AC (50/60 Hz)/24V DC
240AC = 100 – 240V AC (50/60 Hz)

Product Selection

When Ordering Specify

- Catalog Number of Timing Relay

Table 49-170. TR Plug-In Timing Relays

Coil Voltage	Octal		Blade	
	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $
Power Triggered				
24V AC/DC	**TRNP24AD**		**TRNB24AD**	
100 – 240V AC	**TRNP240AC**		**TRNB240AC**	
Signal Triggered				
24V AC/DC	**TRFP24AD**		**TRFB24AD**	
100 – 240V AC	**TRFP240AC**		**TRFB240AC**	

Discount Symbol **1CD1**

Operation

TRNP, TRNB

A: ON-Delay 1 (Power Start)

Set timer for desired delay, apply power to coil. Contacts transfer after preset time has elapsed, and remain in transferred position until timer is reset. Reset occurs with removal of power.

Item	Terminal No.	Operation
Power	(1) 2-7 (2) A-B	
Delayed Contact	(1) 1-4, 5-8 (2) 1-7, 3-9 (NC)	
	(1) 1-3, 6-8 (2) 4-7, 6-9 (NO)	
Indicator	PWR	
	OUT	
Set Time		T

B: Interval (Power Start)

Set timer for desired delay, apply power to coil. Contacts transfer immediately, and return to original position after preset time has elapsed. Reset occurs with removal of power.

Item	Terminal No.	Operation
Power	(1) 2-7 (2) A-B	
Delayed Contact	(1) 1-4, 5-8 (2) 1-7, 3-9 (NC)	
	(1) 1-3, 6-8 (2) 4-7, 6-9 (NO)	
Indicator	PWR	
	OUT	
Set Time		T

C: Cycle 1 (Power Start, OFF First)

Set timer for desired delay, apply power to coil. First transfer of contacts occurs after preset delay has elapsed, after the next elapse of preset delay contacts return to original position. The timer now cycles between on and off as long as power is applied (Duty Ratio 1:1).

Item	Terminal No.	Operation
Power	(1) 2-7 (2) A-B	
Delayed Contact	(1) 1-4, 5-8 (2) 1-7, 3-9 (NC)	
	(1) 1-3, 6-8 (2) 4-7, 6-9 (NO)	
Indicator	PWR	
	OUT	
Set Time		T T

D: Cycle 3 (Power Start, ON First)

Functions in same manner as Mode C, with the exception that first transfer of contacts occurs as soon as power is applied. The ratio is 1:1. Time On = Time Off.

Item	Terminal No.	Operation
Power	(1) 2-7 (2) A-B	
Delayed Contact	(1) 1-4, 5-8 (2) 1-7, 3-9 (NC)	
	(1) 1-3, 6-8 (2) 4-7, 6-9 (NO)	
Indicator	PWR	
	OUT	
Set Time		T T

Note: T=Set Time, Ta=Shorter Than Set Time,
(1):TRNP, (2): TRNB, (A): TRFP, (B): TRFB

Internal Connections

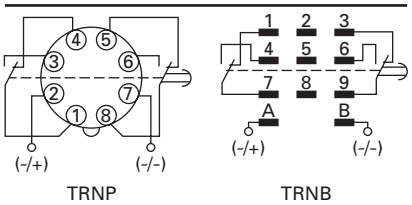
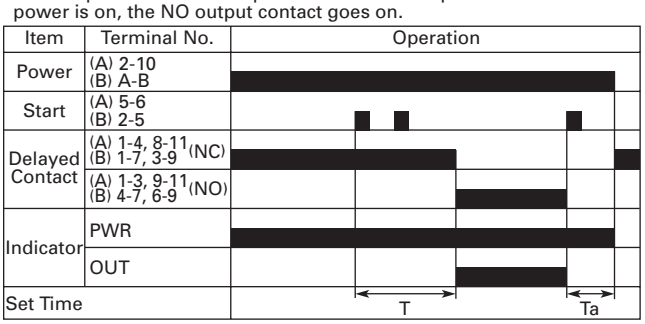


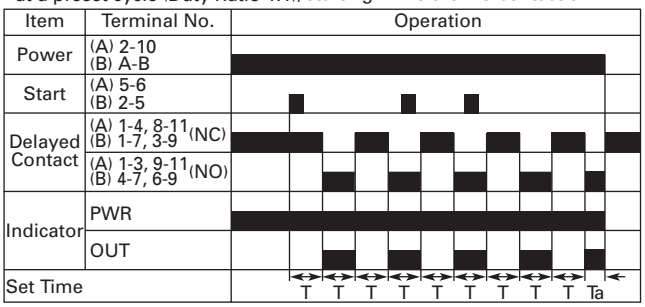
Figure 49-135. Operational Figures (1 of 2)

TRFP, TRFB

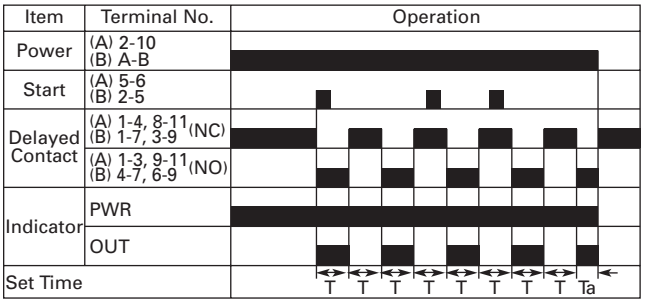
A: ON-Delay 2 (Signal Start)
When a preset time has elapsed after the start input turned on while power is on, the NO output contact goes on.



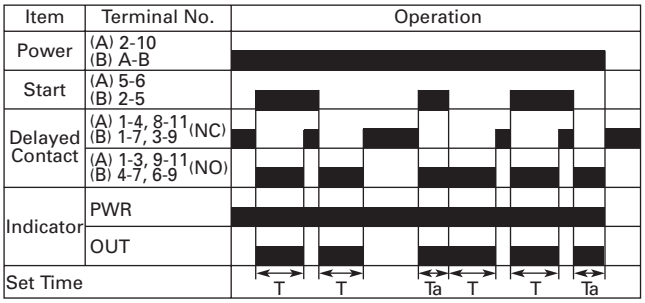
B: Cycle 2 (Signal Start, OFF First)
When the start input turns on while power is on, the output oscillates at a preset cycle (Duty Ratio 1:1), starting while the NO contact off.



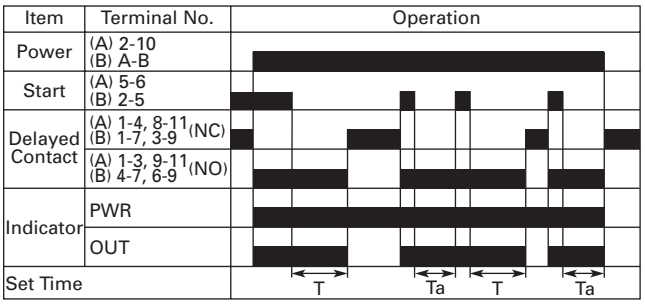
C: Cycle 4 (Signal Start, ON First)
When the start input turns on while power is on the NO contact goes on. The output oscillates at a preset cycle (Duty Ratio 1:1).



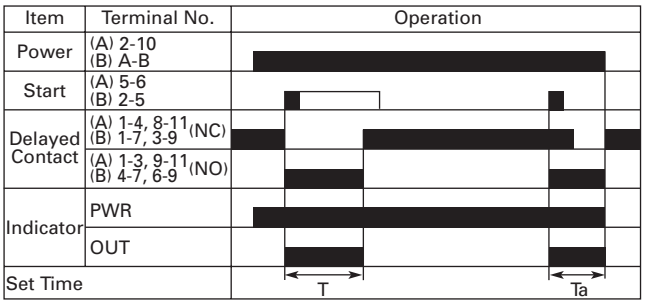
D: Signal ON/OFF-Delay
When the start input turns on while power is on, the NO output contact goes on. When a preset time has elapsed while the start input remains on, the output contact goes off. When the start input turns off, the NO contact goes on again. When a preset time has elapsed after the start input turned off, the NO contact goes off.



E: Signal OFF-Delay
When power is turned on while the start input is on, the NO output contact goes on. When a preset time has elapsed after the start input turned off, the NO output contact goes off.



F: One-Shot (Signal Start)
When the start input turns on while power is on, the NO output contact goes on. When a preset time has elapsed, the output contact goes off.



Note: T=Set Time, Ta=Shorter Than Set Time,
(1):TRNP, (2): TRNB, (A): TRFP, (B): TRFB.

Internal Connections

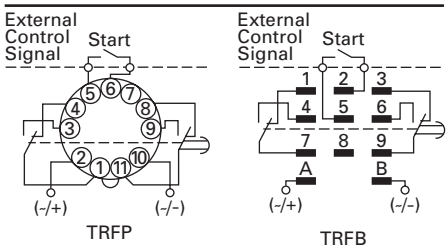


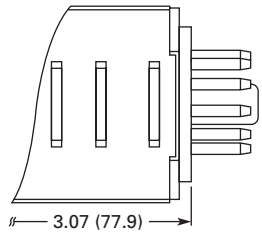
Figure 49-136. Operational Figures (2 of 2)

Accessories

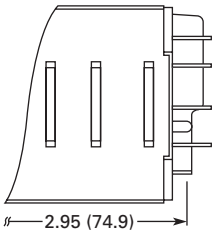
Table 49-171. Sockets for Use with TR Timers — Standard Pack of 10

Timing Relay	Terminal Style	Catalog Number	Price U.S. $
TRNP	8 Pin Octal	**D3PA2**	
TRFP	11 Pin Octal	**D3PA3**	
TRNB, TRFB	0.187" solder/QC terminals (Blade style)	**D5PA2**	

Dimensions



Pin (P) Type



Blade (B) Type

Figure 49-137. Approximate Dimensions in Inches (mm)

D3PR/D3PF Series

D3 Series Relay

Features

D3PR

- Compact relay capable of breaking relatively large load currents
- The contact operation can be easily checked by push-to-test button
- Panel and DIN rail mounting
- 8- or 11-pin octal plug-in

D3PF

- Flag indicator shows relay status in manual or powered condition
- LED status lamp shows coil "ON" or "OFF" status — ideal for use in low light applications
- Push-to-test button allows for manual operation of relay without the need for coil power
- Lock-down door holds pushbutton and contacts in the operate position when activated
- Finger-grip cover allows operator to remove relays from sockets easily
- I.D. tag/write label to identify relays in multiple-relay circuits
- Bi-polar LED allows for reverse polarity applications

Standards and Certifications

c UL us CE CSA (CSA approval not applicable to D3PR5 Relays)

UL Listed When used with accompanying Cutler-Hammer® screw terminal socket (for D3PF only).

Technical Data and Specifications

Table 49-54. Coil Resistance for D3PR Series

Coil Voltage	Ohms		mA			
	D3PR2/PR3	D3PR5 – DC (Each Coil)	D3PR2/PR3 – AC		D3PR5 – AC	
			50 Hz	60 Hz	50 Hz	60 Hz
6V AC	4.2	—	550	458	—	—
12V AC	18	—	275	229	—	—
24V AC	72	52	137	114	13	11
120V AC	2200	1200	28	23	3.5	2.8
240V AC	7200	3200	13	11	1.7	1.6
6V DC	32	—	187		—	
12V DC	120	88	100		136	
24V DC	470	350	50		69	
48V DC	1900	—	25		—	
110V DC	10000	4000	11		27	

Table 49-55. Coil Resistance for D3PF Series

Coil Voltage	Ohms	mA	
		50 Hz	60 Hz
24V AC	72	398.0	340
120V AC	1,700	76.0	65
240V AC	7,200	28.0	24
12V DC	120	100.0	—
24V DC	470	49.9	—
110V DC	10,000	13.2	—

Table 49-56. Relay Specifications

	D3PR2/D3PR3	D3PR2/D3PR3	D3PF2/D3PF3	D3PR5	D3PR5
	Resistive Load (p.f. = 1)	**Inductive Load (p.f. = 0.4, L/R = 7 ms)**	**Resistive Load (p.f. = 1.0)**	**Resistive Load (p.f. = 1)**	**Inductive Load (p.f. = 0.4, L/R = 7 ms)**
Rated Load	240V AC 10A 120V AC 12A 28V DC 10A	240V AC 7A 120V AC 7A 28V DC 7A	240V AC 12A 120V AC 12A 28V DC 12A	240V AC 10A 120V AC 12A 30V DC 10A	240V AC 7A 120V AC 7A 30V DC 7A
Carry Current	10A	10A	12 Amps	10A	10A
Max. Operating Voltage	240V AC/DC	240V AC/DC	110% of nominal	240V AC/DC	240V AC/DC
Contact Resistance	50 milli Ω's Max. @ 10 Amps 120V AC or 24V DC	50 milli Ω's Max. @ 10 Amps 120V AC or 24V DC	50 milli Ω's Max. @ 10 Amps 120V AC or 24V DC	50 milli Ω's Max. @ 10 Amps 120V AC or 24V DC	50 milli Ω's Max. @ 10 Amps 120V AC or 24V DC
Dielectric Strength	1500V	1500V	1500V	1500V	1500V
Approx. Weight	3.5 oz (99.2g)	3.5 oz (99.2g)	3.1 oz (88g)	3.5 oz (99.2g)	3.5 oz (99.2g)
Temperature — Operating Storage	 -49 – 131°F (-45 – 55°C) AC -49 – 158°F (-45 – 70°C) DC -40 – 221°F (-40 – 105°C)	 -49 – 131°F (-45 – 55°C) AC -49 – 158°F (-45 – 70°C) DC -40 – 221°F (-40 – 105°C)	 -22 – 122°F (-30 – 50°C) -22 – 212°F (-30 – 100°C)	 -49 – 131°F (-45 – 55°C) AC -49 – 158°F (-45 – 70°C) DC -40 – 221°F (-40 – 105°C)	 -49 – 131°F (-45 – 55°C) AC -49 – 158°F (-45 – 70°C) DC -40 – 221°F (-40 – 105°C)
Contact Material	AgCdO (Au Flashed)	AgCdO (Au Flashed)	AgCdO (Au Flashed)	AgCdO (Au Flashed)	AgCdO (Au Flashed)
Max. Switching Capacity	2500 VA 280W	1750 VA 196W	12 Amps	1100 VA 72W	440 VA 60W
Min. Permissible Load	100 mA @ 12V	100 mA @ 12V	100 mA	100 mA @ 12V	100 mA @ 12V
Pickup Voltage (max.)	80%	80%	85% AC; 80% DC	—	—
Drop Out Voltage (min.)	10%	10%	30% AC 10% DC	—	—
Set/Reset Voltage (max.)	—	—	—	80%	80%
Voltage (max.)	110%	110%	110%	110%	110%
Mechanical Life (min.)	10,000,000	10,000,000	5 million (No Load)	10,000,000	10,000,000
Electrical Life @ All Contact Ratings (min.)	100,000	100,000	200,000 operations at Rated Res. Load	100,000	100,000
Maximum hp Ratings	1/3 hp (120V AC) 1/2 hp (240V AC)	1/3 hp (120V AC) 1/2 hp (240V AC)	1/3 hp, 120V AC 1/2 hp, 240V AC	1/3 hp (120V AC) 1/2 hp (240V AC)	1/3 hp (120V AC) 1/2 hp (240V AC)

Table 49-57. Socket Specifications

Catalog Number	Electrical Ratings	Mounting Torque	Hook-Up Wire Range
D3PA2	10A, 600V 15A, 300V	8 – 10 in-lbs	AWG 12 to 22 Solid or Stranded
D3PA3-A2	5A, 600V 15A, 300V	8 – 10 in-lbs	AWG 12 to 22 Solid or Stranded
D3PA6	5A, 600V 16A, 300V	8 – 10 in-lbs	AWG 12 to 20 Solid or Stranded
D3PA7	5A, 600V 16A, 300V	8 – 10 in-lbs	AWG 12 to 20 Solid or Stranded
D3PA4	10A, 260V	N/A	AWG 14 Max.
D3PA5	10A, 260V	N/A	AWG 14 Max.

Catalog Number Structure

Table 49-58. D3 Series Catalog Numbering System ①

D3PR 2 3 A

Family Type
D3PR — Standard Relay
D3PF — Full Featured Relay

Contact Configuration
2 = DPDT (8-Pin)
3 = 3PDT (11-Pin)
5 = DPDT Latching (11 Pin) ②

Options
Blank = Relay with Test Button
A = LED, Test Button, Flag Indicator, Lock-Down Door, Finger-Grip Cover, I.D. Tag

Coil Voltage
A = 120V AC
A1 = 110V DC
B = 240V AC
P = 6V AC
P1 = 6V DC
R = 12V AC
R1 = 12V DC
T = 24V AC
T1 = 24V DC
W1 = 48V DC

① For deciphering Catalog Numbers. Do not use for ordering as not all combinations are readily available.
② D3PR only.

Table 49-59. Relay/Socket Quick Reference

Relay Type	Socket Type	Socket	Hold Down Spring/Clip
D3PR2	8 Pin Octal	D3PA2 D3PA4 D3PA6	PQC-1344 Not Available PQC-1332
D3PF2	8 Pin Octal	D3PA2	PQC-1344
	8 Pin Octal — Finger-safe terminals	D3PA6	PQC-1332
D3PR3	11 Pin Octal	D3PA3-A2 D3PA5 D3PA7	PQC-1351 Not Available PQC-1332
D3PF3	11 Pin Octal	D3PA3-A2	PQC-1351
	11 Pin Octal — Finger-safe terminals	D3PA7	PQC-1332
D3PR5	11 Pin Octal	D3PA3-A2 D3PA5 D3PA7	PQC-1351 Not Available PQC-1332

Product Selection

Table 49-60. D3 Product Selection ③

	Std. Pack	Catalog Number	Price U.S. $
Standard DPDT with Test Button			
Coil Voltage:			
12V AC	1	**D3PR2R**	
24V AC	1	**D3PR2T**	
120V AC	1	**D3PR2A**	
240V AC	1	**D3PR2B**	
12V DC	1	**D3PR2R1**	
24V DC	1	**D3PR2T1**	
110V DC	1	**D3PR2A1**	
DPDT Full Featured Relay			
24V AC	1	**D3PF2AT**	
120V AC	1	**D3PF2AA**	
240V AC	1	**D3PF2AB**	
12V DC	1	**D3PF2AR1**	
24V DC	1	**D3PF2AT1**	
110V DC	1	**D3PF2AA1**	
Standard 3PDT with Test Button			
Coil Voltage:			
24V AC	1	**D3PR3T**	
120V AC	1	**D3PR3A**	
240V AC	1	**D3PR3B**	
12V DC	1	**D3PR3R1**	
24V DC	1	**D3PR3T1**	
110V DC	1	**D3PR3A1**	
3PDT Full Featured Relay			
24V AC	1	**D3PF3AT**	
120V AC	1	**D3PF3AA**	
240V AC	1	**D3PF3AB**	
24V DC	1	**D3PF3AT1**	
110V DC	1	**D3PF3AA1**	
DPDT Latching ⑤			
24V AC	1	**D3PR5T**	
120V AC	1	**D3PR5A**	
DIN Rail Sockets			
2-Pole (8-Pin)	10	**D3PA2**	
2-Pole (8-Pin) Finger-Safe ⑥	10	**D3PA6**	
3-Pole (11-Pin)	10	**D3PA3-A2**	
3-Pole (11-Pin) Finger-Safe ⑥	10	**D3PA7**	
Panel Mount Sockets			
2-Pole	10	**D3PA4**	
3-Pole	10	**D3PA5**	
Accessories			
Hold Down Clip	10	**PQC-1344**	
Hold Down Clip	25	**PQC-1332**	
Hold Down Clip	10	**PQC-1351**	
Hold Down Clip	100	**PWC-1325**	
Coil Buss Jumper for D3PA6 & D3PA7	25	**D3PJ1**	
DIN Rail End Stop ④	100	**PFP-M**	

③ Additional coil voltages available — consult Sales Office or Customer Support Center.
④ Dimensions on **Page 49-51.**
⑤ CSA approval is not applicable to D3PR5 Latching Relays.
⑥ IP20 Rated.

Discount Symbol **1CD1**

Dimensions

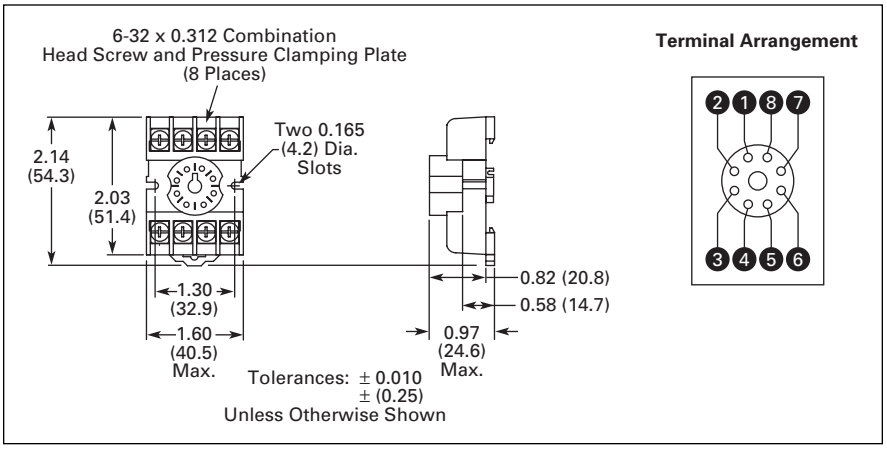


Figure 49-54. D3PA2 — Approximate Dimensions in Inches (mm)

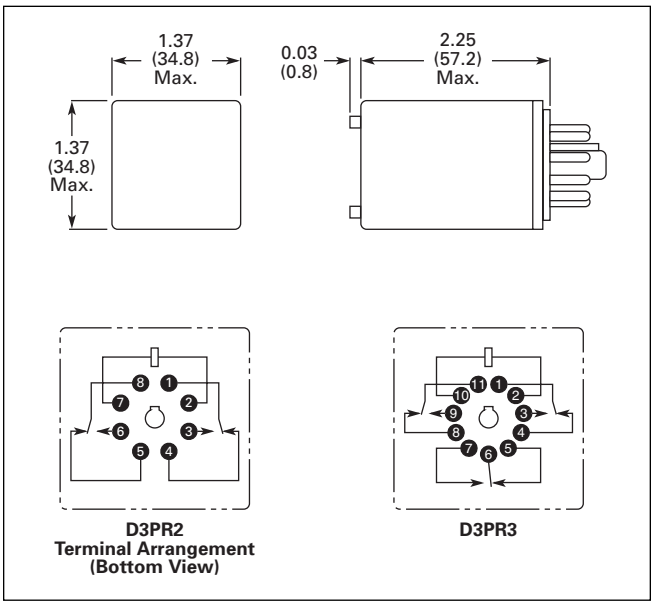


Figure 49-55. D3PR2/D3PR3 — Approximate Dimensions in Inches (mm)

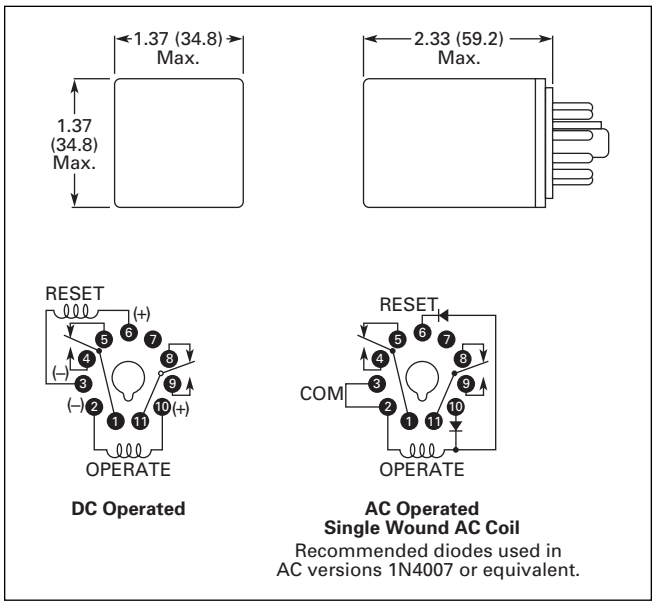


Figure 49-56. D3PR5 — Approximate Dimensions in Inches (mm)

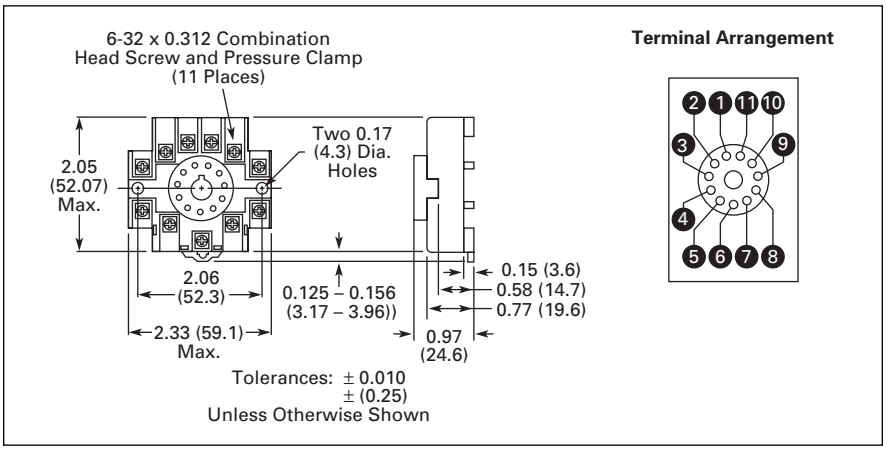


Figure 49-57. D3PA3-A2 — Approximate Dimensions in Inches (mm)

D3PJ1

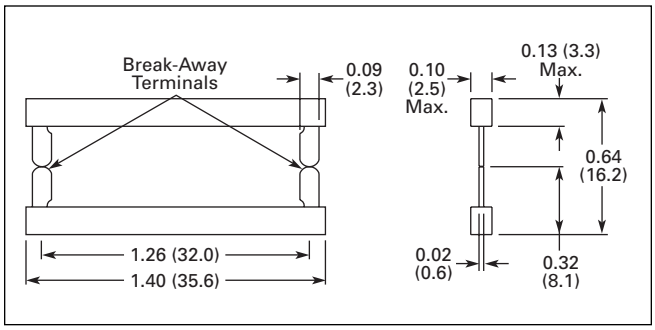


Figure 49-58. D3PJ1 — Approximate Dimensions in Inches (mm)

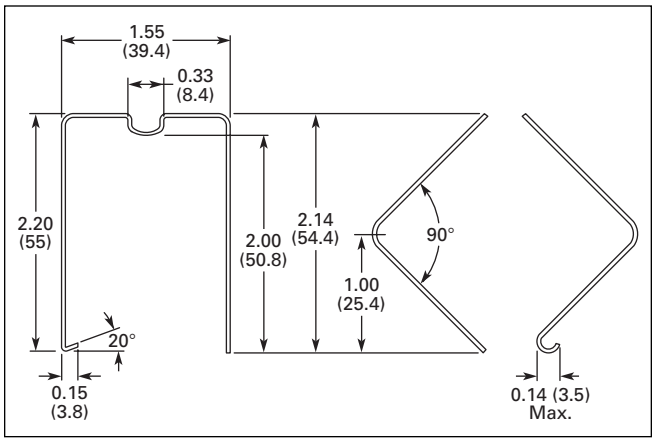


Figure 49-59. PQC-1332 — Approximate Dimensions in Inches (mm)

