

**MERCURY & SOLID STATE CONTACTORS • RELAYS  
• SWITCHES • LIQUID LEVEL CONTROL FLOATS**

# GENERAL INFORMATION FEATURES AND SELECTION FACTORS

## GENERAL INFORMATION

Mercury Displacement Relays are all designed and built to meet the most exacting demands of the industry. They have won their high place in the electrical field by doing the tough and tricky jobs that ordinary equipment could at best do in an uncertain manner. They have proven their ability to stand up to the most adverse conditions of temperature, dust and moisture, in all types of applications. All the care required for the manufacture of high-grade instruments is used in the manufacture of the switches. All switch parts are specially cleaned, and contamination is avoided by use of tweezers, gloves, etc., when making assemblies.

Contactors are hermetically sealed with high quality glass to metal seals.

The stainless steel tube is totally encapsulated in high grade epoxy

## FEATURES

### 1) ADVANTAGE OVER ELECTROMECHANICAL AND SOLID STATE RELAYS

- A) Superior Performance and Reliability
  - (a) Long Life
  - (b) Durable
- B) Compact Size
- C) Low, Predictable Contact Resistance
- D) Reduced RFI for Improved Interface Capability
- E) Handles a Variety of Loads
  - (a) Increases design flexibility
- F) Rapid On-Off Cycling Capability
  - (a) Mercury quickly dissipates contact heat
- G) Low Coil Power Requirements
- H) Minimal Derating Due to Higher Ambient Temperatures
- I) Quiet Action

### 2) DESIGN & CONSTRUCTION

- A) Contacts are within a hermetically sealed steel body
  - (a) Impervious to adverse condition
  - (b) No external arcing
- B) Arcing is in a gaseous atmosphere
  - (a) Quenches the arc

## SELECTION FACTORS

In order to get the right relay for your job -- the relay that will give you the best performance -- it is essential that certain information, concerning the conditions under which the relay must perform, be carefully considered. We therefore recommend that answers to the following questions be forwarded to us with your inquiry or order.

### 1) APPLICATION

- a. What kind of job is relay to do?
- b. Is application special in any way?
- c. Will mounting be stationary?

### 2) TYPE OF LOAD

- a. What is the voltage in the load circuit?
- b. What is the amperage in the load circuit?
- c. Is it A.C. or D.C.? If A.C., what is the frequency?
- d. What is the nature of the load?
  - Heater load?
  - Lamp load?
  - Motor load?
  - Current inrush and running current?
  - Other types of inductive load?

to prevent moisture damage and voltage breakdown through the protective coating.

The coils are wound on compact nylon bobbins and molded on to the metal tube to provide minimum power loss. This allows for low coil power required to actuate the contactor. This also enables the units to handle high loads with minimum derating due to higher ambient temperatures.

Internal gasses prevent excessive arcing between the mercury and the electrodes which enables the unit to function for millions of cycles with very low contact resistance, and minimum deterioration of the internal parts.

Available in all standard coil voltages, in single, two, three and four pole arrangements. Other coil voltages available upon request.

- (b) Extends relay life
- C) Only one moving part (the plunger)
  - (a) No buttons to pit, weld or burn out
- D) One coil for each set of contacts
  - (a) Assures consistent switching
  - (b) Minimizes pull-in variation between contacts
- E) Epoxy encapsulated
  - (a) Moisture resistant
  - (b) High dielectric strength
  - (c) Permanently fixes contacts to coil; eliminating possible misalignment
  - (d) Helps dissipate heat and noise
  - (e) Rugged (impact resistant)

### 3) BENEFITS

- A) Reduction of Operational and Maintenance costs
- B) Increases Utilization and Productivity of equipment
  - (a) By reducing down-time
- C) Installation and service is a routine operation
  - (a) Simple to install
  - (b) No sophisticated equipment is required
  - (c) Easy to trouble-shoot

### 3) CONTACT ARRANGEMENT

- a. Do you require a relay which has a normally open or normally closed contact?

### 4) DUTY

- a. How often is relay to be operated?
- b. How long is relay to be energized in each operation?

### 5) TIME DELAY CHARACTERISTICS

- a. What operating time do you want to achieve, maximum and minimum seconds?
- b. Is timing to be on closing or opening of the contacts?

### 6) COIL RATING

- a. What is your maximum and minimum coil operating voltage or current?
- b. Is coil to be operated from and A.C. or a D.C. circuit? If A.C., what frequency?

### 7) MOUNTING SPACE

- a. Are there any limitations on space for applying relay?