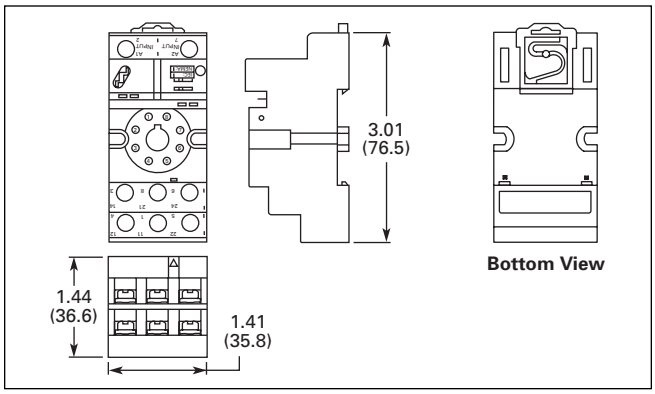


Figure 49-60. D3PA6 — Approximate Dimensions in Inches (mm)

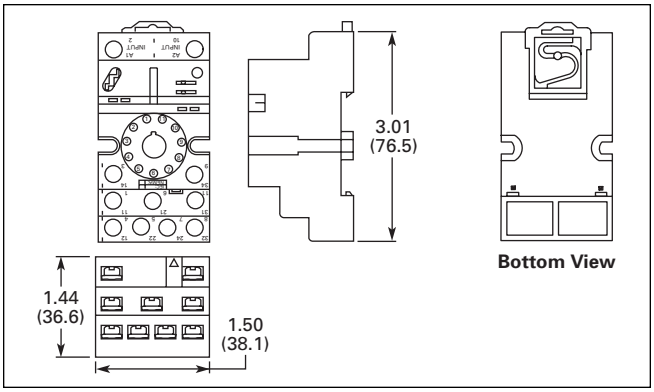


Figure 49-61. D3PA7 — Approximate Dimensions in Inches (mm)

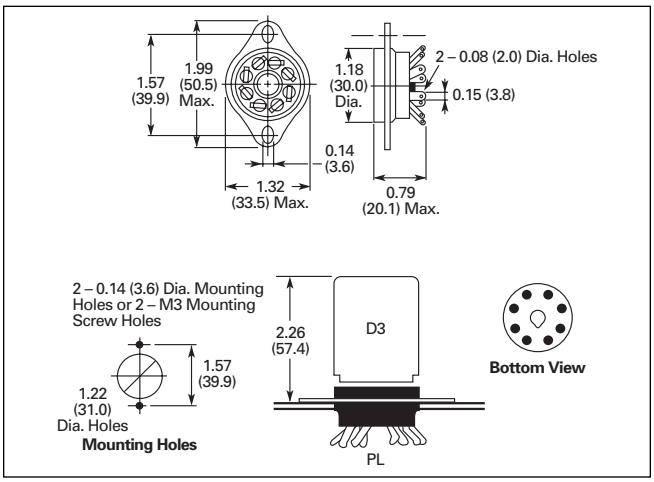


Figure 49-62. D3PA4 — Approximate Dimensions in Inches (mm)

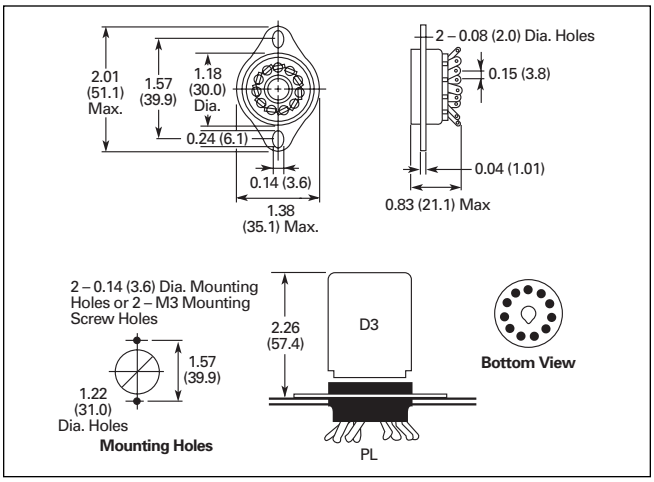


Figure 49-63. D3PA5 — Approximate Dimensions in Inches (mm)

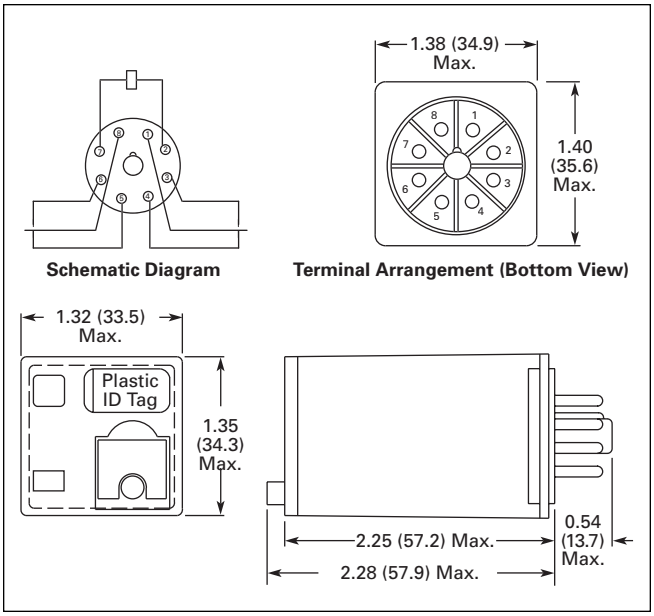


Figure 49-64. D3PF2 — Approximate Dimensions in Inches (mm)

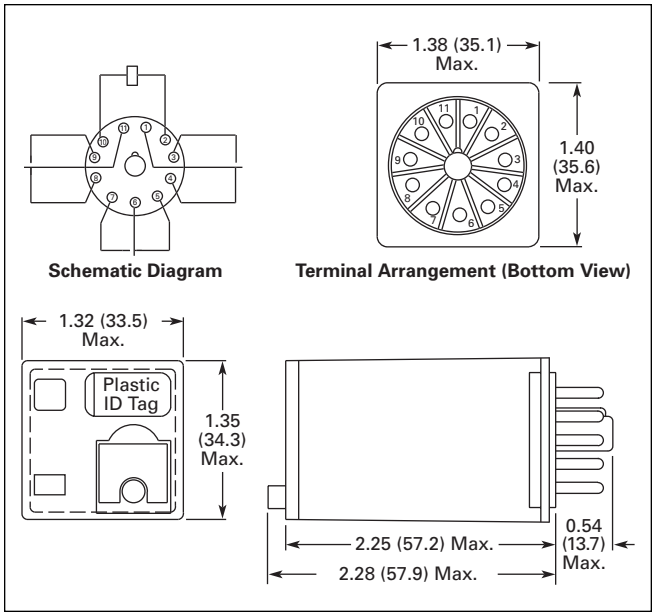


Figure 49-65. D3PF3 — Approximate Dimensions in Inches (mm)

Disconnect Switch (DS)

IT'S EASY TO BUILD YOUR OWN DISCONNECT SWITCH

Simply pick the code number from each of the sections below and combine them to build your part number. See page 1 for more detailed directions.

Series DS2 Disconnect Switches (Non-Fused)

I	II	III	IV	V	VI	VII
	DS2 –			–		

Example: To build one of our most popular Disconnect Switches, the part number would be I + DS2 + III + IV + V + VI + VII or DDS2-325-DHGRY

I. INSTALLATION

CODE	DESCRIPTION	LIST
D	Door Mount	$13.50
P	Panel/Base Mount	$15.00

II. BASIC DISCONNECT SWITCH OPERATOR

CODE	DESCRIPTION
DS2	Non-Fused Disconnect Switch

III. NUMBER OF POLES

IV. CURRENT RATING

CODE		3	4	5
	DESCRIPTION	3 Poles	4 Poles	5 Poles
16	16 Amp	—	$ 7.00	$ 14.00
25	25 Amp	$ 2.00	$ 9.00	$ 16.00
30	32 Amp	$ 5.25	$13.25	$ 21.25
40	40 Amp	$ 7.00	$15.50	$ 24.00
60	63 Amp	$10.00	$19.50	$ 29.00
80	80 Amp	$19.00	$30.00	$ 41.00
100	100 Amp	$21.00	$32.50	$ 44.00
125	125 Amp	$26.00	$38.00	$ 50.00

DISCOUNT SCHEDULE C

16A Door and Panel Mount and 80-125A Door Mount Available March '07.

V. OPERATING HANDLE TYPE

CODE	DESCRIPTION	FOR CURRENT RATING CODES	LIST
	DOOR MOUNT HANDLES FOR DOOR MOUNT SWITCHES		
MDHG	Padlockable Lever (IP55)	16	$ 4.50
MSDHG	Padlockable Lever - Single Hole (22.5mm) Mounting (IP55)	16	$ 4.50
DHM	Round (Type 1, 2, 3, 3R, 4/4X, 12, 13, and IP65)	25 ~ 60	$ 15.50
DHG	Round (Type 1, 2, 3, 3R, 4/4X, 12, 13, and IP65)	25 ~ 60	$ 5.25
	DOOR MOUNT HANDLES FOR PANEL/BASE MOUNT SWITCHES		
MPHG	Padlockable Lever (IP65)	16	$ 4.50
PHM	Round (Type 1, 2, 3, 3R, 4/4X, 12, 13, and IP65)	25 ~ 125	$ 15.50
PHG	Round (Type 1, 2, 3, 3R, 4/4X, 12, 13, and IP65)	25 ~ 125	$ 5.25
SPH	Short Pistol (IP65)	25 ~ 125	$ 20.00
LPH	Long Pistol (IP65)	80 ~ 125	$ 25.00
	INTEGRAL HANDLES FOR PANEL/BASE MOUNT SWITCHES		
SML	Lever (IP30)	25 ~ 60	$ 4.00
SMP	Padlockable Lever (IP30)	25 ~ 60	$ 4.50

VI. OPERATING HANDLE COLOR

CODE	OPERATOR COLOR	BEZEL COLOR	FOR OPERATOR TYPE CODE
RY	Red	Yellow	DHM, DHG, PHM, PHG, MDHG, MSDHG, MPHG, SMP
GB	Grey	Black	DHM, PHM
BB	Black	Black	DHM, PHM
BG	Black	Grey	DHM, DHG, PHM, PHG, MDHG, MSDHG, MPHG
BA	Black	Aluminum	SML
BN	Black	—	SPH, LPH

VII. OPERATING SHAFT LENGTH

CODE	DESCRIPTION	FOR CURRENT RATING CODES	LIST
(Blank)	Door Mount and Panel/Base Mount Switch with Integral Operating Handle	—	—
06	150mm (5.9") Operating Shaft for Panel/Base Mount Switch	16	$ 2.50
11	283mm (11.1") Operating Shaft for Panel/Base Mount Switch	25 ~ 125	$ 3.25

PANEL MOUNT DISCONNECT SWITCH WITH PHG HANDLE

DOOR MOUNT DISCONNECT SWITCH WITH DHG HANDLE

PANEL MOUNT DISCONNECT SWITCH WITH INTEGRAL SMP HANDLE

PANEL MOUNT DISCONNECT SWITCH WITH INTEGRAL SML HANDLE

Series DS2 IEC Non-Fused Disconnect Switches

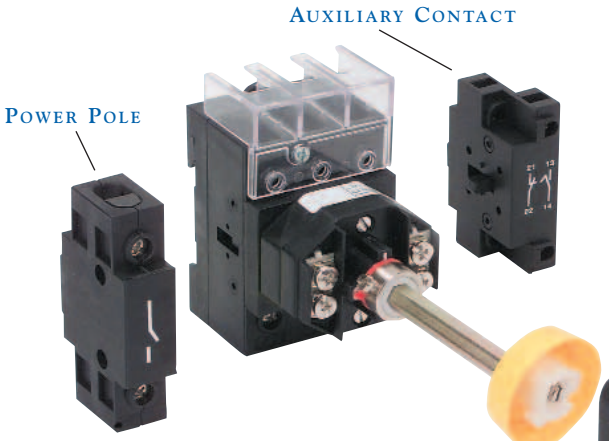
Our Series DS2 IEC Non-Fused Disconnect Switches provide superior performance in rugged applications and are certified as Manual Motor Controllers Suitable as Motor Disconnects for motors up to 40HP at 480V (45kW at 400V). Panel/Base and door mounting options allow switches to be installed in virtually any enclosure.

Panel/Base mount switches are simple to install:

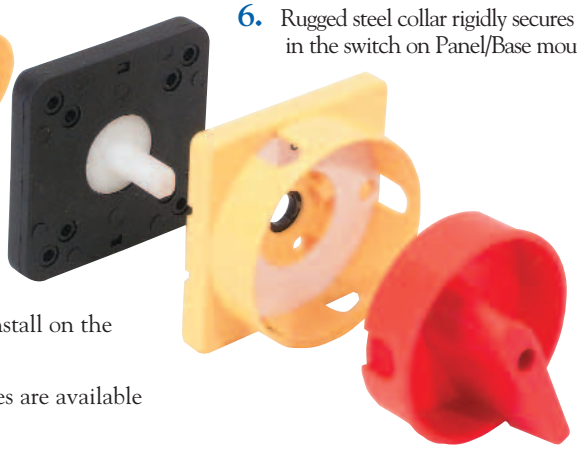
- Snap-on to a 35mm DIN rail.
- Secure to the panel with two (2) fixing screws.
- Dual terminal markings (1/L1, 3/L2, 5/L3 and 2/T1, 4/T2, 6/T3) for fast and easy wiring.

NEW Expanded Product Offering!

Compact size with robust design features for the most demanding disconnecting applications.



1. 10kA short circuit rating at 600V AC with Class J and Class CC fuses.
2. Positive drive to open double break contacts to ensure circuit isolation.
3. Compact space saving design for reduced size control panels. 16A switch is only 43mm wide and our 25A ~ 63A switches are only 50mm wide.
4. Wide variety of operating handle styles and colors with Type 1, 2, 3, 3R, 4/4X, 12 and 13, IP55, and IP65 ingress protection ratings for the most demanding industrial environments.
5. Glass filled polyamide thermoplastic housings are ARC track resistant and provide insulation between poles.
6. Rugged steel collar rigidly secures the operating shaft in the switch on Panel/Base mounted switches.



7. Line side terminal shield and IP20 terminals guard against accidental contact with live parts.
8. Integral captive terminal clamps are shipped in the backed-out position for easy wiring and are plated for corrosion resistance.
9. Auxiliary contacts, power poles, and neutral poles install on the left or right side of the switch.
10. Complete assembled switches with operating handles are available for JIT manufacturing and reduced inventory.

Some of Our Popular Configurations:

SERIES DS2 IEC NON-FUSED DISCONNECT SWITCHES

CATALOG NUMBER	DESCRIPTION	LIST
DDS2-316-MDHGRY	16A Door Mount Disconnect Switch w /3 Poles and Lever Red/Yellow Handle	$18.75
DDS2-325-DHGRY	25A Door Mount Disconnect Switch w/3 Poles and Round Red/Yellow Handle	$20.75
DDS2-330-DHGRY	32A Door Mount Disconnect Switch w/3 Poles and Round Red/Yellow Handle	$24.00
DDS2-340-DHGRY	40A Door Mount Disconnect Switch w/3 Poles and Round Red/Yellow Handle	$25.75
PDS2-316-MPHGRY06	16A Panel Mount Disconnect Switch w /3 Poles and Lever Red/Yellow Handle	$22.00
PDS2-325-PHGRY11	25A Panel Mount Disconnect Switch w/3 Poles and Round Red/Yellow Handle	$25.50
PDS2-330-PHGRY11	32A Panel Mount Disconnect Switch w/3 Poles and Round Red/Yellow Handle	$28.75
PDS2-340-PHGRY11	40A Panel Mount Disconnect Switch w/3 Poles and Round Red/Yellow Handle	$30.50
PDS2-325-SMLBA	25A Panel Mount Disconnect Switch w/3 Poles and Integral Black/Aluminum Lever Handle	$21.00
PDS2-325-SMPRY	25A Panel Mount Disconnect Switch w/3 Poles and Integral Red/Yellow Padlockable Lever Handle	$21.50
PDS2-330-SMLBA	32A Panel Mount Disconnect Switch w/3 Poles and Integral Black/Aluminum Lever Handle	$24.25

SERIES DS2 IEC NON-FUSED OPERATING HANDLES

c3controls Series DS2 IEC non-fused disconnect switch operating handles are available in a wide variety of styles, colors, and ingress protection ratings — perfect for any application from light duty to severe industrial environments. External operating handles are easy to install in standard 5-hole panel drilling layouts. A single hole (22.5mm) operating handle is also available for 16A switches. Operating handles can be installed in enclosures with door thicknesses up to 5mm (3/16").

UNIQUE PRODUCT FEATURES

EASY TO INSTALL, STYLISH OPERATING HANDLES PROVIDE RELIABLE ACTUATION IN DISCONNECTING APPLICATIONS AND CAN BE LOCKED OFF FOR EXTRA SAFETY.

1. Handles can be padlocked off with up to three padlocks to meet global installation codes and standards requirements.
2. Operating handles with ON/OFF and I/O markings.
3. Door interlock — can only be opened in the OFF position.
4. Positive, reliable actuation of the switch is ensured through the rigid steel operating shaft that can be cut to length for enclosure depths up to 204mm (8.0") for 16A switches and up to 355mm (13.98") for 25A ~ 125A switches.

DHG/PHG DOOR/PANEL MOUNT ROUND OPERATING HANDLE
(Type 1, 2, 3, 3R, 4/4X, 12, 13, and IP65)

DHM/PHM DOOR/PANEL MOUNT OPERATING HANDLE
(Type 1, 2, 3, 3R, 4/4X, 12, 13, and IP65)

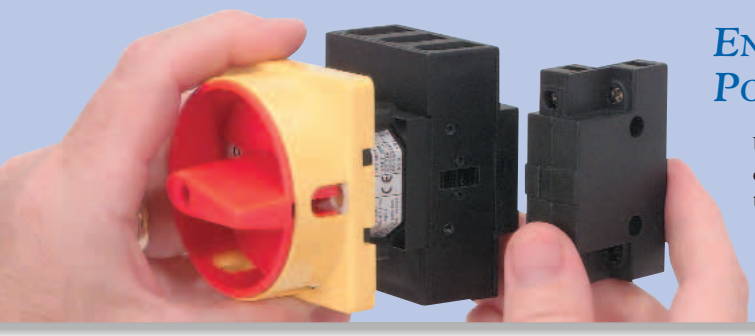
SMP PANEL MOUNT INTEGRAL PADLOCKABLE LEVER OPERATING HANDLE
(IP30)

SPH/LPH PANEL MOUNT PISTOL OPERATING HANDLE
(IP65)

SML PANEL MOUNT INTEGRAL LEVER OPERATING HANDLE
(IP30)

MDHG/MPHG DOOR/PANEL MOUNT LEVER OPERATING HANDLE
(IP55)

SPECIAL FEATURES



Engineered to add Auxiliary Contacts, Power Poles, and Neutral Poles Easily!

Up to two modules (Auxiliary Contacts, Power Poles, and Neutral Poles) can be added to a three pole switch. One module can be installed on the left side and right side of the switch.

NEUTRAL POLE MODULES

Normally open early make (NOEM) configuration. IP20 terminals guard against accidental contact with live parts.

DOOR MOUNT		
CODE	CURRENT RATING CODE	LIST
DNA216	16	$ 7.00
DNA225	25	$ 7.00
DNA230	30	$ 8.00
DNA240	40	$ 8.50
DNA260	60	$ 9.50
DNA280	80	$ 11.00
DNA2100	100	$ 11.50
DNA2125	125	$ 12.00

PANEL MOUNT		
CODE	CURRENT RATING CODE	LIST
PDNA216	16	$ 7.00
PDNA225	25	$ 7.00
PDNA230	30	$ 8.00
PDNA240	40	$ 8.50
PDNA260	60	$ 9.50
PDNA280	80	$ 11.00
PDNA2100	100	$ 11.50
PDNA2125	125	$ 12.00

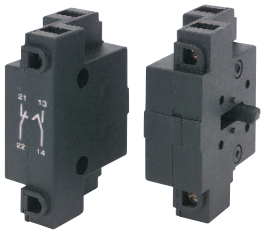
POWER POLE MODULES

Normally open (NO) configuration. IP20 terminals guard against accidental contact with live parts. Electrical ratings are equivalent to the associated switch rating (refer to specifications on page 8).

DOOR MOUNT		
CODE	CURRENT RATING CODE	LIST
DPA216	16	$ 7.00
DPA225	25	$ 7.00
DPA230	30	$ 8.00
DPA240	40	$ 8.50
DPA260	60	$ 9.50
DPA280	80	$11.00
DPA2100	100	$11.50
DPA2125	125	$12.00

PANEL MOUNT		
CODE	CURRENT RATING CODE	LIST
PDPA216	16	$ 7.00
PDPA225	25	$ 7.00
PDPA230	30	$ 8.00
PDPA240	40	$ 8.50
PDPA260	60	$ 9.50
PDPA280	80	$11.00
PDPA2100	100	$11.50
PDPA2125	125	$12.50

AUXILIARY CONTACT MODULES



1 normally open early make (NOEM) and 1 normally closed (NC) contact configuration. IP20 terminals guard against accidental contact with live parts. Auxiliary contacts can be installed on switches rated 16A to 125A, reducing inventory requirements.

Ratings: AC-15: 6A at ≤240V AC
4A at 240V AC to 480V AC
Continuous Thermal Current: 15A

DOOR MOUNT		
CODE	CURRENT RATING CODE	LIST
D16A211	16	$ 11.00
DA211	25 ~ 60	$ 11.00
D125A211	80 ~ 125	$ 11.00

PANEL MOUNT		
CODE	CURRENT RATING CODE	LIST
PA16DA211	16	$ 11.00
PADA211	25 ~ 60	$ 11.00
PA125DA211	80 ~ 125	$ 11.00

TERMINAL SHIELDS

Terminal shields can be installed on the line or load side of the disconnect switch to provide extra protection and guard against accidental contact with live parts.

CODE	CURRENT RATING CODE	LIST
DS2TS60	25 ~ 60	$2.00
DS2TS125	80 ~ 125	$4.00

DISCOUNT SCHEDULE C

SPECIFICATIONS:

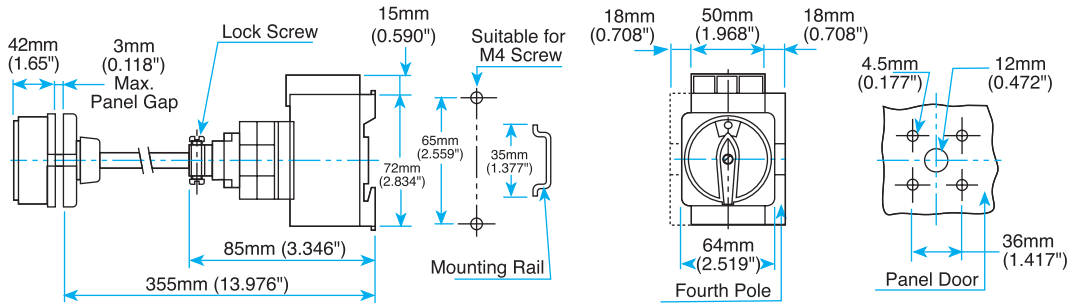
SERIES DS2 IEC NON-FUSED DISCONNECT SWITCH SPECIFICATIONS

		SWITCH CURRENT RATING CODE							
		16	25	30	40	60	80	100	125
ELECTRICAL UL/CSA APPLICATIONS									
	UNITS								
Rated Operating Voltage, Ue	VAC	600							
Rated Operating Current, Ie	A	16	25	32	40	63	80	100	125
RATED 3-PHASE POWER, Pe									
@ 240V AC	HP	3	7.5	7.5	10	15	10	15	15
@ 480V AC	HP	7.5	15	20	20	25	30	30	40
@ 600V AC	HP	10	20	25	30	30	40	40	50
RATED SINGLE PHASE POWER, Pe									
@ 120V AC	HP	0.5	1.5	2	3	3	3	3	3
@ 240V AC	HP	1.5	2	3	4	7.5	7.5	7.5	10
SHORT CIRCUIT RATINGS @ 600V AC									
With Class J and CC Fuses	kA	10	10	10	10	10	10	10	10
Maximum Fuse Size	A	20	45	45	70	70	90	90	90
ELECTRICAL IEC APPLICATIONS									
Rated Insulation Voltage, Ui	VAC	750							
Rated Impulse Voltage, Uimp	kV	6							
Rated Operating Voltage, Ue	VAC	690							
RATED OPERATING CURRENT, Ie									
AC-21A	A	16	25	32	40	63	80	100	125
AC-1	A	20	32	40	63	80	80	100	125
RATED 3-PHASE POWER, AC-23A, Pe									
@ 220 ~ 240V AC	kW	3	5.5	7.5	11	15	18.5	22	30
@ 380 ~ 440V AC	kW	5.5	11	15	18.5	30	30	37	45
@ 500 ~ 690V AC	kW	7.5	11	15	22	30	37	45	55
RATED 3-PHASE POWER, AC-3, Pe									
@ 220 ~ 240V AC	kW	2	4	5.5	7.5	11	15	18.5	22
@ 380 ~ 440V AC	kW	3	7.5	11	18.5	22	22	30	37
@ 500 ~ 690V AC	kW	5.5	11	11	18.5	22	30	37	45
SHORT CIRCUIT RATINGS									
With Type gL Fuses	kA	5	30	30	30	30	30	30	30
Maximum Fuse Size	A	16	25	32	40	63	80	100	125
MECHANICAL									
Operating Torque (Door Mount)	Nm	①	0.8	0.8	0.8	0.8	①	①	①
	Lb-in.	①	7	7	7	7	①	①	①
Operating Torque (Panel Mount)	Nm	①	1.0	1.0	1.0	1.0	1.6	1.6	1.6
	Lb-in.	①	9	9	9	9	14	14	14
ENVIRONMENTAL									
Ambient Operating Temperature	°C/°F	-25 to 55° C (-13 to 131° F)							
Altitude	m/ft.	2,000/6,528							
Ingress Protection									
Switch Body	IP	20							
Operating Handles	—	IP55, IP65	Type 1, 2, 3, 3R, 4/4X, 12 and 13 (refer to specific handle catalog numbers). IP65 and IP30 (refer to specific handle catalog numbers).						
CONSTRUCTION									
CONDUCTOR SIZE									
UL/CSA	AWG	12	8	8	6	6	1	1	1
Solid/Multi-strand	mm^2	1.5 ~ 6	1 ~ 10	1 ~ 10	4 ~ 16	4 ~ 16	6 ~ 70	6 ~ 70	6 ~ 70
Fine strand with sleeve	mm^2	0.5 ~ 6	0.75 ~ 6	0.75 ~ 6	2.5 ~ 10	2.5 ~ 10	4 ~ 50	4 ~ 50	4 ~ 50
Terminal Torque	Nm	0.8	1.7	1.7	1.7	1.7	2.5	2.5	2.5
	Lb-in.	7.1	15	15	15	15	22	22	22

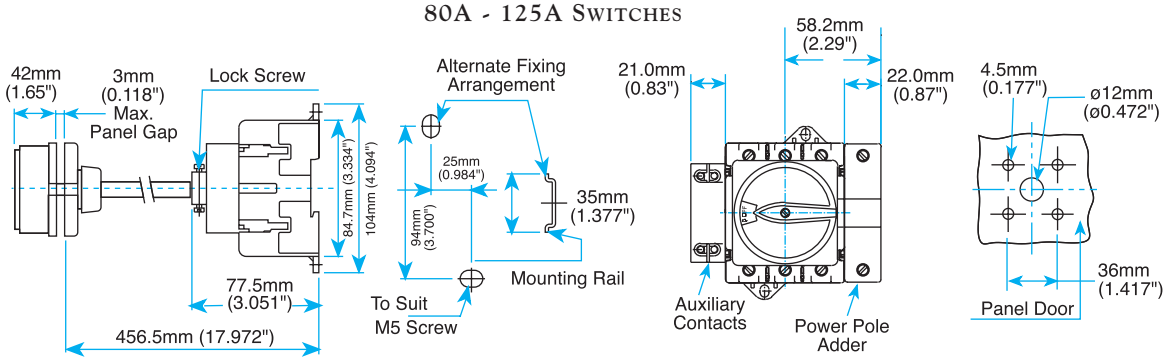
①Consult factory

PANEL MOUNTED DISCONNECT SWITCHES WITH PHG OPERATING HANDLES

25A - 63A SWITCHES

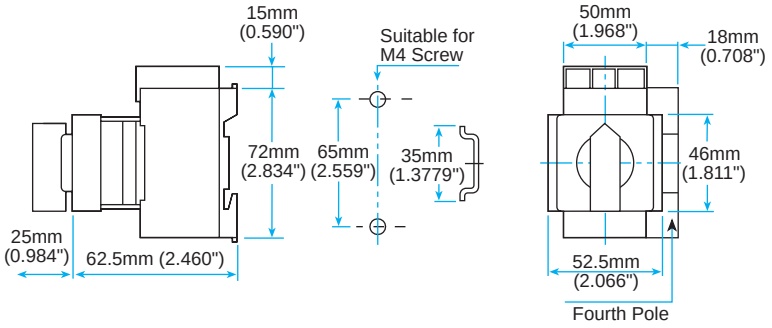


80A - 125A SWITCHES



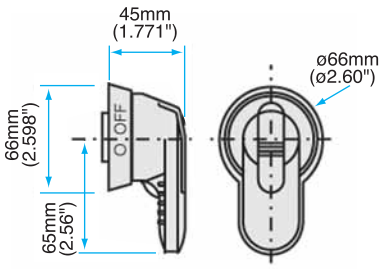
PANEL MOUNTED DISCONNECT SWITCH WITH SML OPERATING HANDLE

25A - 63A SWITCHES

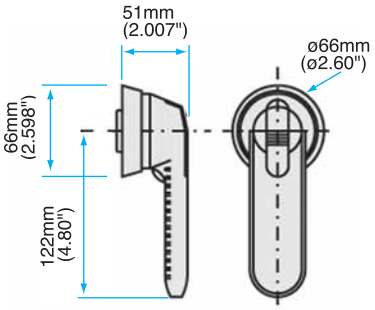


SPH & LPH OPERATING HANDLES FOR PANEL MOUNTED DISCONNECT SWITCHES

SPH



LPH



Circuit Breaker (BKR)

PHOENIX CONTACT DIN Rail Circuit Breakers

PHOENIX CONTACT INSPIRING INNOVATIONS

THERMAL MINIATURE CIRCUIT BREAKERS, TCP

TCP Pushbutton Circuit Breakers

Features:
- Can be switched back on after tripping
- Can be used for switching purposes
- Plugs into DIN Rail terminal blocks (listed below)
- Values can be swapped quickly for testing
- No searching for replacement fuses
- Pluggable Circuit Breakers

Specifications:
- Rated Surge Voltage: 2.5 kV
- Max Amperage: 0.25-4A Types is 6x Rated Current
  6-10A Types is 8x Rated Current
- Contamination Class: 2
- Color: Black

For quantities of 25 and up, call for quote.

MOUSER STOCK NO.	Fig.	Phoenix Type	Nominal Current	Nominal Voltage	Operating Temperature	Price Each		
						1	5	10
651-0712123	A	TCP 0.25	0.25A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0712152	A	TCP 0.5	.5A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0712194	A	TCP 1	1A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0712217	A	TCP 2	2A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0712233	A	TCP 3	3A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0712259	A	TCP 4	4A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0712275	A	TCP 6	6A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0712291	A	TCP 8	8A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0712314	A	TCP 10	10A	250VAC/ 65VDC	-20° to 60°C	9.72	9.10	8.69
651-0803595	-	ZBFM 5/WH:UNPRINTED	White Unprinted Labels (10 strips of 12)			6.65	6.22	5.94

TCP Terminal Blocks

Features:
- Mounts to standard 35mm DIN Rails
- Use with TCP push button circuit breakers
- Can be used with Automotive Type Fuses
- Bridgeable

Specifications:
- Color: Black
- Max Current: 30A
- Max Voltage: 300V

For quantities of 25 and up, call for quote.

MOUSER STOCK NO.	Fig.	Phoenix Type	Terminal Width	Connection Type	AWG	Price Each		
						1	5	10
651-3118203	B	UK 6-FSI/C	8.2mm	Screw-Clamp	26-8	5.99	5.61	5.36
651-3036372	C	ST 4-FSI/C	8.2mm	Spring-Cage	24-10	3.89	3.64	3.48
651-1052002	-	ZB 8: UNPRINTED	White Unprinted Labels (1 strip of 10)			.88	.77	.70

THERMO MAGNETIC CIRCUIT BREAKERS

TMC1 Thermo Magnetic Circuit Breaker - Switch Type

Features:
- Direct DIN Rail Mount (Universal Mounting Foot)
- 1-Position main current path with 1 N/O status contact
- Screw Clamp Connection

Specifications:
- Housing Width: 12.5mm
- AWG: 24-10
- Typical Life: 10,000 Operations
- Color: Black

For quantities of 25 and up, call for quote.

MOUSER STOCK NO.	Fig.	Phoenix Type	Nominal Current	Max Voltage	Operating Temperature	Price Each		
						1	5	10
651-5531370	D	TMC 1 M1 100 0.5A	.5A	250VAC/ 65VDC	-10° to 60°C	52.91	49.55	47.30
651-5531723	D	TMC 1 M1 100 1.0A	1A	250VAC/ 65VDC	-10° to 60°C	52.91	49.55	47.30
651-5531820	D	TMC 1 M1 100 2.0A	2A	250VAC/ 65VDC	-10° to 60°C	52.91	49.55	47.30
651-5530931	D	TMC 1 M1 100 5.0A	5A	250VAC/ 65VDC	-10° to 60°C	52.91	49.55	47.30
651-5531037	D	TMC 1 M1 100 8.0A	8A	250VAC/ 65VDC	-10° to 60°C	52.91	49.55	47.30
651-5531862	D	TMC 1 M1 100 10.0A	10A	250VAC/ 65VDC	-10° to 60°C	52.91	49.55	47.30
651-5510757	D	TMC 1 M1 100 15A	15A	250VAC/ 65VDC	-10° to 60°C	52.91	49.55	47.30

TMC42 Thermo Magnetic Circuit Breaker - Pushbutton Type

Features:
- Direct DIN Rail Mount (Universal Mounting Foot)
- Screw Clamp Connection

Specifications:
- Housing Width: 12.5mm
- AWG: 24-10
- Typical Life: 5000 Operations
- Color: Black

For quantities of 25 and up, call for quote.

MOUSER STOCK NO.	Fig.	Phoenix Type	Nominal Current	Max Voltage	Operating Temperature	Price Each		
						1	5	10
651-5650106	E	TMC 42-01-0.5A	.5A	250VAC/ 80VDC	-10° to 60°C	35.28	33.04	31.53
651-5650108	E	TMC 42-01-1.0A	1A	250VAC/ 80VDC	-10° to 60°C	35.28	33.04	31.53
651-5600314	E	TMC 42-01-2.0A	2A	250VAC/ 80VDC	-10° to 60°C	35.28	33.04	31.53
651-5531082	E	TMC 42-01-5.0A	5A	250VAC/ 80VDC	-10° to 60°C	35.28	33.04	31.53
651-5650120	E	TMC 42-01-8.0A	8A	250VAC/ 80VDC	-10° to 60°C	35.28	33.04	31.53
651-5650121	E	TMC 42-01-10A	10A	250VAC/ 80VDC	-10° to 60°C	35.28	33.04	31.53
651-5600310	E	TMC 42-01-15A	15A	250VAC/ 80VDC	-10° to 60°C	35.28	33.04	31.53

TMC91 Thermo Magnetic Circuit Breaker - Switch Type

Features:
- Direct DIN Rail Mount (Universal Mounting Foot)
- S-Type CBE according to IEC 934
- VDE, EN, UL and CSA Approvals

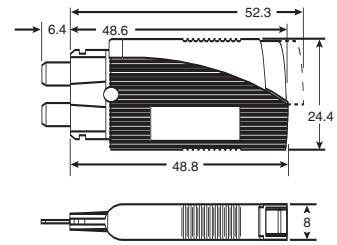
Specifications:
- Housing Width: 18mm
- AWG: 2 (Line Side)/ 3 (Load Side)
- Rupture Capacity: 10kA
- Typical Life: 6000 Operations
- Color: White

For quantities of 25 and up, call for quote.

MOUSER STOCK NO.	Fig.	Phoenix Type	Nominal Current	Max Voltage (UL)	Operating Temperature	Price Each		
						1	5	10
651-5650220	F	TMC 91H-1-10A	10A	347VAC	-25° to 55°C	30.86	28.90	27.59
651-5650219	F	TMC 91H-1-20A	20A	347VAC	-25° to 55°C	30.86	28.90	27.59
651-5650309	F	TMC 91H-1-32A	32A	347VAC	-25° to 55°C	30.86	28.90	27.59
651-5650312	F	TMC 91H-1-63A	63A	277 VAC	-25° to 55°C	39.68	37.16	35.47

DIMENSIONS (mm)

A



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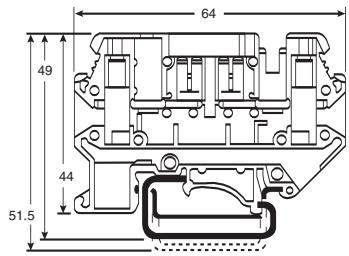

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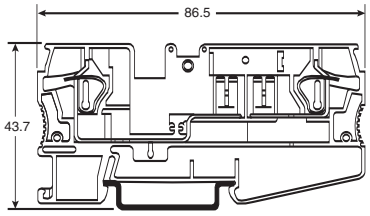

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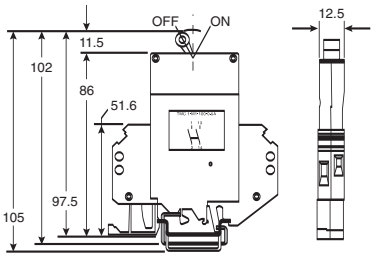

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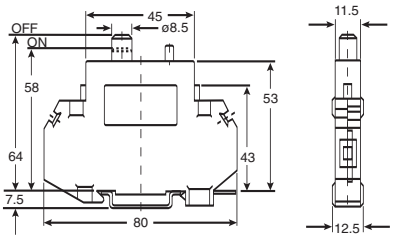

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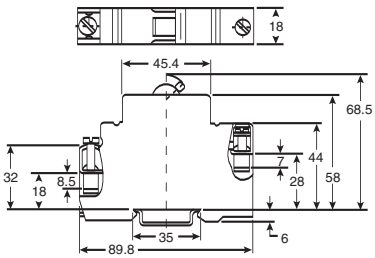

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Push Buttons

IT'S EASY TO BUILD YOUR OWN PUSH BUTTON

Simply pick the code number from each of the sections below and combine them to build your part number. See page 1 for more detailed directions.

Momentary Push Buttons (Non-Illuminated)

PBO – ____ ____ ____ – ____
I II III IV V

Example: To build one of our most popular Push Buttons, the part number would be PBO + II + III + IV + V or PBO-FCGN-NO

I. OPERATOR TYPE

CODE	DESCRIPTION	LIST
PBO	Push Button Operator	$8.40

II. CLAMP RING

CODE	DESCRIPTION	LIST
(Blank)	Polyester (Type 4X)	—
A	Aluminum (Type 4)	$2.00

III. CAP TYPE

CODE	DESCRIPTION	LIST
(Blank)	Operator less Cap	—
FC	Flush Cap	$ 2.40
GFC	Guarded Flush Cap	$ 5.40
XC	Extended Cap	$ 2.40
GXC	Guarded Extended Cap	$ 5.40
MC	Mushroom Cap	$ 8.00
JMC	Jumbo Mushroom Cap	$10.00
SMC	Shrouded Mushroom Cap*	$12.00
SJC	Shrouded Jumbo Mushroom Cap*	$14.00

*NOTE: Aluminum clamp rings are NOT an option for SMC or SJC.

IV. CAP COLOR

CODE	COLOR
(Blank)	Operator less Cap
BK	Black
BE	Blue
GN	Green
GY	Grey
RD	Red
WE	White
YW	Yellow

V. CONTACT BLOCK CONFIGURATION

CODE	DESCRIPTION	LIST
(Blank)	Operator without Contact Blocks	—
NO	1 Normally Open Contact Block	$ 6.00
NC	1 Normally Closed Contact Block	$ 6.00
EM	1 "Early Make" Contact Block	$ 8.00
DB	1 "Delayed Break" Contact Block	$ 8.00
NO/NO	2 Normally Open Contact Blocks	$12.00
NC/NC	2 Normally Closed Contact Blocks	$12.00
NO/NC	1 Normally Open and 1 Normally Closed Contact Blocks	$12.00

DISCOUNT SCHEDULE **A**

LEGEND PLATES *in almost any size & color are available for same day shipping. See pages 118-119 for a complete selection.*

RUBBER BOOTS ALSO AVAILABLE

Your Secondary Defense for Added Protection.

Chemicals on gloves, wash down areas and particularly harsh climates will do damage to any push button. Utilizing our state-of-the-art rubber boots protect both the operators and the circuits behind them.

Our Standard Rubber Boots feature a brass ring that is molded with Neoprene that has been modified to provide added pliability and protection against dust, freezing and thawing environments.

Our Fluorosilicone Rubber Boots feature a nickel-plated brass threaded ring that is insert molded into a special thermoset compound to withstand most applications in corrosive environments and perform well against more chemicals and vapors than Hypalon Boots.

RUBBER BOOTS

STANDARD RUBBER BOOTS			FLUOROSILICONE RUBBER BOOTS		
CODE	COLOR	LIST	CODE	COLOR	LIST
RBBK	Black	$15.00	HRBBK	Black	$18.00
RBGN	Green	$15.00	HRBGN	Green	$18.00
RBRD	Red	$15.00	HRBRD	Red	$18.00
RBYW	Yellow	$15.00	HRBYW	Yellow	$18.00

Example: To build one of our most popular Push Buttons with a Rubber Boot, replace II, III & IV (Clamp Ring, Cap Type & Color) with the code from the rubber boot chart above. The part number would be PBO + (code from rubber boot chart above) + V or PBO-RBGN-NO.

NOTE: Rubber boots come standard with a built-in clamp ring and thrust washer. When installing operator we recommend that the thrust washer be placed behind the panel to prevent rotation.

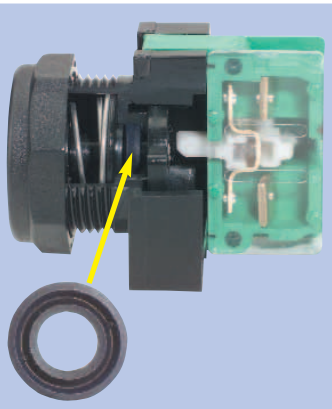
30mm Momentary Non-Illuminated Push Buttons

c3controls goes the extra step to make sure that our products outlast the competition. Our 30mm Momentary Non-Illuminated Push Buttons are durable and flexible for a variety of uses. All c3controls 30mm operators are UL Listed and are rated Type 4/4X as standard for watertight and corrosion resistance. In addition, operators are also listed for Type 1, 2, 3, 3R, 12 and 13, and meet global standards requirements.

Product features include:

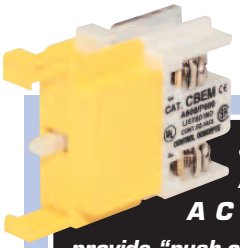
- Polyester construction for superior corrosion resistance, moisture rejection and electrical insulation.
- Optional polyester or polished aluminum clamp rings with coarse 16 pitch threads.
- #6 terminal screws with self-lifting captive wire clamps accommodate #22 through two #12 AWG wires (0.5 - 4mm^2) per terminal.
- Operators conveniently mount in a round 1-13/64" (30.5mm) hole that is directly interchangeable with competitors units and eliminate the labor required for notching.

Unique Product Features



1. Our revolutionary U-Cup seal is infused with a Teflon coating to eliminate cracking when exposed to harsh conditions such as heat, dryness and sunlight. The U-Cup seal rides easily along the stroker and keeps water, oils, dust and other corrosive particles in the air away from the contact blocks. This U-cup seal also acts like a squeegee and forms a permanent watertight seal that meets Type 4/4X with or without a rubber boot. *In fact, our push button was the first to be rated Type 4X without using a rubber boot!*
2. Our push buttons modular design provides endless options for appropriate operator interface with a variety of interchangeable cap types and colors which ultimately will save you time and money by reducing your inventory.

Some of Our Popular Configurations:



Snap-On Alternate Action Blocks

provide "push-on/push-off" operation on our push buttons. *See page 107.*

Momentary Non-Illuminated Push Button Operators with Polyester Clamp Ring (Type 4X)

		Flush Cap		Extended Cap	
	Cap Color	Catalog Number	List	Catalog Number	List
1NO	Black	PBO-FCBK-NO	$16.80	PBO-XCBK-NO	$16.80
	Green	PBO-FCGN-NO	$16.80	PBO-XCGN-NO	$16.80
	Red	PBO-FCRD-NO	$16.80	PBO-XCRD-NO	$16.80
1NC	Black	PBO-FCBK-NC	$16.80	PBO-XCBK-NC	$16.80
	Green	PBO-FCGN-NC	$16.80	PBO-XCGN-NC	$16.80
	Red	PBO-FCRD-NC	$16.80	PBO-XCRD-NC	$16.80
1 NO	Black	PBO-FCBK-NO/NC	$22.80	PBO-XCBK-NO/NC	$22.80
&	Green	PBO-FCGN-NO/NC	$22.80	PBO-XCGN-NO/NC	$22.80
1 NC	Red	PBO-FCRD-NO/NC	$22.80	PBO-XCRD-NO/NC	$22.80

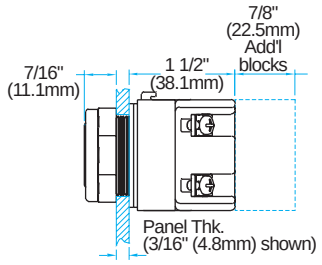
Mix and Match Any Color and Momentary Non-Illuminated Push Button Cap

Flush Cap | Guarded Flush Cap | Extended Cap | Guarded Extended Flush Cap | Mushroom Cap (1.5" (38mm) dia.) | Jumbo Mushroom Cap (2.25" (57mm) dia.) | Shrouded Mushroom Cap (1.5" (38mm) dia.) | Shrouded Jumbo Mushroom Cap (2.25" (57mm) dia.)

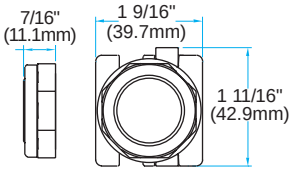
MOMENTARY & MAINTAINED NON-ILLUMINATED PUSH BUTTONS

Fully-assembled operators come standard with one 3/16" (4.8mm) and three 1/16" (1.6mm) gaskets.
See page 127 for mounting gasket specifications.

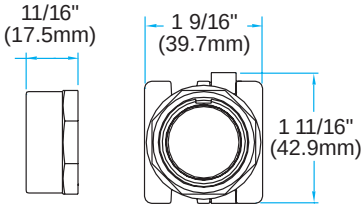
Non-Illuminated Operator (shown with Flush Cap)



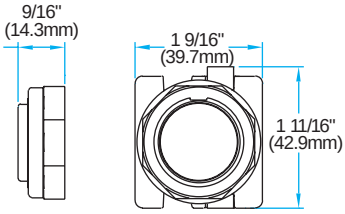
Momentary Flush Cap



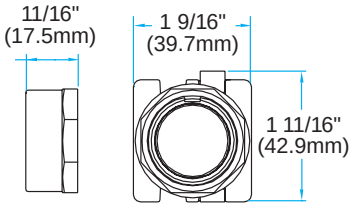
Momentary Guarded Flush Cap



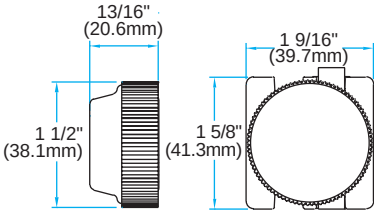
Momentary Extended Cap



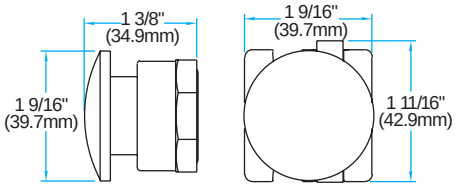
Momentary Guarded Extended Cap



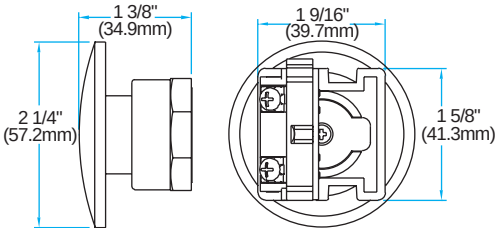
Momentary Standard Rubber Boot



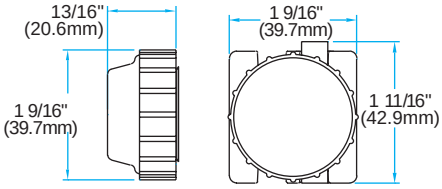
Momentary 1.5" (38mm) Mushroom Cap



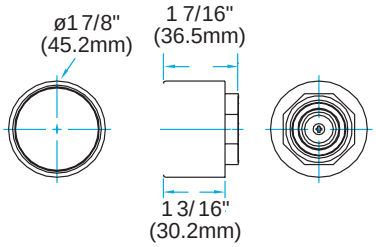
Momentary 2.25" (57.2mm) Jumbo Mushroom Cap



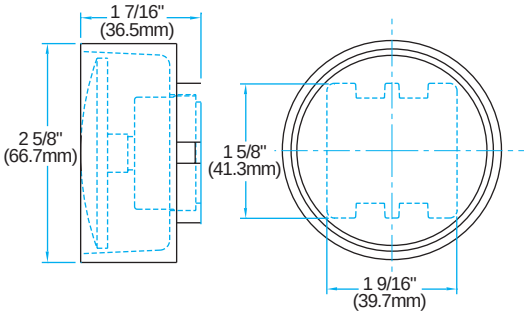
Momentary Fluorosilicone Rubber Boot



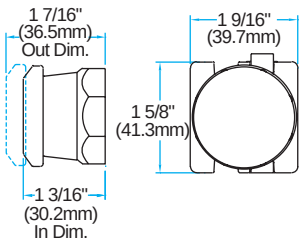
Momentary 1.5" (38mm) Shrouded Mushroom Cap



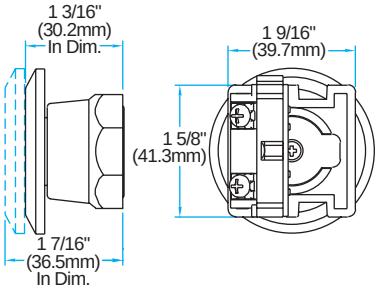
Momentary 2.25" (57.2mm) Shrouded Jumbo Mushroom Cap



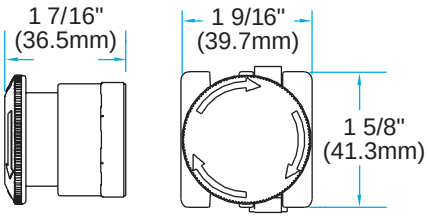
2-Position Push-Pull Maintained 1.5" (38mm) Mushroom Cap



2-Position Push-Pull Maintained 2.25" (57.2mm) Jumbo Mushroom Cap



2-Position Push-Twist Maintained 1.5" (38mm) Mushroom Cap

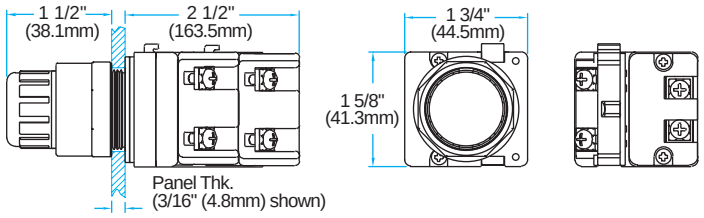


Selector Switch (S1)

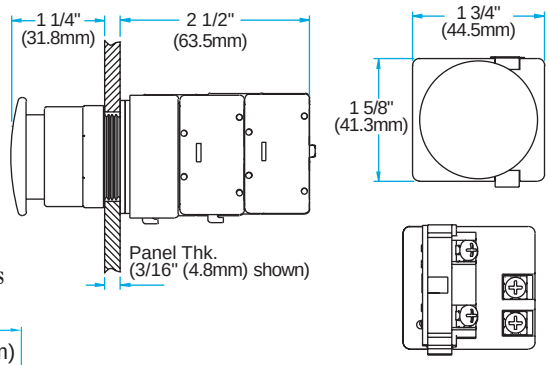
PUSH-TO-TEST PILOT LIGHTS

Fully-assembled operators come standard with one 3/16" (4.8mm) and three 1/16" (1.6mm) gaskets.
See below for mounting gasket specifications.

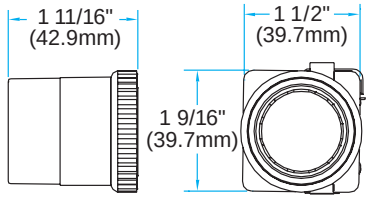
Full Voltage, Transformer & Resistor Push-To-Test Operators (shown with IPBC)



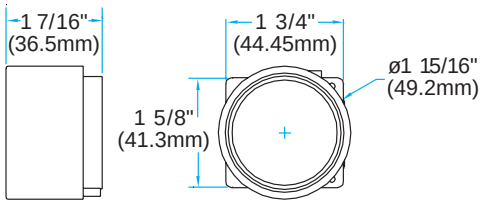
Full Voltage, Transformer & Resistor Push-To-Test Operators (shown with IPBCM)



Guarded Lens



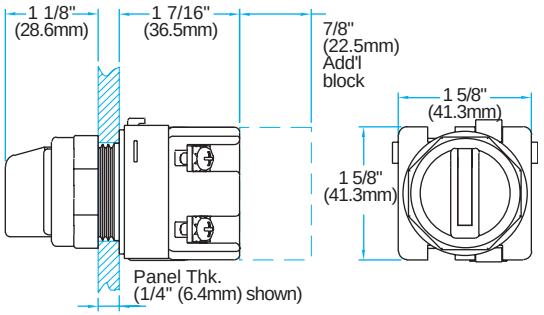
Shrouded Mushrooms Lens



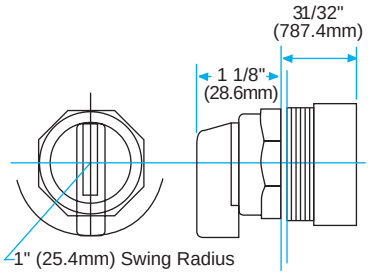
SELECTOR SWITCHES

Fully-assembled operators come standard with one 3/16" (4.8mm) and three 1/16" (1.6mm) gaskets.
See below for mounting gasket specifications.

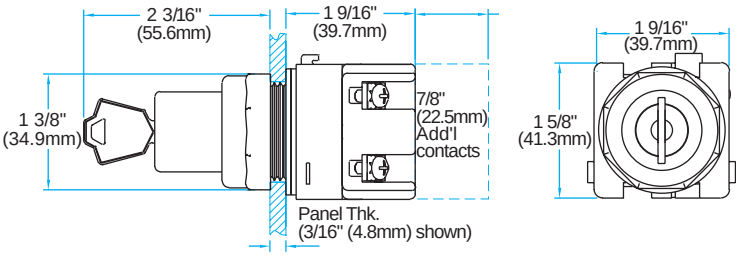
Selector Switch Operator (shown with standard handle)



Selector Switch Lever Handle



Keyed Selector Switch Operator



MOUNTING GASKETS

PANEL THICKNESS IN DECIMALS	# OF GASKETS NEEDED 3/16" (4.8MM)	& 1/16" (1.6MM)
less than .080	1	4
.080 – .132	1	3
.133 – .185	1	2
.186 – .238	1	1
.239 – .291	0	3
.292 – .344	0	2

NOTE: Remove one 1/16" (1.6mm) gasket when using a legend plate.

IT'S EASY TO BUILD YOUR OWN SELECTOR SWITCH

Simply pick the code number from each of the sections below and combine them to build your part number. See page 1 for more detailed directions.

Selector Switches

____ – ____ ____ ____ – ____ / ____

I II III IV V* VI*

*NOTE: Contact block configurations are based on circuit designations (see charts below).

Example: To build one of our most popular Selector Switches, the part number would be I + II + III + IV + V + VI or SS03-SHWE-NO/NO

I. BASIC SELECTOR SWITCH OPERATOR FUNCTION

CODE	POS./FUNCTION	LIST
SS02	2/Maintained	$12.00
SROLR	2/Spring Return, L to R	$21.00
SRORL	2/Spring Return, R to L	$21.00
SS03	3/Maintained	$12.00
SROLC	3/Spring Return, L to C	$21.00
SRORC	3/Spring Return, R to C	$21.00
SROLRC	3/Spring Return, L & R to C	$21.00
SS04	4/Maintained	$12.00
SRO43	4/Spring Return, Pos. 4 to 3	$21.00
SRO1243	4/Spring Return, Pos. 1 to 2 and Pos. 4 to 3	$21.00

Each operating handle is black with a factory assembled color insert.

DISCOUNT SCHEDULE A

II. CLAMP RING

CODE	DESCRIPTION	LIST
(Blank)	Polyester (Type 4X)	—
A	Aluminum (Type 4)	$2.00

III. HANDLE TYPE

CODE	DESCRIPTION	LIST
SH	Standard	$5.00
SL	Lever	$5.00

IV. HANDLE INSERT COLOR

CODE	COLOR
BE	Blue
GN	Green
GY	Grey
RD	Red
WE	White
YW	Yellow

V. CONTACT BLOCK CONFIGURATION (LEFT SIDE)

CODE	DESCRIPTION	LIST
(Blank)	Operator without Contact Blocks	—
NO	1 Normally Open Contact Block	$ 6.00
NC	1 Normally Closed Contact Block	$ 6.00
EM	1 "Early Make" Contact Block	$ 8.00
DB	1 "Delayed Break" Contact Block	$ 8.00
NO-NO	2 Normally Open Contact Blocks	$12.00
NC-NC	2 Normally Closed Contact Blocks	$12.00
NO-NC	1 Normally Open and 1 Normally Closed Contact Blocks	$12.00

VI. CONTACT BLOCK CONFIGURATION (RIGHT SIDE)

CODE	DESCRIPTION	LIST
(Blank)	Operator without Contact Blocks	—
NO	1 Normally Open Contact Block	$ 6.00
NC	1 Normally Closed Contact Block	$ 6.00
EM	1 "Early Make" Contact Block	$ 8.00
DB	1 "Delayed Break" Contact Block	$ 8.00
NO-NO	2 Normally Open Contact Blocks	$12.00
NC-NC	2 Normally Closed Contact Blocks	$12.00
NO-NC	1 Normally Open and 1 Normally Closed Contact Blocks	$12.00

CONTACT BLOCK SELECTION FOR 2-POSITION SELECTOR SWITCHES

CIRCUIT DESIG.	HANDLE POSITION LEFT	HANDLE POSITION RIGHT	BLOCK CATALOG NUMBER	MOUNTING POSITION
A	O	X	CBNO	EITHER
B	X	O	CBNC	EITHER

CONTACT BLOCK SELECTION FOR 3-POSITION SELECTOR SWITCHES

CIRCUIT DESIG.	HANDLE POSITION LEFT	HANDLE POSITION CENTER	HANDLE POSITION RIGHT	BLOCK CATALOG NUMBER	MOUNTING POSITION
C	X	O	O	CBNO	LEFT
D	O	X	O	CBNC	EITHER
E	O	O	X	CBNO	RIGHT
F	O	X	X	CBDB	LEFT
G	X	O	X	CBEM	EITHER
H	X	X	O	CBDB	RIGHT

O = OPEN X = CLOSED

CONTACT BLOCK SELECTION FOR 4-POSITION SELECTOR SWITCHES

CIRCUIT DESIG.	HANDLE POSITION LEFT	HANDLE POSITION LT. CNT.	HANDLE POSITION RT. CNT.	HANDLE POSITION RIGHT	BLOCK CAT. #	MOUNTING POSITION
I	X	O	O	O	CBNO	LEFT
J	O	X	O	O	CBNC	RIGHT
K	O	O	X	O	CBNC	LEFT
L	O	O	O	X	CBNO	RIGHT
M	O	X	X	X	CBDB	LEFT
N	X	O	X	X	CBEM	RIGHT
O	X	X	O	X	CBEM	LEFT
P	X	X	X	O	CBDB	RIGHT

MIX AND MATCH ANY INSERT COLOR AND SELECTOR SWITCH HANDLE

Standard Handle

Standard Handle

Standard Handle

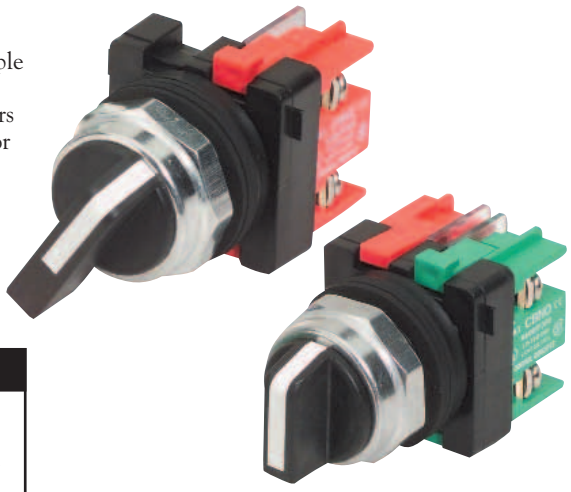
Lever Handle

Lever Handle

Lever Handle

30mm Selector Switches

With our unique universal cam design, c3controls Selector Switches offer multiple functions in a single device eliminating the need to install separate devices to perform individual functions based on contact block configuration. All operators feature polyester housings, are UL Listed, and are rated Type 4/4X as standard for watertight and corrosion resistance. In addition, operators are also listed for Type 1, 2, 3, 3R, 12 and 13, and meet global standards requirements. Add-on contact blocks are available for up to 8 circuits per operator. See pages 94-95 for our complete line of 30mm standard contact blocks.



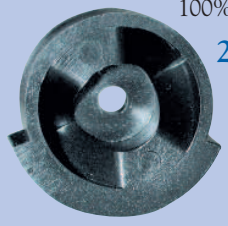
HANDLE POSITIONS

2-POSITION	3-POSITION	4-POSITION

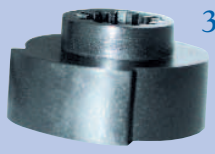
UNIQUE PRODUCT FEATURES

Save time & money - with c3controls, one cam does it all!

1. One-Cam does it all vs. our competitors who need up to fifteen cams to perform the same function. This One-Cam design eliminates the need for multiple cam configurations and selector switch configuration nightmares, saving time, inventory, money, and ensuring 100% cam selection configuration accuracy.



2. Our revolutionary U-Cup seal is infused with a Teflon coating to eliminate cracking when exposed to harsh conditions such as heat, dryness and sunlight.



3. All frictional parts are molded with an internal self-lubricant to provide outstanding wear and smooth cam operations without troublesome greases used by others that attracts dust and other particles in the area.

Some of Our Popular Configurations:

2-POSITION SELECTOR SWITCH OPERATORS WITH POLYESTER CLAMP RING (TYPE 4X)

CONTACT SYMBOL	CONTACT BLOCK MOUNTING POS. Viewed from front of operator	HANDLE POSITION 0=OPEN X=CLOSED		TYPE OF OPERATOR	MAINTAINED POSITION		SPRING RETURN FROM RIGHT TO LEFT		SPRING RETURN FROM LEFT TO RIGHT	
		LEFT	RIGHT		CATALOG #	LIST	CATALOG #	LIST	CATALOG #	LIST
1 NO	EITHER	0	X	STANDARD	SS02-SHWE-NO	$23	SRORL-SHWE-NO	$32	SROLR-SHWE-NO	$32
				LEVER	SS02-SLWE-NO	$23	SRORL-SLWE-NO	$32	SROLR-SLWE-NO	$32
1 NC	EITHER	X	0	STANDARD	SS02-SHWE-NC	$23	SRORL-SHWE-NC	$32	SROLR-SHWE-NC	$32
				LEVER	SS02-SLWE-NC	$23	SRORL-SLWE-NC	$32	SROLR-SLWE-NC	$32

3-POSITION SELECTOR SWITCH OPERATORS WITH POLYESTER CLAMP RING (TYPE 4X)

CONTACT SYMBOL	CONTACT BLOCK MOUNTING POS. Viewed from front of operator	HANDLE POSITION 0=OPEN X=CLOSED			TYPE OF OPERATOR	MAINTAINED POSITION		SPRING RETURN FROM LEFT TO CENTER		SPRING RETURN FROM RIGHT TO CENTER		SPRING RETURN FROM LEFT OR RIGHT TO CENTER	
		LEFT	CENTER	RIGHT		CATALOG #	LIST	CATALOG #	LIST	CATALOG #	LIST	CATALOG #	LIST
NO/NO	LEFT	X	0	0	STANDARD	SS03-SHWE-NO/NO	$29	SROLC-SHWE-NO/NO	$38	SRORC-SHWE-NO/NO	$38	SROLRC-SHWE-NO/NO	$38
	RIGHT	0	0	X	LEVER	SS03-SLWE-NO/NO	$29	SROLC-SLWE-NO/NO	$38	SRORC-SLWE-NO/NO	$38	SROLRC-SLWE-NO/NO	$38

IT'S EASY TO BUILD YOUR OWN LEGEND PLATE

Simply pick the code number from each of the sections below and combine them to build your part number. See page 1 for more detailed directions.

Legend Plates

_____ _____ – _____
I II III

Legend plates feature 2 lines of text with approximately 16 characters per line.
*The tall legend plate (LPT) features 3 lines of text with approximately 16 characters per line and the Potentiometer legend plate comes standard with a scale and one or two lines of text, see chart D below.

I. STANDARD LEGEND PLATE TYPE

CODE	DESCRIPTION	LIST
LP	Standard 2"h x 2"w	$2.00
LPN	Narrow 2"h x 1.75"w	$2.00
LPS	Short 1.75"h x 2"w	$2.00
LPT	*Tall 2.25"h x 2"w	$2.50
LPR	Standard Round 2.4" Dia.	$3.50
LPRM	Medium Round 2.75" Dia.	$4.00
LPRJ	Jumbo Round 3.75" Dia.	$4.50

II. FACE AND LETTER COLOR

CODE	FACE COLOR	LETTER COLOR
AL	Aluminum	Black
(Blank)	Black	White
BE	Blue	White
GN	Green	White
RD	Red	White
WE	White	Black
YW	Yellow	Black

III. LEGEND DESIGNATION

A. PUSH BUTTONS AND LIGHTS

CODE	DESCRIPTION
00	(Blank)
01	Auto
02	Close
31	Cycle Start
100	Cycle Stop
03	Down
04	Emergency Stop
06	Fast
101	Fault
07	Forward
08	Hand
32	High
33	In
09	Inch
10	Jog
38	Jog Forward
39	Jog Reverse
34	Low
35	Lower
11	Manual
26	Motor Run
12	Off
13	On
14	Open
36	Out
27	Overload
15	Power Off
16	Power On
30	Push-To-Reset
17	Push-To-Test
37	Raise
18	Reset
19	Reverse
20	Run
21	Slow
22	Start
23	Stop
24	Test
29	Trip
25	Up

B. 2-POSITION SELECTOR

CODE	LEGEND LEFT	LEGEND RIGHT
00	(Blank)	(Blank)
50	Auto	Hand
68	Auto	Manual
51	Down	Up
63	Fast	Slow
52	Fwd	Rev
53	Hand	Auto
73	High	Low
54	Inch	Run
75	Left	Right
70	Local	Remote
55	Manual	Auto
56	Off	On
57	On	Off
58	Open	Close
65	Pull Start	Push Stop
66	Push Off	Pull On
64	Push On	Push Off
67	Push To Stop	Pull To Start
71	Raise	Lower
59	Rev	Fwd
60	Run	Jog
69	Slow	Fast
61	Start	Stop
62	Stop	Start
74	Summer	Winter
72	Up	Down

C. 3-POSITION SELECTOR

CODE	LEGEND LEFT	LEGEND CENTER	LEGEND RIGHT
00	(Blank)	(Blank)	(Blank)
92	Auto	Off	Hand
93	Auto	Man	Off
80	Down	Off	Up
81	Fwd	Auto	Rev
82	Fwd	Off	Rev
83	Hand	Off	Auto
94	High	Off	Low
99	Jog	Off	Auto
90	Local	Off	Remote
84	Manual	Off	Auto
89	Off	Run	Start
85	Off	Start	Run
86	Off	1	2
95	Open	Off	Close
91	Raise	Off	Lower
96	Slow	Off	Fast
97	Summer	Off	Winter
98	Up	Off	Down
87	1	Off	2
88	1	2	3

D. POTENTIOMETER

CODE	DESCRIPTION
40	Blank Legend 0 - 10
41	"Speed" 0 - 10
43	Blank Legend 0 - 100
44	"Speed" 0 - 100

NOT FINDING WHAT YOU NEED IN A STANDARD PLATE?

We offer Special and Custom Engraving up to 12" x 24" (304.8mm x 609.6mm). Please consult factory or see page 119 for details. While our standard legend plates are available for same day shipping, our special and custom legend plates are not.

DISCOUNT SCHEDULE **A**

POPULAR CONFIGURATIONS:

LEGEND PLATES

CATALOG NO.	DESIGNATION	LIST
LPRYW-04	Emergency Stop	$3.50
LPT-83	Hand Off Auto	$2.50
LP-41	Speed 0 - 10	$2.00

Pilot Lights

IT'S EASY TO BUILD YOUR OWN PILOT LIGHT

Simply pick the code number from each of the sections below and combine them to build your part number. See page 1 for more detailed directions.

Pilot Lights

I	II	III	IV	– PLL V	VI

Example: To build one of our most popular Pilot Lights, the part number would be I + II + III + IV + PLL + VI or FVLU120LG-PLLGN

I. BASIC PILOT LIGHT OPERATOR

CODE	DESCRIPTION	LIST
FVLU	Full Voltage	$26.00
TFLU	Transformer (50/60 Hz)	$38.00
RLU	Resistor	$32.00
RTLU	Dual Input Remote Test	$35.00

II. VOLTAGE BASED ON OPERATOR TYPE

CODE	DESCRIPTION
	FULL VOLTAGE
6	6V AC/DC
12	12V AC/DC
24	24V AC/DC
120	120V AC/DC
	TRANSFORMER
120	120V AC
240	240V AC
277	277V AC
480	480V AC
	RESISTOR
120	120V AC/DC
240	240V AC/DC
480	480V AC/DC
	DUAL INPUT REMOTE TEST
6	6V AC/DC
12	12V AC/DC
24	24V AC/DC
120	120V AC/DC
240	240V AC/DC

III. LAMP TYPE/COLOR

CODE	COLOR	LIST
	LED	
LA	Amber	$10.00
LB	Blue	$10.00
LG	Green	$10.00
LR	Red	$10.00
LW	White	$10.00
	INCANDESCENT	
(Blank)	Clear	—
F	Clear Flashing Bulb*	$ 4.00
	*NOTE: Incandescent flashing bulbs available for any 6V full voltage or transformer application.	
	NEON†	
NG	Green	—
NR	Red	—
	†NOTE: Only Available in FVLU120, RLU240 and RLU480.	
NL	**No Lamp**	– $ 1.00

IV. CLAMP RING

CODE	DESCRIPTION	LIST
(Blank)	Polyester (Type 4X)	—
A	Aluminum (Type 4)	$2.00

V. LENS TYPE

CODE	DESCRIPTION	LIST
PLL	Pilot Light Lens	$6.00

VI. LENS COLOR

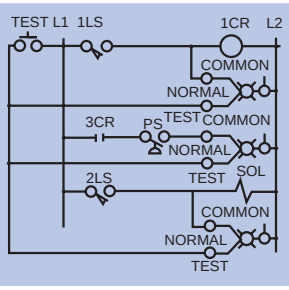
CODE	COLOR
AR	Amber
BE	Blue
CR	Clear
GN	Green
RD	Red
WE	White

SEE PAGE 121 FOR LAMP REPLACEMENT CHART AND PAGE 122 FOR LAMP TECHNICAL DATA.

DISCOUNT SCHEDULE A

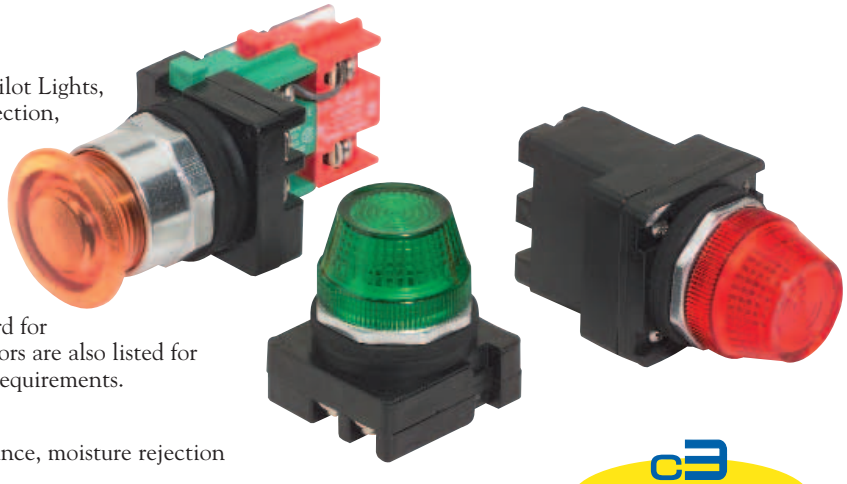
DUAL INPUT REMOTE TEST

Our unique Dual Input Remote light unit can be used as a pilot light while also permitting the testing of a number of lights from a single push button. A diode circuit isolates the test supply from the normal supply. The schematic shown represents a typical dual input application.



AVAILABLE LENS COLORS FOR PILOT LIGHTS

30MM PILOT LIGHTS



Our 30mm Pilot Lights and Illuminated Push-To-Test Pilot Lights, when utilized with our LED lamps provide leakage protection, long-lasting life and high quality with tremendous resistance to shock and vibration. Our reflection technology and state-of-the-art LED lamps improve visibility from all angles. c3controls LED lamps last 100,000 hours — *that's 11.4 years!* Combine these LEDs with our full voltage, transformer or resistor packages for optimum durability. All c3controls 30mm operators are UL Listed and are rated Type 4/4X standard for watertight and corrosion resistance. In addition, operators are also listed for Type 1, 2, 3, 3R, 12 and 13, and meet global standards requirements.

Product features include:

- Polyester construction for superior corrosion resistance, moisture rejection and electrical insulation.
- Full voltage lights incorporate a unique insulated socket design to minimize accidental contact during lamp change.
- All lights use miniature bayonet base lamps to provide reliable lamp secureness.
- Available with Incandescent, Neon, or our LED lamps with leakage protection.
- #6 terminal screws with self-lifting captive wire clamps accommodate #22 through two #12 AWG wires (0.5 - 4mm^2) per terminal.
- Operators conveniently mount in a round 1-13/64" (30.5mm) hole that is directly interchangeable with competitors units and eliminates the labor required for notching.

c3 Exclusive!

Multi-Voltage Light!
See page 113.

UNIQUE PRODUCT FEATURES

1. Compact, thin design is also vibration resistant.
2. Our seal is infused with a coating to eliminate cracking when exposed to harsh conditions such as heat, dryness and sunlight. This seal also acts as a light reflector because it is white which increases light output and improves visibility from all angles.
3. Our rugged Lexan™ lenses provide better visibility and can resist high impact for reliable performance in most environments, even in high temperature ambients.
4. We utilize premium 130V incandescent and LED lamps for improved, long-lasting life.

SOME OF OUR POPULAR CONFIGURATIONS:

PILOT LIGHTS WITH POLYESTER CLAMP RING (TYPE 4X)

CATALOG NUMBER	DESCRIPTION	LIST
FVLU120LG-PLLGN	Full Voltage 120V Green LED w/Green Lens	$42.00
FVLU120LR-PLLRD	Full Voltage 120V Red LED w/Red Lens	$42.00
FVLU120LA-PLLAR	Full Voltage 120V Amber LED w/Amber Lens	$42.00

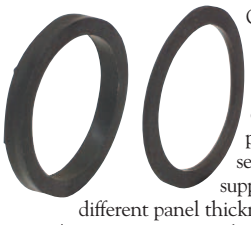
EXTENDED CLAMP RINGS

We offer four types of 30mm extended clamp rings that guard against accidental operation. Use our Extended Clamp Rings (ECR or AECR) with flush caps, our Clear Guarded Clamp Ring (EECR) with illuminated push buttons and our Large Extended Clamp Ring (LECR) with flush or extended caps, which also provides easier access to your push buttons.

FOR USE WITH NON-ILLUMINATED CAPS		
CODE	DESCRIPTION	LIST
ECR	Extended Ring	$3.00
LECR	Large Extended Ring	$5.00
AECR	Aluminum Extended Ring	$5.00

FOR USE WITH ILLUMINATED LENS		
CODE	DESCRIPTION	LIST
EECR	Guarded Clear Polyester Ring	$4.00

PANEL GASKETS



Our panel gaskets are constructed of Neoprene for long life and low compression set and provide a watertight seal. Panel gaskets are supplied to accommodate different panel thickness. In order to meet Type 4/4X requirements, at least one 1/16" (1.6mm) gasket must be used. NOTE: All c3controls 30mm operators are provided with gaskets.

CODE	DESCRIPTION	LIST
PG2	1/16" (1.6mm) Gasket	$0.50
PG6	3/16" (4.8mm) Gasket	$0.50

THRUST & TRIM WASHERS

Anti-rotation device for use with 30mm push buttons, selector switches and pilot lights to provide additional protection from rotation and aid in alignment. This product is optional with c3controls gasket technology. NOTE: Can only be used in conjunction with special legend plates that have the "up notch" design.

CODE	DESCRIPTION	LIST
TTW	30mm Anti-Rotation Washers	$1.00

LOCK OFF ATTACHMENTS

c3controls offers a wide variety of 30mm corrosive resistant lock-off attachments for maintained and momentary push buttons and selector switches. Our LOAX, LOAM and LOAP lock-offs permit locking operators in the depressed position. Our LOAFC lock-off covers and locks the operator so its position cannot be changed and features a 1/4" (6.4mm) diameter padlocking hasp.

LOAFC

LOAX/LOAM/LOAP

CODE	FITS	LIST
LOAX	Standard Extended Cap	$16.00
LOAM	Standard Momentary Mushroom Cap	$16.00
LOAP	Push-Pull Maintained Mushroom Cap (PPMC) or Push Maintained Extended Cap (PMXC)	$16.00
LOAFC	Most Push Buttons and Selector Switches	$25.00

GUARD ATTACHMENT

Our PPGD guards against accidental operation and is made of a high strength polyester material.

CODE	FITS	LIST
PPGD	Maintained Push Buttons	$20.00

HOLE PLUG

Use to seal unused panel holes. Our hole plug comes with additional sealing panel gaskets to ease installation and is rated Type 4X.

CODE	DESCRIPTION	LIST
HP	30mm Grey Hole Plug	$4.00

PUSH MAINTAINED FLUSH AND EXTENDED CAPS

Use with a secondary standard cap and mechanical interlock to provide two button momentary/maintained operation or use on adjacent operators with mechanical interlock to provide two-button maintained/maintained operation. Comes with our standard polyester clamp ring. **An optional polished aluminum clamp ring is also available, add prefix "A" to catalog code and increase the price $2.00.**

COLOR	FLUSH CODE	EXTENDED CODE	LIST
Black	PMFCBK	PMXCBK	$22.00
Green	PMFCGN	PMXCGN	$22.00
Red	PMFCRD	PMXCRD	$22.00
Yellow	PMFCYW	PMXCYW	$22.00

MECHANICAL INTERLOCK

Our Mechanical Interlock features a 2" (50.8mm) center and can be used to interlock two adjacent operators. This may also be used to interlock a two-unit maintained/momentary assembly. NOTE: Factory installation recommended.

CODE	DESCRIPTION	LIST
MI	30mm Mechanical Interlock	$12.00

CLAMP RING WRENCH

To simplify tightening and loosening of standard polyester and aluminum 1-3/8" (34.9mm) octagonal clamp rings. Won't scratch your lens or panel.

CODE	DESCRIPTION	LIST
CRW	30mm Clamp Ring Wrench	$10.00

DISCOUNT SCHEDULE A

LED, INCANDESCENT & NEON REPLACEMENT LAMPS

c3controls offers a full range of lamp options in a miniature bayonet base for direct interchangeability which provides flexibility in choosing the best lamp for each installation application. Multiple voltage options in Incandescent, LED and Neon lamps are available. Please refer to the chart at the bottom of the page to determine the appropriate replacement lamp based on your operator voltage. For lamp technical data, see page 122.

LED Lamps

LED _____ _____
/ II III

To order LED Lamps, the part number would be LED + II + III

I. LAMP TYPE

CODE	DESCRIPTION
LED	LED Lamp

Our LED lamps feature built-in leakage protection.

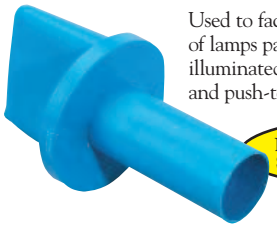
II. VOLTAGE

CODE	DESCRIPTION
6	6V
12	12V
24	24V
48	48V
120	130V

III. LAMP COLOR

CODE	COLOR	LIST
AR	Amber	$14.00
BE	Blue	$14.00
GN	Green	$14.00
RD	Red	$14.00
WE	White	$14.00

LAMP REMOVAL TOOL



Used to facilitate the removal of lamps particularly in illuminated push buttons and push-to-test operators.

DISCOUNT SCHEDULE **C**

CODE	DESCRIPTION	LIST
LRT	Lamp Removal Tool	$4.00

Incandescent Lamps

CODE	VOLTAGE	LIST
FVB6	6V	$2.00
FVB12	12V	$2.00
FVB24	24V	$2.00
FVB55	55V	$4.00
FVB120	120V	$4.00
FVB6F	6V Flashing	$6.00

Incandescent Lamp

Neon Lamps

CODE	VOLTAGE	COLOR	LIST
FVB120NG	120V	Green	$2.00
FVB120NR	120V	Red	$2.00

Neon Lamp

DISCOUNT SCHEDULE **A**

NOTE: Discount Schedule A does not apply to Lamp Removal Tool.

30MM REPLACEMENT LAMP REFERENCE CHART (FOR REFERENCE ONLY - USE CHARTS ABOVE TO ORDER)

OPERATOR CODE	OPERATOR VOLTAGE	LED (ALL COLORS)	INCANDESCENT	NEON
FVLU6	Full Voltage 6V AC/DC	LED6	FVB6 or FVB6F	—
FVLU12	Full Voltage 12V AC/DC	LED12	FVB12	—
FVLU24	Full Voltage 24V AC/DC	LED24	FVB24	—
FVLU120	Full Voltage 120V AC/DC	LED120	FVB120	FVB120NG or FVB120NR
TFLU120	Transformer 120V AC	LED6	FVB6 or FVB6F	—
TFLU240	Transformer 240V AC	LED6	FVB6 or FVB6F	—
TFLU277	Transformer 277V AC	LED6	FVB6 or FVB6F	—
TFLU480	Transformer 480V AC	LED6	FVB6 or FVB6F	—
RLU120L	Resistor 120V AC/DC*	LED24	—	—
RLU120I	Resistor 120V AC/DC*	—	FVB55	—
RLU240L	Resistor 240V AC/DC*	LED24	—	—
RLU240I	Resistor 240V AC/DC*	—	FVB120	—
RLU240N	Resistor 240V AC/DC*	—	—	FVB120NG or FVB120NR
RLU480N	Resistor 480V AC/DC*	—	—	FVB120NG or FVB120NR
RTLU6	Dual Input 6V AC/DC	LED6	FVB6	—
RTLU12	Dual Input 12V AC/DC	LED12	FVB12	—
RTLU24	Dual Input 24V AC/DC	LED24	FVB24	—
RTLU120	Dual Input 120V AC/DC	LED120	FVB55	

*NOTE: Lamps are unique to Resistor Light Units. Refer to side of light unit for correct replacement lamp part number.

30MM INDUSTRIAL PILOT DEVICES

ELECTRICAL RATINGS

Lamp	Industry Number	Rated Volts	Lumens (MSCD)	Design Life (Hrs.)	Current Draw (mA)	Lamp Type	Shock & Vibration	Leakage Protection
FVB6	1866	6.3V	0.65	5,000	250	Incandescent	Very Good	N/A
FVB12	756	14V	0.31	15,000	80	Incandescent	Good	N/A
FVB24	757	28V	0.62	7,500	80	Incandescent	Good	N/A
FVB55	1835	55V	1.1	5,000	50	Incandescent	Good	N/A
FVB120	**	130V	0.36	10,000	20	Incandescent	Good	N/A
LED6	**	6V	Varies w/ Color 2000 mcd Typical	100,000	50	LED	Excellent	14 mA
LED12	**	12V		100,000	<20	LED	Excellent	4 mA
LED24	**	24V		100,000	<20	LED	Excellent	4 mA
LED48	**	48V		100,000	<20	LED	Excellent	3 mA
LED120	**	120/130V		100,000	<10	LED	Excellent	2 mA
FVB120NG	—	95-135V	Typical (Glows)	25,000	<5	Neon/Green	Very Good	N/A
FVB120NR	—	95-135V	Typical (Glows)	25,000	<5	Neon/Red	Very Good	N/A

**Designates a lamp design optimized for c3controls Illuminated devices. See LED replacement lamps on page 121.

DIELECTRIC STRENGTH (TERMINAL TO GROUND) 2200V for 1 Minute

STANDARD CONTACTS

	Utilization Category					
		IEC	UL	Make Rating	Break Rating	Ith-Thermal Current
	AC	AC-15	A600	7200VA	720VA	10A
	DC	DC-13	P300	138VA	138VA	5A

Note: For AC voltage below 72VAC the max. allowed switching current is 10A= Ith

For DC voltages below 28VDC the max. allowed switching current is 5A=Ith

For switching applications below 24V/40mA - Hermetic REED contacts are recommended. Hermetic Reeds are also excellent in environments containing chemical vapors, oxidizing agents, and explosive gases. Please refer to the HAZARDOUS section of the Series 30 devices for more information. Available on c3controls' 30MM products only.

ENVIRONMENTAL RATINGS

TYPE 1, 2, 3, 3R, 4/4X, 12, 13, and IP65

Operating Temperature
-40 to +131° F (-40 to +55° C)

Storage Temperature
-40 to +185° F (-40 to +85° C)

Operating environments below freezing temperatures are assumed to be absent of freezing liquids or pollutants.

TERMINAL & WIRING CONSIDERATION

Wire- AWG 22-12 CU
(Copper Only – Solid & Stranded) [.5 ~ 4 mm^2]
One or Two wires permitted per termination

Recommended Tightening Torque
7 lb-in (+3.0/-0.0 lb-in) — [.8 Nm]

MECHANICAL DESIGN LIFE CYCLES

Pushbuttons	
Momentary	5,000,000
Maintained	250,000
Selector Switches	500,000
All Other Devices	250,000
Standard Contact Blocks	10,000,000
Indicating Lights – Refer to the appropriate Lamp Data	

OPERATING FORCES

Pushbuttons (Operator Only)	
Momentary	1.3 lbs. [5.8 N]
Illuminated Momentary	2.8 lbs. [12.4 N]
Maintained	4 to 6 lbs. [17.9~26.7 N]
Illuminated Maintained	4.6 lbs. [20.5 N]
Reset Pushbutton	1.5 lbs. [6.7 N]
Selector Switches	
Maintained	1.7 in-lbs [.19 Nm]
Momentary	1.7 in-lbs [.19 Nm]
Key Operated	1.7 in-lbs [.19 Nm]
Cable Pull	
Standard	4 to 6 lbs. [17.9~26.7 N]
Heavy Duty	13 lbs. [57.8 N]
Push-Twist Release	4.7 lbs. [20.9 N]
Potentiometer 2 Watt "J" Series	3-12 in-oz. [.11 Nm Max.] (300° Rotation)
Standard Contact Blocks	1 lb. [4.45 N]
Indicating Lights	Refer to the appropriate Lamp Data
Multi-Voltage Light	20-240 VAC/VDC (Burden .65W max.)
Transformer	2 VA

MATERIALS

Thermoplastic Polyester and Polyester Blends (UV Stabilized for outdoor use)
- Operator Housings
- Operator Caps and Handles - Non-Illuminated (Glass Reinforced Grades)
- Mounting Rings and Nuts
- Thrust Washer
- Trim Washer

High Impact Polycarbonate (UV Stabilized for outdoor use)
- Pilot Light Lens
- Transparent PB and Mushroom Caps

Custom Polymers
- Certain CAM and Bearing parts are Teflon, Silicone, & Moly-Disulfide Impregnated for improved wearability
- Fluorosilicone and Thermoplastic Neoprene Boot Accessories

Seals
- Neoprene Gaskets
- Thermoplastic – Molded Neoprene and alloy derivitives
- BUNA N – Rubber – Teflon Coated
- Thermoplastic – Elastomer Molded Seals
- Fluorosilicone – Boots

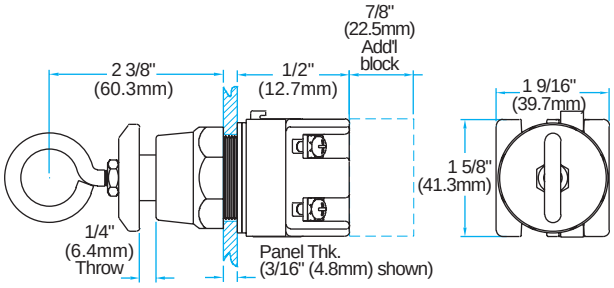
Metal: Brass & Stainless Steel
- Push Pull Bushings
- Internal tubes for Maintained Devices
- Detents for Maintained Devices
- Springs (Stainless Steel throughout)

Aluminum
- Optional Mounting Nut

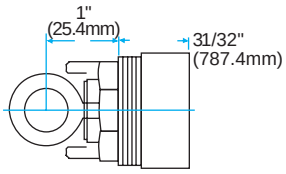
CABLE PULL OPERATORS

Fully-assembled operators come standard with one 3/16" (4.8mm) and three 1/16" (1.6mm) gaskets.
See page 127 for mounting gasket specifications.

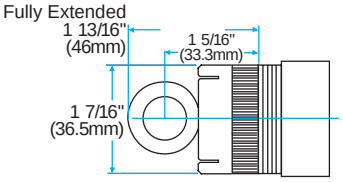
Push-Pull Maintained Cable Pull Operator



Momentary and Heavy Duty Cable Pull Operators



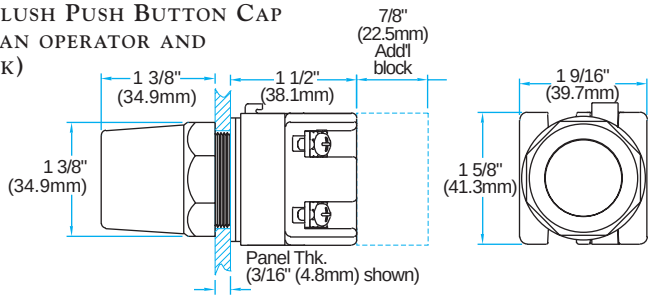
Momentary Booted Cable Pull Operator



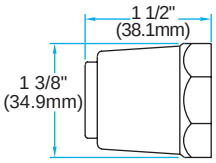
MAINTAINED FLUSH & EXTENDED PUSH BUTTON CAPS

Fully-assembled operators come standard with one 3/16" (4.8mm) and three 1/16" (1.6mm) gaskets.
See page 127 for mounting gasket specifications.

Maintained Flush Push Button Cap (shown with an operator and contact block)



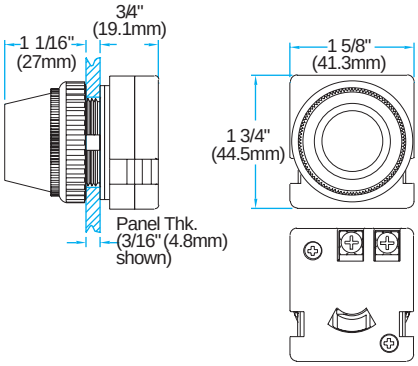
Maintained Extended Push Button Cap



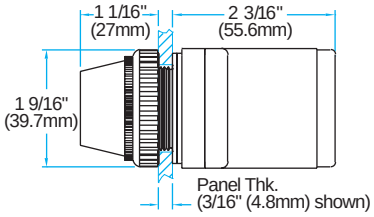
PILOT LIGHTS

Fully-assembled operators come standard with one 3/16" (4.8mm) and two 1/16" (1.6mm) gaskets.
See page 127 for mounting gasket specifications.

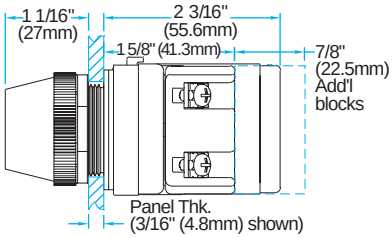
Full Voltage Pilot Light Operator (shown with PLL)



Transformer & Resistor Pilot Light Operators (shown with PLL)



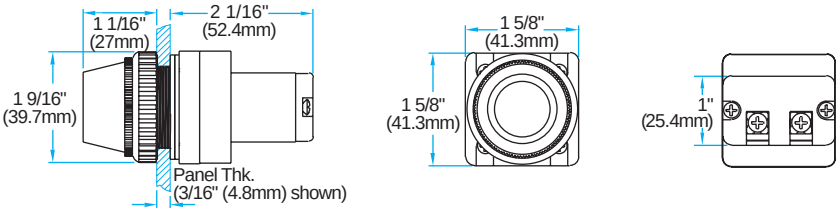
Dual Input Pilot Light Operator (shown with PLL)



MULTI-VOLTAGE PILOT LIGHT

Fully-assembled operators come standard with four 1/16" (1.6mm) gaskets.
See page 127 for mounting gasket specifications.

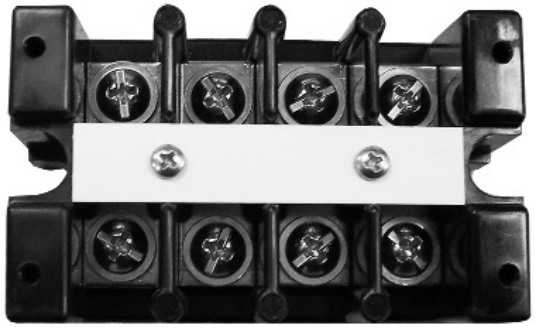
Multi-Voltage Pilot Light (shown with PLL)



Terminal Block

1500 Series

600 Volts

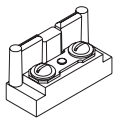


Specifications:

- Base, General Purpose Phenolic, 150° C
- Connector, Brass, Nickel Plated
- Screws, Brass, Nickel Plated, 10-32
- Rated 30 Amps with unprepared wire, #10-16 AWG Copper
- Rated 75 Amps with properly terminated wire
- 5/8" Line To Line Spacing
- UL Recognized File No. #E62806
- CSA Certified File No. LR19766
- CE

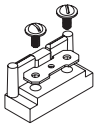
Catalog #:	# of Poles	Catalog #:	# of Poles
1504 STD	4	1504 ST	4
1506 STD	6	1506 ST	6
1508 STD	8	1508 ST	8
1512 STD	12	1512 ST	12
1504 DJ	4	1504 SC	4
1506 DJ	6	1506 SC	6
1508 DJ	8	1508 SC	8
1512 DJ	12	1512 SC	12
1504 DJSV	4	1504 H	4
1506 DJSV	6	1506 H	6
1508 DJSV	8	1508 H	8
1512 DJSV	12	1512 H	12

1500 STD



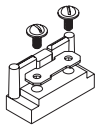
Standard Connector

1500 DJ



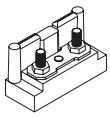
Removable Connector With Brass Insert

1500 DJSV



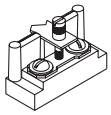
Removable Connector With Brass Insert Removable Cover

1500 ST*



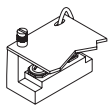
10-32 Stud Removable Connector

1500 SC



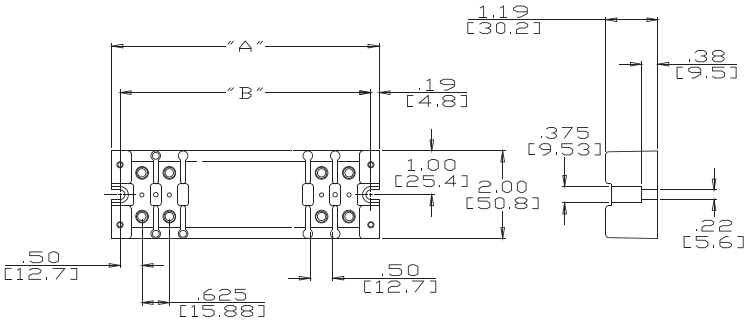
Short Circuiting Bar With Brass Insert 4 Shorting Pins Per Block

1500 H



Standard Connector With Hinge Cover

* STRC: 10-32 Stud with Riveted Connector
MCJ-Jumper Available



Catalog #:	# of Poles	A	B
1504	4	3.25	2.88
1506	6	4.50	4.12
1508	8	5.75	5.38
1512	12	8.25	7.88

MM = Dim X 25.4

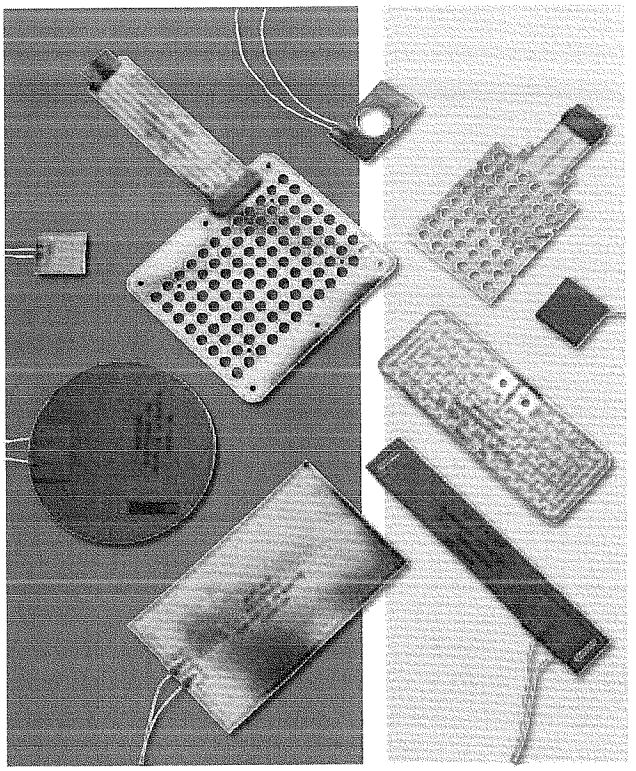
Space Heater

Flexible Heaters

Flexible Shapes and Geometries

Flexible heaters from Watlow are just what the name implies: thin, bendable and shaped to fit most any equipment. Heat can be applied to the most complex shapes and geometries, without sacrificing efficiency or dependability.

Excellent heat transfer results from the heater's thin design and its direct bonding to the application. Flexible heaters also provide fast heat-up and cool-down rates, uniform heat distribution and high watt densities.



Features and Benefits

Flat geometry
- Permits holes, notches and unusual shapes

Option of two material types and two element styles
- Allows for wider flexibility

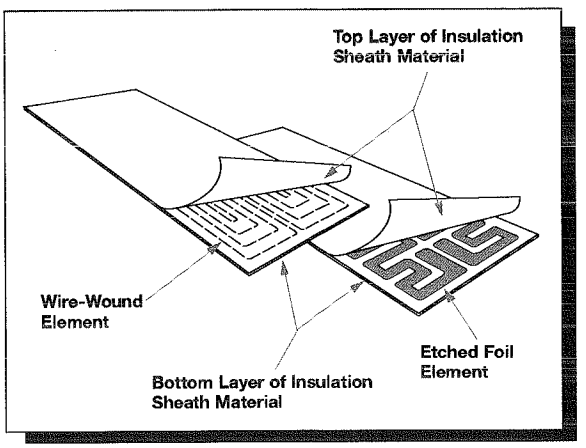
Lightweight construction and low thermal mass
- Permits use in applications that have limited space or weight requirements

Close heating elements as close as 0.003 in. (0.08 mm)
- Creates faster heat-up and cool-down time

Uniformly spaced element paths
- Distributes heat more evenly

Typical Applications

- Medical equipment such as blood analyzers, respiratory therapy units and hydrotherapy baths
- Semiconductor equipment
- Foodservice equipment
- Battery heating
- Satellite and communication equipment
- Freeze protection for military hardware, aircraft instrumentation, hydraulic equipment, etc.
- Any application requiring a flexible shape or design



Flexible Shapes and Geometries

Applications and Technical Data

Two Material Types

Silicone Rubber

This rugged, moisture- and chemical-resistant material is easily bonded or adhered to parts. Watlow silicone rubber heaters can handle temperatures up to 500°F (260°C). Many styles of these heaters are available with UR®, cUR®, VDE and CE recognition.

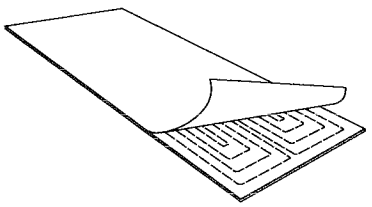
Polyimide

Polyimide is a thin, lightweight transparent material and is designed for precise heating requirements ranging from -319° to 392°F (-195° to 200°C). It is ideal for applications requiring low outgassing in a vacuum, or resistance to radiation, fungus and chemicals. Many custom heaters can be UR® and cUR® recognized.

Two Element Types

Watlow offers both wire-wound and etched foil resistance elements. These element types are available in most insulating materials, and Watlow can recommend the type best suited to your application.

Wire-Wound Elements

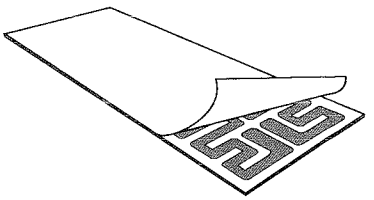


Available on silicone rubber heaters, this element style is created by spiraling fine resistance wires around a fiberglass cord. The element is then laid out in a pattern designed specifically for a specific application. The benefits of wire-wound elements include:

- Its excellent physical strength and flexibility; repeated flexing of the heater has no harmful effects on its performance
- The ability to conform readily to curved surfaces, including small radius bends

Drum heaters and conduit bender heaters are typical examples of applications that use the wire-wound method. These heaters are flexed repeatedly during use, but due to their wiring, no internal damage will occur.

Etched Foil Elements



This element type, created by acid etching a circuit in nickel alloy resistance foil, is available in silicone rubber and polyimide heater types. The etched foil element is noted for its excellent circuit pattern repeatability and superior heat transfer, which results from greater area coverage of the element. Other benefits include:

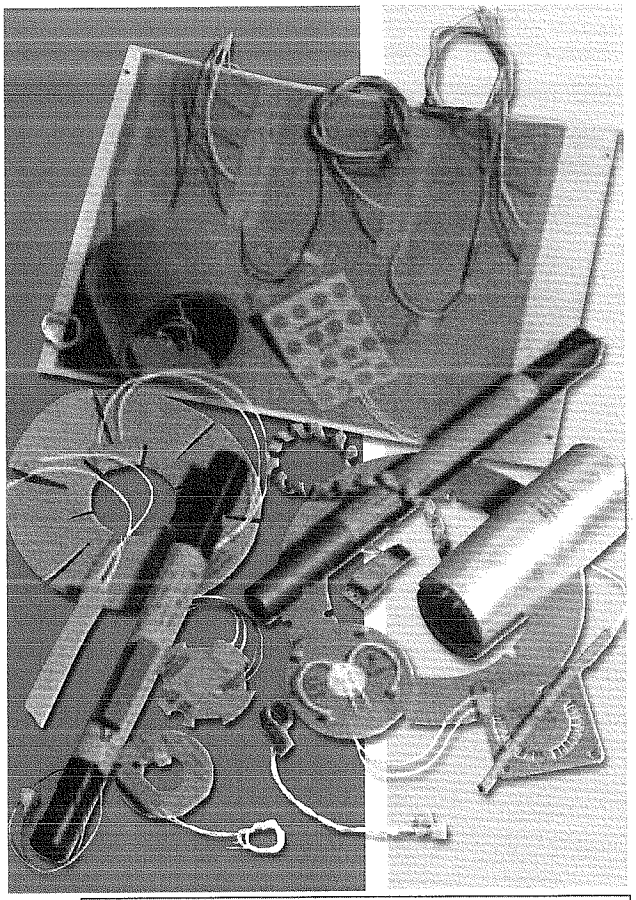
- The delivery of more heat and up to twice the watt density of a wire-wound element, thus providing longer heater life
- Complex heat distribution patterns

The etched foil element style is usually recommended for applications requiring high temperatures, watt densities, or multiple zoning.

Silicone Rubber Heaters

Rugged, yet thin, lightweight and flexible—the use of Watlow® silicone rubber heaters is limited only by the imagination. With these heaters, heat can be put where it is needed. In the application process these heaters improve heat transfer, speed warm ups and decrease wattage requirements.

Fiberglass-reinforced silicone rubber gives the heater dimensional stability without sacrificing flexibility. Because very little material separates the element from the part, heat transfer is rapid and efficient. The heaters are constructed with a wire-wound element or an etched foil element. The heater construction creates a very thin heater allowing it to fit applications where space is limited.



Performance Capabilities

- Operating temperatures up to 500°F (260°C)
- Watt densities up to 80 W/in^2 (12.5 W/cm^2), dependent upon application temperature
- Wire-wound element thickness — 0.055 in. (1.4 mm)
- Etched foil element — 0.022 in. (0.56 mm)
- UR®, cUR®, VDE and CE recognitions are available on many designs up to 428°F (220°C)

Features and Benefits

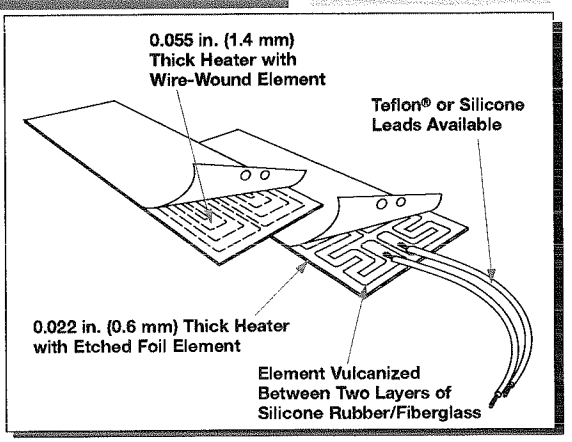
Designed to the exact shape and size needed
- Conforms to your component and/or equipment

More than 80 designs available immediately from stock
- Reduces downtime

Constructed with wire-wound or etched foil elements
- Delivers a thin, lightweight heater
- Provides the desired flexibility for many dynamic applications
- Delivers low mass and easily repeatable distributed watt densities

Moisture and chemical-resistant silicone rubber material
- Provides longer heater life

Vulcanizing adhesives or fasteners
- Allows heaters to be easily bonded to the part



Typical Applications

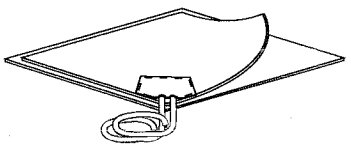
- Freeze protection and condensation prevention for many types of instrumentation and equipment
- Medical equipment such as blood analyzers and test tube heaters
- Computer peripherals such as laser printers
- Curing of plastic laminates
- Photo processing equipment
- Semiconductor processing equipment

Silicone Rubber Heaters

Mounting Methods

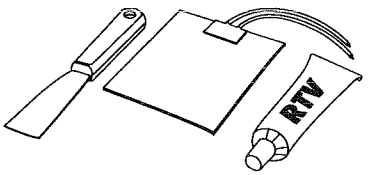
Watlow offers various attachment techniques, all designed for fast installation. These include three types of adhesives and mechanical fasteners.

Pressure Sensitive Adhesive Surface (PSAS)



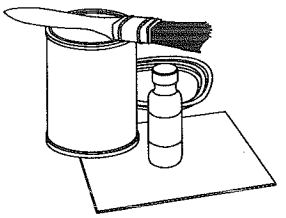
For speed, convenience and economy of installation, specify PSAS. Simply peel off the protective backing and roll the heater in place for an even bond to a clean, smooth surface. PSAS is not recommended for curved surfaces or for heaters rated above 10 W/in^2 (1.5 W/cm^2). It should not be used for applications exceeding 400°F (205°C) on silicone rubber and 300°F (150°C) on polyimide.
Note: PSAS has a maximum six months storage life before heater installation when stored at or below 86°F (30°C)

Field Applied Adhesive



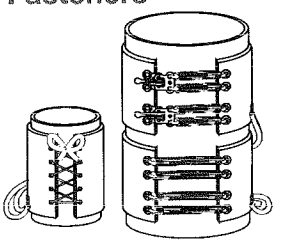
For a stronger bond, or when long storage is probable, a room temperature vulcanizing (RTV) silicone adhesive is available within two days. Watlow offers red RTV for temperatures up to 500°F (260°C). White RTV is available from adhesive suppliers for temperatures up to 400°F (205°C). Watlow's one-part RTV is self-priming and can be ordered in either 3 oz (90 ml) or 12 oz (355 ml) tubes. For larger heaters requiring longer adhesive working time, two-part RTV kits can be purchased from adhesive suppliers. These kits require primer on the surface prior to application of the adhesive.
Note: Not recommended for polyimide heaters.

Silicone Contact Cement Kit



This two-part adhesive consists of a resin and catalyst that are easily mixed together and applied with a paintbrush. Recommended usage is for field cementing of silicone rubber heaters to customer parts. Available for immediate delivery, the cement kit will handle temperatures up to 350°F (175°C). The resin is available in pint or quart containers. To order, specify **silicone contact cement** and the container size.

Mechanical Fasteners



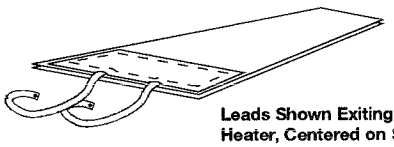
When a wire-wound flexible heater must be detachable, any type of fastener normally used with fabrics can usually be built into the sheath material of Watlow flexible heaters. The most common types are latch fasteners, boot hooks and grommets. Other styles include snap fasteners, springs and lacing cord. (Hook and loop style fastener strips are only available as part of the extended capabilities offering.) The grommets and boot hooks are commonly used with tension springs to compensate for slight variations in part size.

Silicone Rubber Heaters

Termination Styles

Watlow offers many types of leads and terminations. Leads can project from any position along the perimeter of the unit. **They will be centered on the short side width of rectangular heaters unless otherwise specified.**

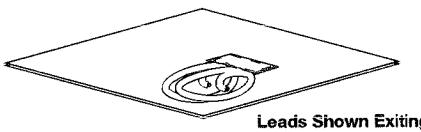
Teflon® UL®1180 CSA



Leads Shown Exiting End of Heater, Centered on Short Side

Watlow's leads are 12 in. (305 mm) long, white, Teflon® insulated, flexible, plated copper UL® 1180 CSA wire. They are rated for 392°F (200°C)/300V. The lead connections on or at the heater are insulated with a cap of sheath material, vulcanized to the heater body.

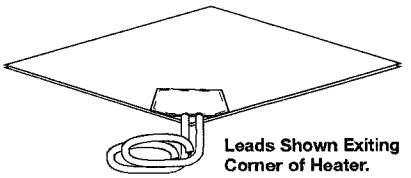
Teflon® Leads



Leads Shown Exiting Middle of Heater.

Teflon® Type E (MIL-W-16878) and Teflon® UL® 1199 rated for 392°F (200°C)/600V are also available.

Silicone Insulated Leads

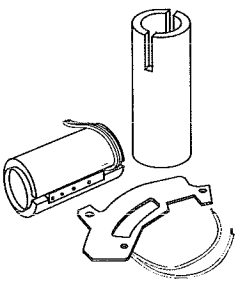


Leads Shown Exiting Corner of Heater.

For a better moisture seal, specify UL® silicone insulated lead wires. This lead type is rated for 302°F (150°C)/ 600V. Any lead length is available. **Note:** Silicone rubber heaters are not designed to be waterproof. Excess exposure to moisture may facilitate premature heater failure.

Option

Thermal Insulation



To increase the heating efficiency of your application, silicone rubber heaters can be thermally insulated with silicone sponge rubber, bonded to one side in the following thicknesses: 1/16, 1/8, 1/4, 3/8 or 1/2 in. (1.6, 3.2, 6, 9.5 or 13 mm)

An aluminized surface can be added to the back of the heater to reduce radiated heat losses. This aluminized surface, called "low loss treatment," adds very little to the unit thickness and maintains a very clean appearance.

Silicone Rubber Heaters

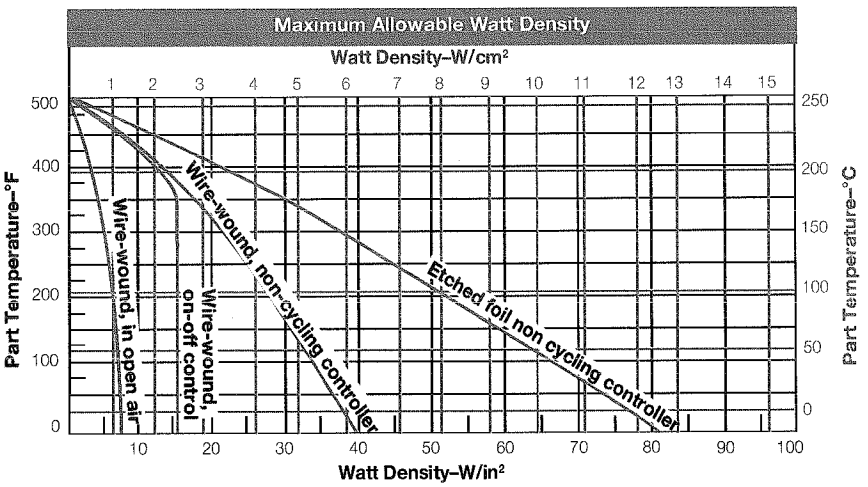
Applications and Technical Data

Determining Watt Density

The *Maximum Allowable Watt Density* graph illustrates the maximum recommended heater watt density at various metal parts or ambient air temperatures. However, it does not indicate the watt density necessary to achieve a given part temperature. See the *Surface Temperature vs. Time* graph on the next page for assistance with those calculations. When using this graph, remember:

- Part temperature is measured at the point where the heater contacts the metal part.
- Thermostats and on-off controllers are typically bimetal or capillary bulb.
- Non-cycling controllers are typically solid state, time-proportioning or silicone controlled rectifier (SCR) temperature controllers.
- Watt density values should be de-rated by one third if insulation is used.
- UL® recognition temperature limits are not detailed.
- Contact your Watlow representative before doing either of the following: selecting high watt density etched-foil elements or operating heaters with back side insulation or non-metallic parts, which are poor thermal conductors.

Example: A wire-wound heater with non-cycling controller at a part temperature of 250°F (120°C) can be rated at 24 W/in² (3.7 W/cm²) maximum. An etched foil heater under the same conditions can be rated at 45 W/in² (7 W/cm²) maximum.



Silicone Rubber Specifications

Max. width x max. length

- Wire wound: 36 x 120 in. (914 mm x 3048 mm)
- Etched foil: 18 x 34 in. (457 mm x 863 mm)

Thickness

- Wire wound: 0.055 in. (1.4 mm)
- Etched foil: 0.022 in. (0.6 mm)

Weight

- Wire wound: 8 oz/ft² (0.24 g/cm²)
- Etched foil: 3 oz/ft² (0.09 g/cm²)

Max. operating temperature: 500°F (260°C)

Max. temperature for UL® recognition: 428°F (220°C)

Min. ambient temperature: -80°F (-62°C)

Max. voltage: 600V

Max. wattage: see watt density graph

Lead size: sized to load

Lead length: 12 +1½ -½ in. (305 mm +38 mm -13 mm)

Wattage tolerance

- Wire: ±5%
- Foil: +5% -10%

Dimensional tolerances

- 0 to 6 in. (0 to 152 mm): ±1/16 in. (1.59 mm)
- 6 to 18 in. (152 to 457 mm): ±⅛ in. (3.18 mm)
- 18 to 36 in. (457 mm to 914 mm): ±3/16 in. (4.76 mm)
- Over 36 in. (914 mm): ±1%

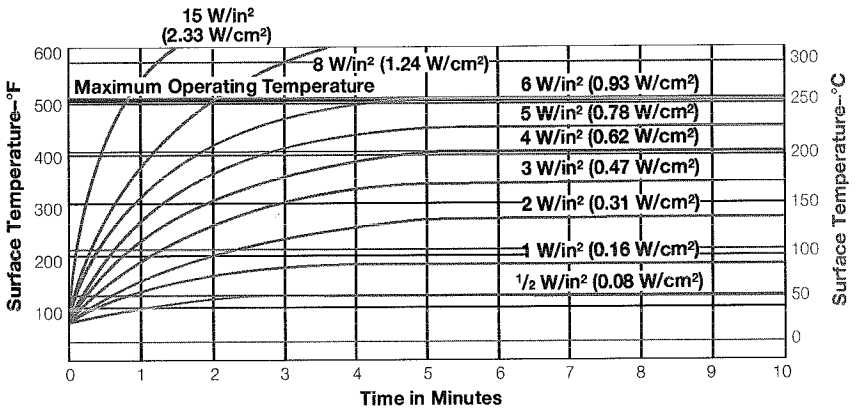
Silicone Rubber Heaters

Applications and Technical Data *(Continued)*

Surface Temperature vs. Time

This graph illustrates the surface temperature a silicone rubber heater will reach when the heater is uninsulated and is suspended vertically in 70°F (20°C) still air.

This data is based on 0.055 in. (1.4 mm) thick construction and is offered as a reference tool.



UR®, cUR®, VDE and CE Recognition for Silicone Rubber Heaters

Watlow frequently works with customers requiring agency approvals such as UR®, cUR®, VDE and CE. Many silicone rubber heaters are available with one or more of these certifications.

UL® Component Recognition (UR®) of factory-bonded heaters is available up to 392°F (200°C) and for customer installed heaters up to 428°F (220°C) (UL® File No. E52951).

For Canadian recognition Watlow offers **cUR® Recognized** silicone rubber heaters under UL® File #E52951. Several constructions are available with ratings to 600V and 428°F (220°C) maximum surface temperature. Contact your Watlow representative for further information.

VDE Approval is available on several constructions of both wire-wound (File No. 62533) and etched foil (File No. 62535) silicone rubber heaters. The maximum ratings are 440V and 428°F (220°C) surface temperature. Under VDE guidelines, minimum installed bend radius is ⅛ in. (3.2 mm) for etched foil and ¼ in. (6 mm) for wire wound. VDE also states that the user is responsible for the safe application, installation and wiring of the heaters. Maximum working temperature must be maintained by an appropriate temperature controller.

The **CE mark** is available on UR® and/or VDE recognized heaters.

Options

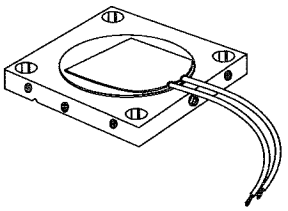
Watlow offers a variety of options such as attachment techniques, thermostats, special leads, holes and cutouts and three-dimensional shapes. These are all described in the introduction to flexible heaters section.

EXTENDED CAPABILITY

Extended Capabilities For Silicone Rubber Heaters

Mounting Methods

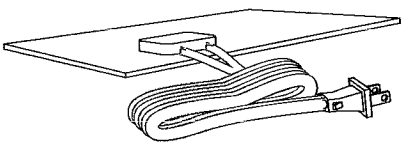
Factory Bonding



This attachment technique provides a strong, void-free bond for excellent heat transfer and extended heater life. Watlow's expertise in bonding heaters to customer parts has proven extremely successful. Bonding is recommended for applications that reach maximum temperatures of 500°F (260°C) on silicone rubber and 300°F (150°C) on polyimide.

Termination Styles

HPN Cord and Plug Set

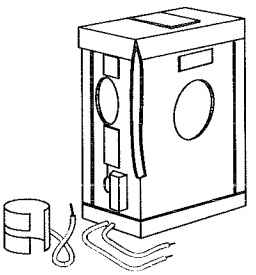


Molded Leads are Shown Exiting Edge of Heater. Capped Leads are also Available.

For removable heaters, a 6 ft (1.8 m) HPN cord and plug set provides convenience. It is rated for 194°F (90°C)/ 300V. HPN cord without a plug is also available in any length.

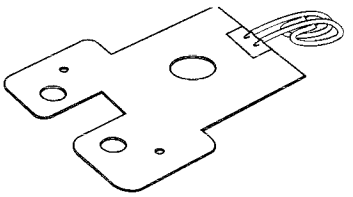
Construction

Formed Heaters



Many three-dimensional shapes, such as cylinders, cones and boxes, can be factory formed. Semi-rigid shapes can be self-gripping to the part. Special tooling may be required for some designs.

Holes, Cutouts and Notches



Watlow can provide flexible heaters with special holes, cutouts and notches in nearly any position required for your design. The resistance element can be brought to within ⅛ in. (3.2 mm) of all edges. Standard spacing is ¼in. (6 mm) from all edges.

Silicone Rubber Heaters

Wire-Wound Elements — RAPID SHIP Offering

Width in.	Width (mm)	Length in.	Length (mm)	Watts	120VAC Code Number	120/240VAC Code Number
1	(25)	2	(51)	10	**010020C1***	
		3	(76)	15	**010030C1***	
		4	(102)	20	**010040C1***	
		5	(127)	25	**010050C1***	
		5	(127)	6.25/25		**010050C2***
		10	(254)	50	**010100C1**	
		10	(254)	12.50/50		**010100C2***
		15	(381)	75	**010150C1**	
		15	(381)	18.75/75		**010150C2**
		20	(508)	100	**010200C1**	
		20	(508)	25/100		**010200C2**
		25	(635)	125	**010250C1**	
		30	(762)	150	**010300C1**	
		35	(889)	175	**010350C1**	
		40	(1016)	200	**010400C1**	
		80	(2032)	400	**010800C1**	
		120	(3048)	600	**010F10C1**	
2	(51)	2	(51)	20	**020020C1***	
		5	(127)	50	**020050C1**	
		5	(127)	12.50/50		**020050C2***
		10	(254)	100	**020100C1**	
		10	(254)	25/100		**020100C2**
		15	(381)	150	**020150C1**	
		15	(381)	37.50/150		**020150C2**
		20	(508)	200	**020200C1**	
		20	(508)	50/200		**020200C2**
		25	(635)	250	**020250C1**	
		30	(762)	300	**020300C1**	
		35	(889)	350	**020350C1**	
		40	(1016)	400	**020400C1**	
3	(76)	3	(76)	45	**030030C1**	
		5	(127)	75	**030050C1**	
		5	(127)	18.75/75		**030050C2**
		10	(254)	150	**030100C1**	
		10	(254)	37.50/150		**030100C2**
		15	(381)	225	**030150C1**	
		15	(381)	56.25/225		**030150C2**
		20	(508)	300	**030200C1**	
		20	(508)	75/300		**030200C2**
		25	(635)	375	**030250C1**	
		30	(762)	450	**030300C1**	
		35	(889)	525	**030350C1**	
		40	(1016)	600	**030400C1**	

CONTINUED

RAPID SHIP
- 2 to 5 day shipment

*** Due to the high resistance, these heaters are not recommended for curved or flexing applications.**

Notes:
- Thickness 0.055 in. (1.4 mm)
- Heaters have lead length of 12 in. (305 mm) UL® 1180 Teflon®
- UL® component recognition
- Silicone rubber wire-wound elements rated at 5 W/in² (0.78 W/cm²)

Silicone Rubber Heaters

Wire-Wound Elements — RAPID SHIP Offering (Continued)

Width in.	Width (mm)	Length in.	Length (mm)	Watts	120VAC Code Number	120/240VAC Code Number
4	(102)	4	(102)	80	**040040C1**	
		5	(127)	100	**040050C1**	
		5	(127)	25/100		**040050C2**
		10	(254)	200	**040100C1**	
		10	(254)	50/200		**040100C2**
		15	(381)	300	**040150C1**	
		15	(381)	75/300		**040150C2**
		20	(508)	400	**040200C1**	
		20	(508)	100/400		**040200C2**
		25	(635)	500	**040250C1**	
		30	(762)	600	**040300C1**	
		35	(889)	700	**040350C1**	
		40	(1016)	800	**040400C1**	
5	(127)	5	(127)	125	**050050C1**	
		5	(127)	31.25/125		**050050C2**
		10	(254)	250	**050100C1**	
		10	(254)	62.50/250		**050100C2**
		15	(381)	375	**050150C1**	
		15	(381)	9.38/375		**050150C2**
		20	(508)	500	**050200C1**	
		20	(508)	125/500		**050200C2**
		25	(635)	625	**050250C1**	
		30	(762)	750	**050300C1**	
		35	(889)	875	**050350C1**	
		40	(1016)	1000	**050400C1**	
6	(152)	5	(127)	150	**060050C1**	
		5	(127)	37.50/150		**060050C2**
		10	(254)	300	**060100C1**	
		10	(254)	75/300		**060100C2**
		15	(381)	450	**060150C1**	
		15	(381)	112.50/450		**060150C2**
		20	(508)	600	**060200C1**	
		20	(508)	150/600		**060200C2**
		25	(635)	750	**060250C1**	
		30	(762)	900	**060300C1**	
		35	(889)	1050	**060350C1**	
		40	(1016)	1200	**060400C1**	

RAPID SHIP
- 2 to 5 day shipment

*** Due to the high resistance, these heaters are not recommended for curved or flexing applications.**

Notes:
- Thickness 0.055 in. (1.4 mm)
- Heaters have lead length of 12 in. (305 mm) UL® 1180 Teflon®
- UL® component recognition
- Silicone rubber wire-wound elements rated at 5 W/in² (0.78 W/cm²)

Silicone Rubber Heaters

Wire-Wound Elements — RAPID SHIP Offering Coding Configured Options

To order, complete the code number with the information below:

Wire Wound

0_____-_ _ _ _ _

Modification Options
0 = None
A = PSAS bottom
B = PSAS top
E = With plate, heater on side opposite flange
F = With plate, heater on flange side
G = Flaps + grommets
H = Flaps + boot hooks
J = Flaps + latch fasteners
K = PSAS and low loss
L = Low loss
M = Low loss + flaps + grommets
N = Low loss + flaps + boot hooks
P = Low loss + flaps + latch fasteners
R = 1/16 in. sponge
S = 1/8 in. sponge
T = 1/4 in. sponge
U = 3/8 in. sponge
V = 1/2 in. sponge
W = PSAS + 1/16 in. sponge
Y = PSAS + 1/8 in. sponge
1 = PSAS + 1/4 in. sponge
2 = PSAS + 3/8 in. sponge
3 = PSAS + 1/2 in. sponge

Sensors

Type	LOC	WIR
0 = None		
L = T10	STD	STD
M = T10	STD	ALT
N = T10	ALT	STD
P = T10	ALT	ALT
R = T207	STD	STD
S = T207	STD	ALT
T = T207	ALT	STD
U = T207	ALT	ALT
V = T207E	On heater	STD
W = T207E	Remote	STD
Y = B200	STD	STD
1 = B200	STD	ALT
2 = B200	ALT	STD
3 = B200	ALT	ALT
4 = JSTD	STD	STD
6 = JALT	STD	STD
7 = KSTD	STD	STD

- For thermostats, standard location is as shown in catalog; standard wiring is integral or in series with the heater, alternate location is rotated parallel with heater width, alternate wiring is separate leads for pilot control.
- For thermocouples, Type J standard is Teflon® insulation, Type J alternate is fiberglass insulation, Type K standard is fiberglass insulation.

T10 Set °F*
0 = None
A = 125
B = 150
E = 175
F = 200
G = 225
H = 250
J = 275
K = 300

T207 Set °F*
0 = None
1 = 40/55
2 = 60/75
3 = 95/110
4 = 145/160

B200 Set °F*
0 = None
2 = 100-500
3 = 25-330

T/C Length
0 = None
A = 8 in.
B = 12 in.
E = 18 in.
F = 24 in.
G = 30 in.
H = 36 in.
J = 40 in.
K = 4 ft
L = 5 ft
M = 6 ft
N = 7 ft
P = 8 ft
R = 9 ft
S = 10 ft
T = 12 ft
U = 15 ft
V = 18 ft
W = 20 ft
Y = 22 ft
1 = 25 ft
2 = 30 ft

*For all thermostats the heater must be a 2 in. (51 mm) min. width and 5 in. (127 mm) min. length.

Lead Insulation
0 = None
1 = 1180 UL® R/C
2 = 1180 C-UL® R/C
3 = 3133 22 GA
6 = 1199 CSA
7 = HPN
8 = 6 ft HPN set
9 = Type E Teflon®
A = 1180VDE*
B = 1199VDE*
C = Silicone leads w/waterproof cap
E = SJO cord
F = 6 ft SJO set

*1180VDE denotes a C-UL® heater plus a VDE stamp.

Lead Length*
A = 8 in.
B = 12 in.
E = 18 in.
F = 24 in.
G = 30 in.
H = 36 in.
J = 40 in.
K = 4 ft
L = 5 ft
M = 6 ft
N = 7 ft
P = 8 ft
R = 9 ft
S = 10 ft
T = 12 ft
U = 15 ft
V = 18 ft
W = 20 ft
Y = 22 ft
1 = 25 ft
2 = 30 ft

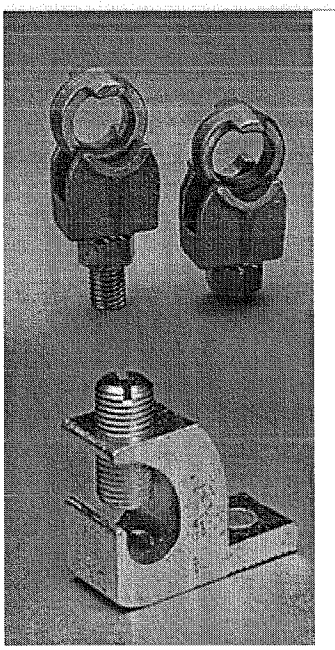
*Customer specified length must be noted in inches when ordering.

RAPID SHIP
- 2 to 5 day shipment

Ground Lug

PENN-UNION® 814.734.1631

HOME : SALES LOCATIONS : PRODUCTS : CUSTOMER SERVICE : COMPANY : CONTACT US



PRODUCT QUICK SEARCH:

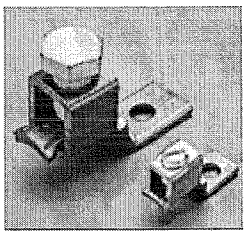
Penn Union Search:

Search

Competitor Search:

Search

Now In: Penn-Union Products → Mechanical Lugs & Splices → Copper Solderless & Soldering Lugs → SLU - Solderless Lug - Single Collar → SLU-35 - Copper Solderless Lug



SLU-35 - Copper Solderless Lug

One hole, single collar

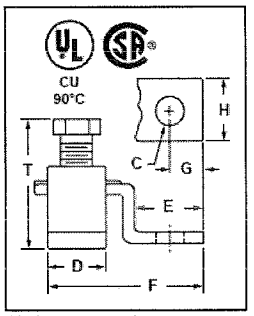
For copper stranded wire

100% pure electrolytic copper for utmost efficiency

Unique design of the concave pressure bar and V-bottom collar assures positive contact and firm, permanent grip

For tin plating, suffix catalog number with "-TN"

Product Drawing:



Click to expand.

Conductor Type	Conductor Range
Copper Stranded	14 - 6 Str.

Additional Details	
Ampere Rating:	30-50
UL Listing:	CU 90°C
CSA Listing:	Yes

Approximate Dimensions	
C (in.):	13/64
D (in.):	7/16
E (in.):	9/16
F (in.):	1 1/8
G (in.):	7/32
H (in.):	3/8
T (in.):	3/4

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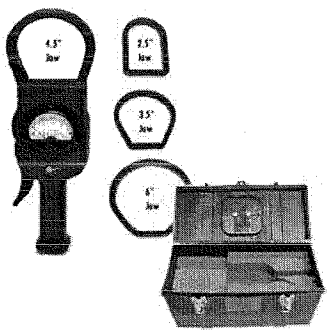
Phone: 814-734-1631 · Fax: 814-734-4946 · info@penn-union.com

Designed & Developed by O-Web Technologies, Ltd.

Ground Fault Clamp Ammeter

AC Clamp-On Ammeter / Ground Fault



Catalog #	Description	Jaw Size (in.)
50107-G-01	1/2/5/10/20/50 Amps	2.5
50107-G-02	1/2/5/10/20/Short Amps	2.5
50107-G-03	1/2/5/10/20/50 Amps	3.5
50107-G-04	1/2/5/10/20/Short Amps	3.5
50107-G-05	1/2/5/10/20/50 Amps	4.5
50107-G-06	1/2/5/10/20/Short Amps	4.5
50107-G-07	1/2/5/10/20/50 Amps	6
50107-G-08	1/2/5/10/20/Short Amps	6

NOTE: UNITS YOU WANT AS DIGITAL – SUBSTITUTE **-DIG-** FOR THE **-G-** in part number

Technical Details

- Ideal for preventative maintenance
- Will indicate ground faults and electrical leakage while the equipment is in operation
- Measures leakage current directly and locates faults
- Prevents shutdown time
- Tests without load interruption
- The unit is also excellent for checking splices for leakage
- Operates on single-phase and three-phase networks
- Use on a single cable or a bundle
- Clamps easily onto any size conductor (Choice of Jaw openings - 2½" , 3½", 4½", 6", 9")
- Convenient one-hand operation
- Maximum operating temperature range -5°F to +150°F (-20°C to +65°C)

Available Adapters

Hot Stick Adapter for Clamp Ammeter, 1/2 Set of Hot Sticks

These units have been purchased by customers such as: Powell, General Electric, SMUD, Square D, and the Bellagio Hotel (Las Vegas).

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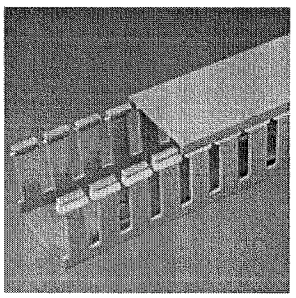
STB ELECTRICAL TEST EQUIPMENT INC.

50107-G-01 thru 50107-G-10
GROUND FAULT MODELS

- Ideal for preventative maintenance
- Will indicate ground faults and electrical leakage while the equipment is in operation
- Measures leakage current directly and locates faults
- Prevents shutdown time
- Tests without load interruption
- The unit is also excellent for checking splices for leakage
- Operates on single-phase and three-phase networks
- Use on a single cable or a bundle
- Clamps easily onto any size conductor (Choice of Jaw openings - 2½” , 3½”, 4½”, 6”, 9“)
- Convenient one-hand operation
- Maximum operating temperature range -5°F to +150°F (-20°C to +65°C)

Wiring Parts

G2X2LG6



Choose from 36 sizes of *PANDUIT*® Type G Wiring Duct from 0.5 "x 0.5" up to 6.0" x 4.0" in popular colors. Used for general purpose control panel wiring and to route and protect wiring in communication closets. The non-slip cover conceals all wiring and is easy to install. The duct and cover form a flush sidewall providing increased capacity and improved aesthetics.

Specifications
- Made of lead-free PVC
- UL Recognized continuous use temperature: 122 °F (50°C)
- UL94 Flammability Rating of V-0
- Conforms with NFPA 79-2002 section 14.3.1 requirement for flame retardant material
- Provided with mounting holes

Features and Benefits
- Wide finger/slot design provides greater sidewall rigidity and can be used with a wide range of wire bundle sizes
- *PANDUIT*® exclusive rounded edges protects hands and wiring/cabling from abrasion
- Non-slip cover stays in place during shipment, vibration and when in vertical orientation, eliminating rework
- Flush cover design holds 10-12% more wires than traditional duct designs
- Double scoreline allows quick modification for larger cabling bundles saving installation time leading to a lower installed cost
- Specially formulated lead-free material eliminates health concerns associated with PVC that contains lead
- Restricted slot design retains wire in slot for fast, easy wire installation or removal

Base and cover sold separately.

Part Number	G2X2LG6
RoHS Compliancy Status	Compliant
Part Description	Wide finger, slotted wiring duct.
Material	Lead–Free PVC
Color	Light Gray
CSA Certified	Yes
UL Recognized (File No. E147128)	Yes
Length (ft.)	6
CE Compliant	Yes
Duct Size W x H (In.)	2.25 x 2.12
Duct Size W x H (mm)	57.2 x 53.8
Mounting Method	Standard Mounting Holes
Pricing Description	Slotted Duct, PVC,2"X2"X6',LGRY
Slot Width (In.)	0.31
Slot Width (mm)	7.9
Cover Part Number	C2LG6
Min. Order UOM	PKG
Min. Order Qty.	6
BOM Qty. (# of Pkgs.)	0
Add to Favorite Product List	☐

Related Products
Panduct® Handheld ..
Panduct® Duct Fin ..
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Panduct® Nylon Riv ..
Panduct® Nylon Riv ..
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Please register to utilize the 'Bill of Materials', 'Submit Quotes' and 'Favorite Product List' features.

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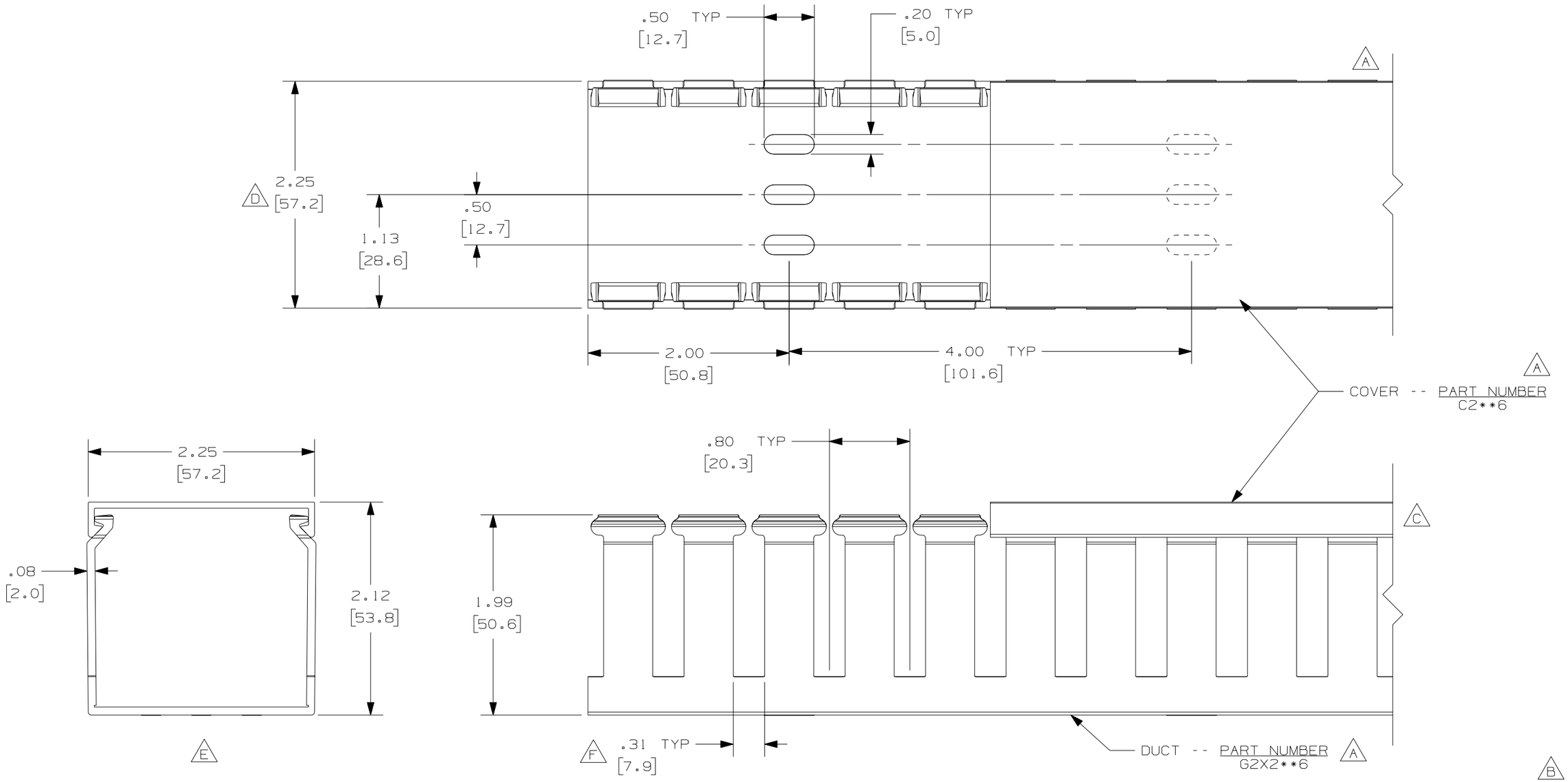


A G

NOTE.

1. ALL DIMENSIONS ARE REFERENCE ONLY.
2. DIMENSIONS IN PARENTHESES ARE METRIC.
3. THE ** DENOTE COLOR.
4. DUCT AND COVER ARE AVAILABLE IN 6 FT [1828.8] LENGTHS.

REV	DATE	BY	CHK	DESCRIPTION
--	--------	---	---	G. ADDED LENGTH NOTE F. CORRECTED PICK POINT / DIMENSION
2	--------	JCST	MKBE	E. DELETED DIMENSION D. ADDED DIMENSION
1	5/7/04	JCST	MKBE	B. CHANGED DRAWING SIZE C. CHANGED VIEW A. ADDED TOP VIEW, LABELS, AND NOTE
R	2/17/03	JCST	JGG	DRAWING RELEASED

CAD FILENAME/LAYERS: D110000R_DC_00C

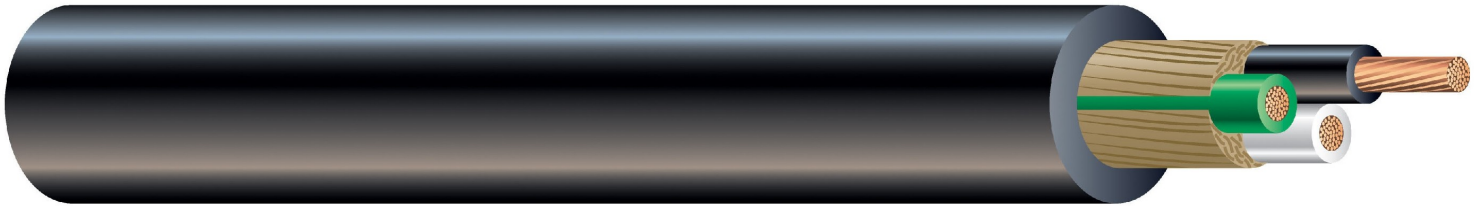
PANDUIT CORP. TINLEY PARK, ILLINOIS

WIRING DUCT - TYPE G WITH COVER
2 x 2
MARKETING DRAWING

DRAWN BY	MAT'L:	SCALE
JCST	PVC	FULL
DATE 2/17/03		DRAWING NO. 36897-705
CHECKED BY JGG		DWG B SIZE

QUANTUM® SEOOW

Southwire's Quantum® SEOOW 105°C TPE Cord. 600 Volts.
Black Jacket. Rated -50°C to 105°C. RoHS Compliant
Rated as Extra Hard-Usage Service Cord.
Sizes 18 AWG - 10 AWG CSA Certified as Type STOOW (TPE) and meet CSA FT-2.
Sizes 8-2 AWG are non-UL and non-CSA Listed.
Listed for Outdoor Use. Provides Premium Oil Resistance, Water Resistance and Flexibility.



APPLICATIONS

Southwire Type SEOOW Flexible Cords are permitted for use as specified by Article 400 and related articles of the National Electrical Code. Some typical applications for Type SEOOW Cords include wiring for industrial machinery, washing machines and various other large appliances, heavy-duty tools, motors, and temporary electrical power and lighting installations for construction sites. Type SEOOW Cords are suitable for use in (i) dry locations not to exceed minimum -50°C or maximum 105°C; or (ii) wet locations or other applicable locations - may be completely immersed in water - when exposed to oil or coolant at temperatures not to exceed 60°C. Type SEOOW cords are ideal for flex applications in harsh environments where the highest degree for oil resistance and extended service life are essential.

SPECIFICATIONS

- UL 62
- CSA Standard 22.2 No. 49
- MSHA flame resistance for Mining Applications
- Federal Specification J-C-580B
- NEC Article 400
- OSHA acceptable
- RoHS
- Sizes 8 AWG through 2 AWG are non-UL and non-CSA Listed, but meet industry accepted standards for the insulation and jacket thickness.

CONSTRUCTION

Southwire Type SEOOW Flexible Cords are manufactured using bare flexible stranded Class K copper conductors per ASTM B-174, and heat, moisture and oil resistant 105°C color-coded TPE insulation. The insulated conductors are cabled with non-wicking polypropylene fillers, with a tissue-paper separator wrapped around the assembly to promote easier removal of

Southwire
One Southwire Drive
Carrollton, Ga. 30119 USA

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the jacket. A heat, moisture and oil resistant flexible TPE jacket is extruded over the assembly to complete the construction. Some sizes may be subject to minimum order quantity.

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QuantumTPE SEOOW Black

Conductor Size (AWG)	Conductor Stranding (#/AWG)	Nominal Insulation Thickness (Inches)	Nominal Jacket Thickness (Inches)	Nominal Overall Diameter (Inches)	Weight (lbs/1000ft)	Ampacity*
18/2	16 X 30	0.030	0.060	0.350	52	10
18/3	16 X 30	0.030	0.060	0.370	64	10
18/4	16 X 30	0.030	0.060	0.395	78	7
16/2	26 X 30	0.030	0.060	0.375	63	13
16/3	26 X 30	0.030	0.060	0.395	80	13
16/4	26 X 30	0.030	0.060	0.425	96	10
16/5	26 X 30	0.030	0.080	0.500	135	8
14/2	41 X 30	0.045	80.00	0.505	131	18
14/3	41 X 30	0.045	0.080	0.530	167	18
14/4	41 X 30	0.045	0.080	0.575	206	15
14/5	41 X 30	0.045	0.095	0.655	219	12
12/2	65 X 30	0.045	0.095	0.580	155	25
12/3	65 X 30	0.045	0.095	0.605	190	25
12/4	65 X 30	0.045	0.095	0.655	233	20
10/2	104 X 30	0.045	0.095	0.625	197	30
10/3	104 X 30	0.045	0.095	0.660	243	30
10/4	104 X 30	0.045	0.095	0.715	301	25
8/2**	65 X 26	0.050	0.060	0.635	300	40
8/3**	65 X 26	0.050	0.060	0.665	315	40
8/4**	65 X 26	0.050	0.060	0.740	400	35
6/3**	133 X 27	0.050	0.060	0.805	470	45
6/4**	133 X 27	0.050	0.080	0.930	635	45
4/3**	133 X 25	0.050	0.080	0.980	710	70
4/4**	133 X 25	0.050	0.080	1.075	920	60
2/3**	162 X 24	0.050	0.080	1.120	1015	95
2/4**	162 X 24	0.050	0.080	1.240	1330	80

*Ampacity values are based on NEC Table 400.5(A) for sizes 18 AWG through 2 AWG.
**Sizes 8 AWG through 2 AWG are not UL or CSA listed.

#OF CONDUCTORS	COLOR SEQUENCE
2	BLACK, WHITE
3	BLACK, WHITE, GREEN
4	BLACK, WHITE, GREEN, RED
5	BLACK, WHITE, GREEN, RED, ORANGE

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One Southwire Drive
Carrollton, Ga. 30119 USA

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5F Cord and Cable Fittings

Straight Body Male Thread Sealing Gaskets and Locknuts Sizes 1/2″ – 1″

Cl. I, Div. 2*, Groups A,B,C,D
Cl. II, Div. 1, Groups E,F,G
Cl. II, Div. 2, Groups F,G
Cl. III
Wet Locations

Application:

For use with portable cord and types MV (unarmored), PLTC, SE (round), TC and UF cables.
CGB – SG cord and cable fittings are installed to:
- provide means for passing a cord or cable into an enclosure or through a bulkhead
- form a seal for cord or cable

Features:

- Rugged construction protects cord and cable from damage
- Compact, permitting close grouping of several cords and/or cables
- Tightening one nut makes watertight seal
- Large range of NPT sizes for use with any conduit system
- Available for straight entrance
- Armored sealing gaskets facilitate assembly of connectors to sheet metal boxes and cabinets. The steel ring positively retains the PVC gasket for a distortion-free 100% seal; it can't squirt out of the body-to-box joint

Standard Materials:

- Form B through Form D bodies and gland nuts – steel. Forms E & F bodies and gland nuts – *Feraloy*® iron alloy
- Bushing – neoprene
- Sealing gasket – steel and PVC

Standard Finishes:

- Steel – electrogalvanized with chromate treatment
- *Feraloy* iron alloy – electrogalvanized and aluminum acrylic paint
- PVC – natural

Size Ranges:

- Cable O.D. – .125″ to 2.50″
- NPT thread – ½″ to 1″

Certifications and Compliances:

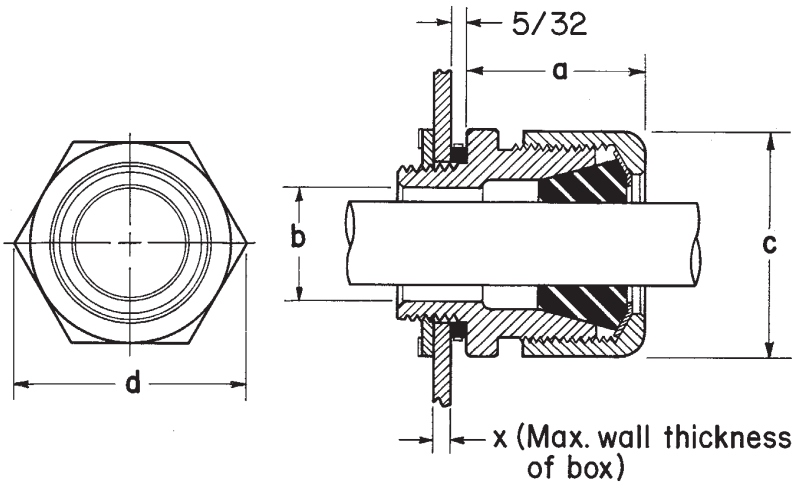
- UL Standard: 514B
- CSA Standards: C22.2
- NEC/CEC: Class I, Division 2*
- Wet locations

Complete with locknut, sealing gasket, gland nut and Neoprene bushing.

Dimensions

Thread Size	Form	a	b	c	d	x
½	B	1 5/16	5/8	1 3/16	1 9/32	3/16
½	C	1 3/4	5/8	1 5/8	1 21/32	3/16
¾	C	1 3/4	3/4	1 5/8	1 21/32	3/16
¾	D	2 1/2	13/16	2 1/4	2 1/8	3/16
1	C	1 11/16	31/32	1 5/8	1 7/8	1/4
1	D	2 3/8	1 1/32	2 1/4	2 3/8	3/16

CGB – SG Series



* May be used in hazardous locations with specific cords and cables when installed in accordance with NEC/CEC requirements.

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Cord and Cable Fittings

Straight Body Male Thread Sealing Gaskets and Locknuts Sizes 1/2″ – 1″

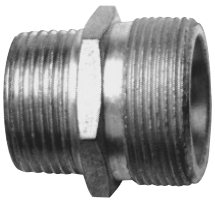
Cl. I, Div. 2*, Groups A,B,C,D
Cl. II, Div. 1, Groups E,F,G
Cl. II, Div. 2, Groups F,G
Cl. III
Wet Locations*

Complete with locknut, sealing gasket, gland nut and Neoprene bushing

Locknut

Sealing gasket

Body only



Neoprene bushing

Gland nut

Wire mesh grip

CGB-SG With Locknut, Sealing Gasket, Gland Nut and Tapered Neoprene Bushing‡

Thread Size	Form	Cord Range Dia.	Inside Body Dia.	Complete with Locknut, Sealing Gasket, Gland Nut & Neoprene Bushing ♦ Cat. #	Sealing Gasket Cat. #	Body Only Cat. #	Neoprene Bushing Cat. #	Gland Nut Cat. #	Wire Mesh Grip ♦ Cat. #
½	B	.125 to .250	.625	CGB192-SG	SG1	CGB:0104355	BUSH92	NUT94	
½	B	.250 to .375	.625	CGB193-SG	SG1	CGB:0104355	BUSH93	NUT94	
½	B	.375 to .500	.625	CGB194-SG	SG1	CGB:0104355	BUSH94	NUT94	RPE417-115
½	B	.500 to .625	.625	CGB195-SG	SG1	CGB:0104355	BUSH05	NUT94	RPE417-116
½	C	.625 to .750†	.625	CGB196-SG	SG1	CGB:1702A	BUSH96	NUT95	RPE417-117
½	C	.750 to .875†	.625	CGB197-SG	SG1	CGB:1702A	BUSH97	NUT95	RPE421-119
¾	C	.625 to .750†	.750	CGB296-SG	SG2	CGB:4318A	BUSH96	NUT95	RPE417-117
¾	C	.750 to .875†	.750	CGB297-SG	SG2	CGB:4318A	BUSH97	NUT95	RPE421-119
¾	D	.875 to 1.000†	.813	CGB298-SG	SG2	CGB:4320A	BUSH98	NUT98	16676N
1	C	.500 to .625	.969	CGB395-SG	SG3	CGB:4319A	BUSH95	NUT95	RPE417-129
1	C	.625 to .750	.969	CGB396-SG	SG3	CGB:4319A	BUSH96	NUT95	RPE417-117
1	C	.750 to .875	.969	CGB397-SG	SG3	CGB:4319A	BUSH97	NUT95	RPE421-119
1	D	.875 to 1.000†	1.031	CGB398-SG	SG3	CGB:4321A	BUSH98	NUT98	16676N
1	D	1.000 to 1.188†	1.031	CGB399-SG	SG3	CGB:4321A	BUSH99	NUT98	RPE421-121
1	D	1.188 to 1.375†	1.031	CGB3911-SG	SG3	CGB:4321A	BUSH911	NUT98	RPE433-122

* May be used in hazardous locations with specific cords and cables when installed in accordance with NEC/CEC requirements.

† Remove sufficient outer covering of cord or cable to pass conductors through the connector body.

‡ A wide variety of connectors may be made up using combinations of bodies, gland nuts and Neoprene bushings, providing all parts are of the same form.

♦ Order wire mesh grip separately.

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Catamount® Terminals

Vinyl Insulated Ring Terminals

CAT. NO.	WIRE RANGE	BOLT SIZE	PKG. QTY.
TV18-6R		#6	50
TV18-8R		#8	50
TV18-10R	22–16	#10	50
TV18-14R		¼"	50
TV18-516R		5/16"	50
TV14-6R		#6	50
TV14-8R		#8	50
TV14-10R		#10	50
TV14-14R	16–14	¼"	50
TV14-516R		5/16"	50
TV14-38R		⅜"	50
TV10-6R		#6	25
TV10-8R		#8	25
TV10-10R		#10	25
TV10-14R	12–10	¼"	25
TV10-516R		5/16"	25
TV10-38R		⅜"	25
TV10-12R		½"	25
TV8-8R		#8	10
TV8-10R		#10	10
TV8-14R		¼"	10
TV8-516R	8 AWG	5/16"	10
TV8-38R		⅜"	10
TV8-12R		½"	10
TV6-10R		#10	10
TV6-14R		¼"	10
TV6-516R	6 AWG	5/16"	10
TV6-38R		⅜"	10
TV6-12R		½"	10

**8 AWG 25 to a package **6 AWG 10 to a package*

Non-Insulated Ring Terminals

CAT. NO.	WIRE RANGE	BOLT SIZE	PKG. QTY.
T18-6R		#4–#6	50
T18-8R	22–16	#8	50
T18-10R		#10	50
T14-6R		#6	50
T14-8R	16–14	#8	50
T14-10R		#10	50
T10-6R		#6	25
T10-8R		#8	25
T10-10R	12–10	#10	25
T10-14R		¼"	25

Vinyl Insulated Fork Terminals

CAT. NO.	WIRE RANGE	BOLT SIZE	PKG. QTY.
TV18-6F		#6	50
TV18-8F		#8	50
TV18-10F	22–16	#10	50
TV18-14F		¼"	50
TV14-6F		#6	50
TV14-8F		#8	50
TV14-10F	16–14	#10	50
TV14-14F		¼"	50
TV10-6F		#6	25
TV10-8F		#8	25
TV10-10F	12–10	#10	25
TV10-14F		¼"	25
TV10-516F		5/16"	25

Non-Insulated Fork Terminals

CAT. NO.	WIRE RANGE	BOLT SIZE	PKG. QTY.
T18-6F		#6	50
T18-8F	22–16	#8	50
T18-10F		#10	50
T14-6F		#6	50
T14-8F	16–14	#8	50
T14-10F		#10	50
T10-6F		#6	25
T10-8F		#8	25
T10-10F	12–10	#10	25
T10-14F		¼"	25

Vinyl Insulated Locking Fork Terminals

CAT. NO.	WIRE RANGE	BOLT SIZE	PKG. QTY.
TV18-6LF		#6	50
TV18-8LF	22–16	#8	50
TV18-10LF		#10	50
TV14-6LF		#6	50
TV14-8LF	16–14	#8	50
TV14-10LF		#10	50
TV10-6LF		#6	25
TV10-8LF	12–10	#8	25
TV10-10LF		#10	25

Non-Insulated Locking Fork Terminals

CAT. NO.	WIRE RANGE	BOLT SIZE	PKG. QTY.
T18-6LF		#6	50
T18-8LF	22–16	#8	50
T18-10LF		#10	50
T14-6LF		#6	50
T14-8LF	16–14	#8	50
T14-10LF		#10	50
T10-6LF		#6	25
T10-8LF	12–10	#8	25
T10-10LF		#10	25

Vinyl Insulated Butt Splices

CAT. NO.	WIRE RANGE	PKG. QTY.
TV18-BS	22–18	50
TV14-BS	16–14	50
TV10-BS	12–10	25

Nylon Wire Joints

CAT. NO.	WIRE RANGE	STD. PKG.
TN18-WJ	22–16	50
TN14-WJ	16–14	50
TN10-WJ	12–10	25

Multiple Quick Splices

CAT. NO.	WIRE RANGE	PKG. QTY.
TV18-00QS	22–16	50
TV14-00QS	16–14	50
TV10-00QS	12–10	25

Sta-Kon®

Catamount® Terminals

Vinyl Insulated Female Disconnects — 250 Series

CAT. NO.	WIRE RANGE	PKG. QTY.
TV18-250FD	22–16	50
TV14-250FD	16–14	50
TV10-250FD	12–10	25

Nylon Fully Insulated Female Disconnects — 250 Series

CAT. NO.	WIRE RANGE	PKG. QTY.
TNF18-250FD	22–16	50
TNF14-250FD	16–14	50
TNF10-250FD	12–10	25

Vinyl Fully Insulated Female Disconnects — 250 Series

CAT. NO.	WIRE RANGE	PKG. QTY.
TVF18-250FD	22–16	50
TVF14-250FD	16–14	50
TVF10-250FD	12–10	25

Vinyl Insulated Male Disconnects — 250 Series

CAT. NO.	WIRE RANGE	PKG. QTY.
TV18-250MD	22–16	50
TV14-250MD	16–14	50
TV10-250MD	12–10	25

Nylon Fully Insulated Male Disconnects — 250 Series

CAT. NO.	WIRE RANGE	PKG. QTY.
TNF18-250MD	22–16	50
TNF14-250MD	16–14	50
TNF10-250MD	12–10	25

Vinyl Insulated Piggyback Disconnects — 250 Series

CAT. NO.	WIRE RANGE	PKG. QTY.
TV18-250PD	22–16	50
TV14-250PD	16–14	50
TV10-250PD	12–10	25

Vinyl Fully Insulated Female Bullet Connectors — 4mm (.156")

CAT. NO.	WIRE RANGE	PKG. QTY.
TVF18-4FB	22–16	50

Nylon Fully Insulated Female Bullet Connectors

CAT. NO.	WIRE RANGE	PKG. QTY.
TNF18-4FB	22–16	50
TNF14-4FB	16–14	50

Vinyl Insulated Straight Blade Terminals

CAT. NO.	WIRE RANGE	PKG. QTY.
TV18-10BL	22–16	50
TV18-18BL		50
TV14-10BL	16–14	50
TV14-18BL		50
TV10-10BL	12–10	25

Vinyl Insulated Male Bullet Connectors — 4mm (.156")

CAT. NO.	WIRE RANGE	PKG. QTY.
TV18-4MB	22–16	50
TV14-4MB	16–14	50

Fully Insulated Nylon Male Bullet Connectors

CAT. NO.	WIRE RANGE	PKG. QTY.
TNF18-4MB	22–16	50
TNF14-4MB	16–14	50

Vinyl Insulated Straight Pin Terminals

CAT. NO.	WIRE RANGE	PKG. QTY.
TV18-12PT	22–16	50
TV14-12PT	16–14	50
TV10-14PT	12–10	25

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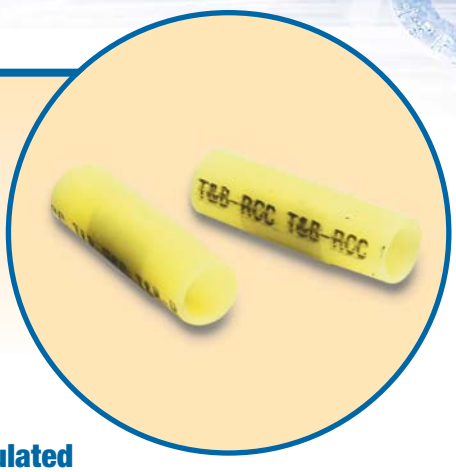
Splices

Butt Splices

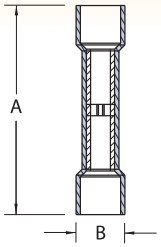
- Wires are butted together and crimped at each end of the splice
- Available either non-insulated or insulated with nylon or PVC
- Nylon insulated splices meet or exceed the requirements of MIL-T-7928
- Color-coded according to wire size

Parallel Splices

- Wires are laid side by side in the connector, and the connection is made in one crimp
- Offer advantages in simplicity of installation and small size
- One crimp completes the splice

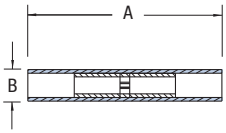


Vinyl-Insulated Splices — Butt Type — Expanded Insulation



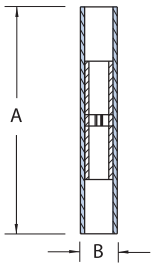
CAT. NO.	PKG. QTY.	WIRE RANGE	MAX. INS	REC. TOOL	DIMENSIONS A	DIMENSIONS B
2RA18X	100	22–18	.170	ERG2001	1.13	.25
RAA217-170	1,000	22–18	.170		1.13	.25
RAA217	1,000	22–18	.155		1.13	.23
2RB14X	100	16–14	.200		1.13	.26
RBB217-200	1,000	16–14	.200		1.13	.26
RBB217	1,000	16–14	.180		1.13	.23
2RC10X	50	12–10	.250		1.31	.31
RCC217-250	500	12–10	.250		1.31	.31
RCC217	1,000	12–10	.210		1.31	.29

Nylon-Insulated Butt Splices



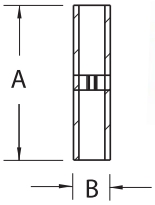
CAT. NO.	PKG. QTY.	MAX INS. DIA.	WIRE RANGE	REC. TOOL	DIMENSIONS A	DIMENSIONS B
2RA18	100	.115	22–18	ERG2001	1.19	.18
RAA21	1,000	.115	22–18		1.19	.18
2RB14	100	.148	16–14		1.19	.21
RBB21	1,000	.148	16–14		1.19	.21
2RC10	50	.210	12–10		1.26	.28
RCC21	500	.210	12–10		1.26	.28
2RD8	25	.340	8	ERG2007 TBM6S	1.69	.36
RDD27	200	.340	8		1.69	.36
2RE6	20	.420	6		1.85	.45
REE28	200	.420	6		1.85	.45
2RF4	15	.510	4	TBM6S	1.85	.52

Nylon-Insulated Aircraft Splices



CAT. NO.	PKG. QTY.	WIRE RANGE	REC. TOOL	DIMENSIONS A	DIMENSIONS B
2RZZ	50	26–22	ERG2006	1.22	.15
2RAA	50	22–18	ERG2001	1.52	.25
RAA23	500	22–18		1.52	.25
2RBB	50	16–14		1.52	.28
RBB23	500	16–14		1.52	.28
2RCC	25	12–10		1.54	.35
RCC23	250	12–10		1.54	.35

Tefzel®-Insulated Butt Splice



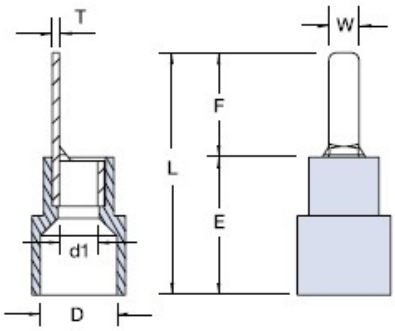
CAT. NO.	PKG. QTY.	WIRE RANGE	MAX. INS. DIA.	REC. TOOL	DIMENSIONS A	DIMENSIONS B
RAAT21	1,000	22–18	1.22	WT145C	1.22	.115
RBBT21	1,000	16–14	1.22		1.22	.148
RCCT21	1,000	12–10	1.22		1.22	.210

Tefzel® is a registered trademark of DuPont.

Spec-Kon

T&B Catalog Number: **TV14-10BL-L**
UPC Number: 78620993759
Description: Insulated Vinyl Blade Terminal for Wire Range 16-14 , Blue

Status: Active



Features	
	For use in DIN-Style Blade Terminal blocks. Molded Funnel Entry Insulator. Brazed Seam. Internal Barrel Serrations.
General	
Insulation Type	Insulated Vinyl
Material	Copper
Finish	Electro -Tin Plated
Color	Blue
Wire Range	16-14
Dimension Information	
d1 (inches)	.091
D (inches)	.177
E (inches)	.433
F (inches)	.394
L (inches)	.819
T (inches)	.031
W (inches)	.094
Specifications	
Temperature Rating	75°C
Voltage Rating	600V
Flammability Rating	UL 94 V-0
Tooling	
Application Tools	WT112M, CM2000A
Packaging	
T&B Order Multiple	50
T&B Inner Pack	50
Package in Units	500
T&B Sold in UOM	Each
T&B Weight Per UOM	0.3 lbs. per 100
Certifications	

File Nbr:
E9809

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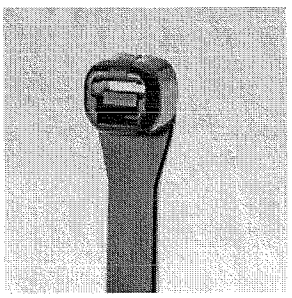

- Greater resistance to damage caused by ultraviolet light – indoor or outdoor use
- Designed to grip the bundle tightly to resist lateral movement of the tie once installed
- High strength allows the tie to withstand rough installation practices that occur in MRO and construction environments such as securing cables to vertical and horizontal ladder cable tray systems
- Thin, wide strap body provides flexibility enabling it to conform to bundle while maintaining tensile strength
- Curved tip is easy to pick up from flat surfaces and allows faster initial threading to speed installation

Related Products

Cable Tie Tools – Tool C ..
Cable Tie Tools – Instal ..
Super-Grip® Adhesive Back ..
Super-Grip™ Masonary Pus ..
Super-Grip® Tie Mounts
More...

Part Number	SG200S-C0
RoHS Compliancy Status	Compliant
Part Description	Cable Tie, 8.3", Standard cross section
Material	Weather Resistant Nylon 6.6
Color	Black
CSA Certified	Yes
UL Listed (File #E56854)	Yes
UL Recognized (File #E56854)	Yes
Length (In.)	8.3
Length (mm)	211
Width (In.)	0.225
Width (mm)	5.7
CE Compliant	Yes
Cross Section	Standard
Head Height (In.)	0.220
Head Height (mm)	5.6
Head Width (In.)	0.342
Head Width (mm)	8.7
Locking Style	Locking
Material Flammability Rating	UL 94V-2
Max. Bundle Diameter (In.)	2.00
Max. Bundle Diameter (mm)	51
Max. Continuous Use Temperature	185°F (85°C)
Min. Loop Tensile Strength (Lbs.)	50
Min. Loop Tensile Strength (N)	222
Pricing Description	Cable Tie, SG Series, 8.3"L (211mm), Standard, Weather Resistant, Black
Thickness (In.)	0.046
Thickness (mm)	1.2
Tool	GTS, GTSL, GS2B, GTH, GS4H, PTS, PTH, PPTS, STS2, STH2
Min. Order UOM	PKG
Min. Order Qty.	100
BOM Qty. (# of Pkgs.)	0
Add to Favorite Product List	

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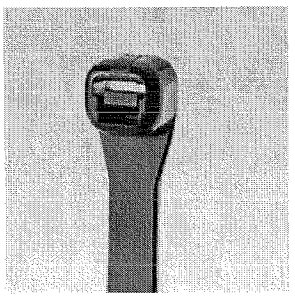
SG100M-C0



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Related Products

Cable Tie Tools – Tool C ..
Cable Tie Tools – Instal ..
Super-Grip® Adhesive Back ..
Super-Grip™ Masonary Pus ..
Super-Grip® Tie Mounts
More...

Part Number	SG100M-C0
RoHS Compliancy Status	Compliant
Part Description	Cable Tie, 4.2", Miniature cross section
Material	Weather Resistant Nylon 6.6
Color	Black
CSA Certified	Yes
UL Listed (File #E56854)	Yes
UL Recognized (File #E56854)	No
Length (In.)	4.2
Length (mm)	106
Width (In.)	0.118
Width (mm)	3.0
CE Compliant	Yes
Cross Section	Miniature
Head Height (In.)	0.154
Head Height (mm)	3.9
Head Width (In.)	0.209
Head Width (mm)	5.3
Locking Style	Locking
Material Flammability Rating	UL 94V-2
Max. Bundle Diameter (In.)	0.90
Max. Bundle Diameter (mm)	23
Max. Continuous Use Temperature	185°F (85°C)
Min. Loop Tensile Strength (Lbs.)	18
Min. Loop Tensile Strength (N)	80
Pricing Description	Cable Tie, SG Series, 4.2"L (106mm), Miniature, Weather Resistant, Black
Thickness (In.)	0.038
Thickness (mm)	1.0
Tool	GTS, GTSL, GS2B, PTS, PPTS, STS2
Min. Order UOM	PKG
Min. Order Qty.	100
BOM Qty. (# of Pkgs.)	0
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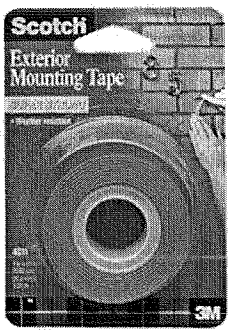

This professional-quality mounting tape is designed for attaching items up to 5 pounds to virtually any smooth surface. It is weather-resistant and holds securely even on rough outdoor surfaces such as brick or stucco.

- Can be used on most textured surfaces such as painted cement or brick.
- Two sizes: 1" x 60" and 1" x 450".
- Made in USA.

Where to buy

Rating: ★★★★★

Read all 3 reviews | Review this product

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Scotch® Reclosable Fasteners, 3/4 in x 5 ft, White

Scotch® Advanced Formula Super Glue Gel

Scotch® Reclosable Fasteners, 3/4 in x 18 in

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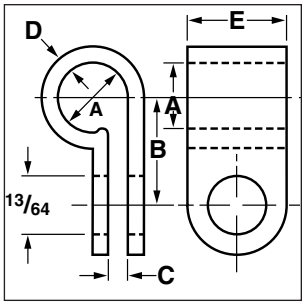
Plastic Cable Clamps

Holds harnesses, cables and tubing.

- Used for construction, maintenance and assembly-line operations.
- Use in control cabinets, panels and general applications.
- Tough, durable, yet extremely lightweight.
- Working temperature range: -54 °C (-66 °F) to 170 °C (340 °F).
- Clean, smooth edges for easy handling.
- Fast installation.

Part #	Pkg Qty	Dimensions A dia.	B	C	D	E width	Color
PPC-1525	18/card	1/4"	25/64"	1/32"	3/64"	3/8"	Natural
PPC-1525UVB	18/card	1/4"	25/64"	1/32"	3/64"	3/8"	Black
PPC-1538	15/card	3/8"	31/64"	1/32"	3/64"	3/8"	Natural
PPC-1538UVB	15/card	3/8"	31/64"	1/32"	3/64"	3/8"	Black
PPC-1550	12/card	1/2"	35/64"	3/64"	3/64"	3/8"	Natural
PPC-1550UVB	12/card	1/2"	35/64"	3/64"	3/64"	3/8"	Black
PPC-1575	6/card	3/4"	3/64"	3/32"	3/64"	1/2"	Natural
PPC-1575UVB	6/card	3/4"	3/64"	3/32"	3/64"	1/2"	Black
PPC-1600	4/card	1"	51/64"	3/32"	3/64"	1/2"	Natural



Rubber Insulated Clamps

Secures wire and cable in industrial, auto/marine and where vibrations may occur.

- Corrosive-resistant plated steel clamp.
- Flexible 1/2" wide body.
- Secure with 1/4" screw.

Part #	Size	Pkg Qty
PPR-1550	1/2"	2 pcs
PPR-1575	3/4"	2 pcs
PPR-1600	1"	1 pc

Plastic Kwik Clips

Mount bundles, cables, cords, tools etc. to drywall, wood and painted surfaces.

- Ratcheting/releasable feature allows adjustment to a range of bundle diameters.
- Adhesive backed.

Part #	Pkg Qty	Description	Color
GKK-1538	6/card	Holds 3/8" Cable	Natural
GKK-1538UVB	6/card	Holds 3/8" Cable	Black
GKK-1550	4/card	Holds 1/2" Cable	Natural
GKK-1575	2/card	Holds 3/4" Cable	Natural

Drawing

BILL OF MATERIALS

ITEM	QTY	DESCRIPTION	PART No.	MANUF.
1	1	MICRO RELAY, DIGITAL (MR)	820-10-0-RMAS	YOKOGAWA
2	1	RESISTOR, NEUTRAL GROUNDING	NR277-5F23R0ATY	POWEROHM
3	1	SPACE HEATER, 50W, 120V	G000DCC1-00018	WATLOW
4	1	MAIN ENCLOSURE, NEMA 3R, HINGED DOOR	A30R301BHCR	HOFFMAN
5	1	FLOOR STAND, 12" (2 SIDES)	AFK2412	HOFFMAN
6	1	BACK PANEL, 27"x27"	A30P30	HOFFMAN
7	1	RECTICLE TIMER (RT)	TRIP240AC	CUTLER HAMMER
8	1	DELAY TIMER (DT)	TRIP240AC	CUTLER HAMMER
9	1	LOSS OF POWER RELAY (UV)	D3PR1A	CUTLER HAMMER
10	3	RELAY SOCKET	D3PA2	CUTLER HAMMER
11	1	PULSING CONTACTOR (PC)	C25DN023TA	CUTLER HAMMER
12	1	PILOT LIGHT, 120VAC, R/GREEN COVER (PL1)	PALR120LG-PLLGN	C3 CONTROLS
13	1	PILOT LIGHT, 120VAC, R/RED COVER (PL2)	PALR120LR-PLLRD	C3 CONTROLS
14	1	SELECTOR SWITCH (S1)	SS22S-SH2Y-RD	C3 CONTROLS
15	1	PUSH BUTTON, (RESET) (PB1)	PB2-FC3X-RC	C3 CONTROLS
16	1	PUSH BUTTON, (TEST) (PB2)	PB2-FC3X-RD	C3 CONTROLS
17	1	COIL, 3/4", STRAIGHT, 6.625" - 0.75" CORD DIAMETER	C6E3S4-SS	CROUSE-HINDS
18	1	CORD, TYPE SEOW, 6/4, 600V, 0.7" DIAMETER, 10'	6/3SEOOUT	SOUTHWIRE
19	1	TERMINAL BLOCK, 12 POINT (TB)	1512569	WAGO
20	1	DISCONNECT SWITCH, THREE-PHASE, 480V, 32A (DS)	P2S3-330	C3 CONTROLS
21	1	CIRCUIT BREAKER, HIGH DENSITY 230V, 5A (BKR)	TAC 42-01-5.0A	PHOENIX CONTACT
22	1	DIN RAIL	-	-
23	1	PANDUIT 2" X 2"	G2X2LG6	PANDUIT
24	1	LEGEND PLATE, SELECTOR SWITCH	LP-S6	C3 CONTROLS
25	1	GROUND-FAULT CLAMP ON AMMETER	S0101-E-00 AC	SSI ELECTRICAL TEST
26	1	2G 2N0 TRANSFORMER (DELTA SYSTEMS ONLY)	02H-3004	PC RESEARCH INC.
27	1	480-115V, 1000VA CPT (480 CONTROL ONLY)	C010D23A	CUTLER HAMMER
28	1	GROUND LUG	SLU-35	PENN-UNION
29	1	10-32 X 3/4" BOLT AND 10/32 NYLON NUT	-	-

NAMEPLATE SCHEDULE

ITEM	SIZE TYPE	TEXT SIZE	COLOR NAMEPLATE	COLOR LETTERING	INSCRIPTION
1	2.5"x1"	1/10"	BLACK	WHITE	VOLTMETER
2	2.5"x1"	1/10"	BLACK	WHITE	NORMAL
3	2.5"x1"	1/10"	BLACK	WHITE	TEST
4	2.5"x1"	1/10"	BLACK	WHITE	GROUND FAULT
5	2.5"x1"	1/10"	BLACK	WHITE	PULSER
6	2.5"x1"	1/10"	BLACK	WHITE	RESET
7	8.5"x6"	1/16" & 3/8"	RED	WHITE	SEE DETAIL "A"
8	5" X 2"	1/16" & 3/8"	BLACK	WHITE	SEE DETAIL "B"

HIGH RESISTANCE GROUND SYSTEM

NORMAL OPERATION

1. ENSURE "PULSER" SWITCH IS IN "OFF" POSITION. GREEN LIGHT INDICATES NORMAL CONDITIONS & SYSTEM IS PROPERLY ENERGIZED.
2. ANY CHANGE IN "VOLTMETER" READING SHOWS ABNORMAL SYSTEM CONDITION.
3. RED LIGHT ON & GREEN LIGHT OFF INDICATES A GROUND FAULT.

GROUND FAULT DETECTION

1. TURN "PULSER" SWITCH TO "ON" POSITION.
2. TRACE PULSING CURRENT WITH PORTABLE DETECTOR.
3. REMOVE FAULT.
4. RETURN "PULSER" TO "OFF" POSITION.
5. PRESS "RESET" BUTTON TO RESTORE TO NORMAL CONDITIONS.

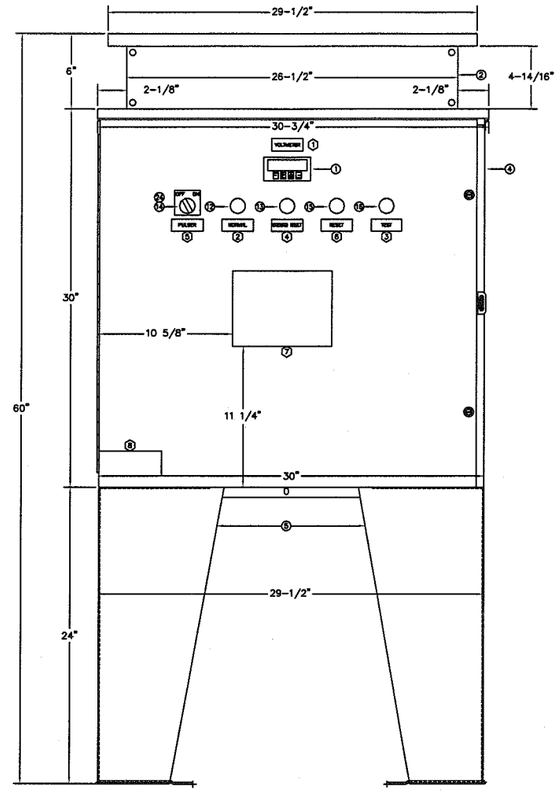
TEST

1. WITH "PULSER" SWITCH IN "OFF" POSITION, PRESS "TEST" BUTTON FOR FIVE SECONDS TO SIMULATE GROUND FAULT.
2. PRESS "RESET" BUTTON TO RETURN SYSTEM TO NORMAL OPERATING CONDITIONS.

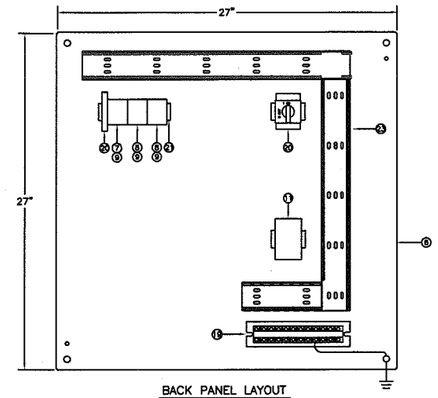
DETAIL – "A"
N.T.S.

LAPTEC, LLC. (225) 751-7535
DRAWING # L701-001
JOB # TMD402, SC-48
LAPTEC PROJECT# L701
VOLTAGE 480 VAC
SERIAL # L701-001-101

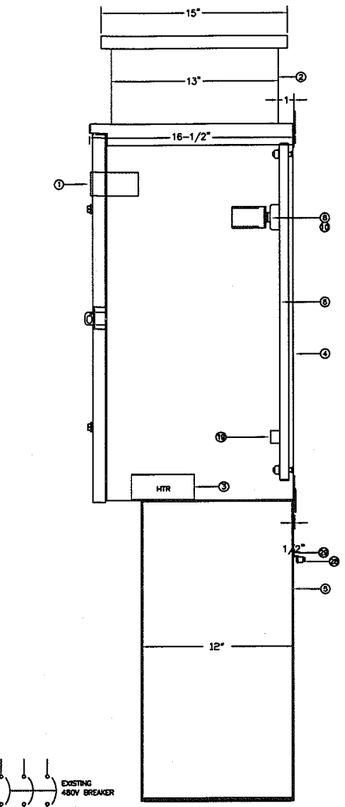
DETAIL – "B"
N.T.S.



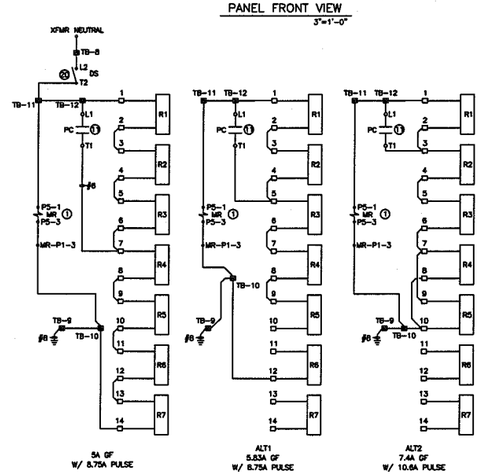
PANEL FRONT VIEW
3"=1'-0"



BACK PANEL LAYOUT
3"=1'-0"

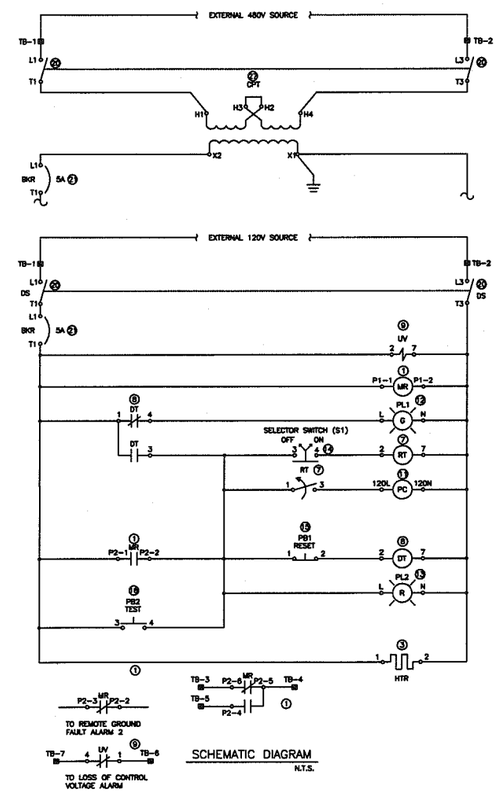


SIDE SECTION VIEW
3"=1'-0"

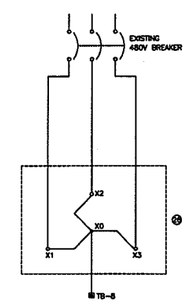


FACTORY CONNECTION

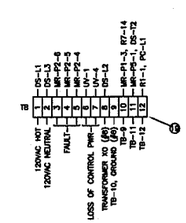
ALTERNATE CONNECTIONS



SCHEMATIC DIAGRAM
N.T.S.



ZIG ZAG TRANSFORMER
(DELTA SYSTEMS ONLY)



INTERCONNECT WIRING

LEGEND

—— – FIELD WIRING (BY OTHERS)
○ – DEVICE TERMINAL
■ – TB TERMINAL BLOCK
□ – LOCATED ON RESISTORS

REVISIONS	DATE	BY
00-ISSUED FOR CONSTRUCTION	8/11	BOG

REFERENCE DRAWINGS

PROPRIETARY INFORMATION

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ENGINEER DATE
B. O. GOODLY 07/7/11

APPROVED DATE
B. O. GOODLY 07/7/11

NOT TO SCALE

SHEET TITLE
HRG SYSTEM LAYOUT/WIRING

inoLECT
Innovation in electric power.
9330 NORTH INTERSTATE DR.
BATON ROUGE, LA. 70809

DATE: 8/1/2011

DWG NO: HRG-001

Factory Test Data

inOLECT

Innovation in electric power.

inOLECT.COM

Infrastructure—provides substation design, switchyard design, substation packaging, project management and procurement services.

Analysis and Configuration—provides network analysis including system studies, coordination, configuration, and training.

Protection, Monitoring, and Control—provides engineering associated with system protection, power monitoring, power quality analysis, power system control, and system audits.

Field Service—provides commissioning/startup, predictive and preventative maintenance, repair, and shop services.

Manufactured Products—provides remote circuit breaker racking, remote switch operation, and high resistance grounding products. This allows for complete arc flash hazard solutions including arc flash hazard analysis, training, labeling, arc flash hazard remediation studies, and turnkey arc flash hazard remediation.

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