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## GLOSSARY OF TERMS & EXPRESSIONS

**AMBIENT:** The temperature of air or liquid surrounding any electrical part or device.

**CONSTANT DUTY:** If the contactor will remain "on" in normal use for indefinite periods of time, in excess of 100 hours.

**CONTACTOR:** 1.) A device for the purpose of repeatedly establishing or interrupting an electric power circuit; 2.) A heavy duty relay used to control electrical circuits. Relays rated at 15 to 30 amps and up are generally referred to as contactors.

**CONTACT:** 1.) One of the current-carrying parts of a relay, switch or connector that is engaged or disengaged to open or close the associated electrical circuits. 2.) To join two conductors or conducting objects in order to provide a complete path for current flow. 3.) The juncture point to provide the complete path.

**CONTACTS: Mercury to Metal:** The contacts of a standard mercury displacement relay or contactor. The upper contact is metal and stationary. The lower contact is a pool of mercury that gets displaced by the plunger assembly, thereby coming in contact with the metal electrode during operation. (See page 4.)

**Mercury to Mercury:** The contacts of a standard mercury timer relay. This contact arrangement utilizes a cup, which has the electrode in it, and is filled with mercury. When the mercury at the bottom of the unit is displaced, it floods over the sides of the cup, completing the circuit. This provides a clean make and break with no chatter and little erosion. (See page 11.)

**CONTINUITY:** A continuous path for the flow of current in an electric circuit.

**DERATE:** To reduce the voltage, current, or power rating of a device to improve it's reliability or to permit operation at high ambient temperatures.

**DIELECTRIC:** The insulating material between the metallic elements of an electronic component.

**DROP-OUT:** The current, voltage, or power value that will cause an energized relays contacts to return to their normal deenergized condition.

**GAUSS:** The centimeter-gram-second electromagnetic unit of magnetic induction. One gauss represents one maxwell per square centimeter.

**HEAT RISE:** In a mercury displacement relay; The heat developed from the coil and contacts as a unit.

**HERMETIC SEAL:** A mechanical or physical closure that is impervious to moisture or gas, including air.

**HERTZ:** Cycles per second.

**INRUSH CURRENT:** In a solenoid or coil, the steady-state current drawn from the line with the armature, or plunger, in its maximum open position.

**LOAD, CONTACT:** The electrical power encountered by a contact set in any particular application.

**MAXWELL:** The cgs electromagnetic unit of magnetic flux, equal to one gauss per square centimeter, or one magnetic line of force.

**OPERATE TIME:** In a mercury displacement relay; the amount of time that passes when power is applied to the coil, to when the contacts close in a normally open set of contacts, or when the contacts open in a normally closed set of contacts.

Quick Operate is when the operate time is less than the stated release

time. Slow operate is when the operate time is no longer than the stated release time.

**PLUNGER:** In a mercury displacement relay; The device used to displace mercury. The plunger is lighter than mercury so it floats on the mercury. The plunger also contains a magnetic shell or sleeve, so it can be pulled down into the mercury with a magnetic field. The plunger does the same job in a mercury displacement relay as an armature in a mechanical relay.

**POLE:** 1.) Output terminals on a switch. 2.) A single set of contacts; (i.e., three sets of contacts equal three poles)

**POWER FACTOR:** Ratio of the actual power of an alternating or pulsating current to the apparent power.

**PULL-IN:** (Pick-up): The minimum current, voltage, power or other value which will trip a relay or cause it to operate.

**RELAY:** An electromechanical or electronic device in which continuity is established or interrupted in one circuit by a control circuit. Typically used to switch large currents by supplying relatively small currents to the control circuit. Also see Contactor.

**RELEASE TIME:** In a mercury displacement relay; The amount of time that passes when power is removed from the coil, until the contacts of a normally open unit reopen, or when contacts of a normally closed unit recloses.

Quick Release is when the release time is less than the stated operate time. Slow release is when the release time is longer than the stated operate time.

**STEADY-STATE:** A condition in which circuit values remain essentially constant, occurring after all initial transients or fluctuating conditions have settled down.

**TRANSIENT (Transient Phenomena):** Rapidly changing action occurring in a circuit during the interval between closing of a switch and settling to steady-state conditions, or any other temporary actions occurring after some change in a circuit or it's constants.

**VOLT-AMPERE:** A unit of apparent power in an AC circuit containing reactance. It is equal to the potential in volts multiplied by the current, in amperes, without taking phase into consideration.

**VOLTAGE SPIKES:** An abrupt transient which comprises part of a pulse but exceeds it's average amplitude considerably.

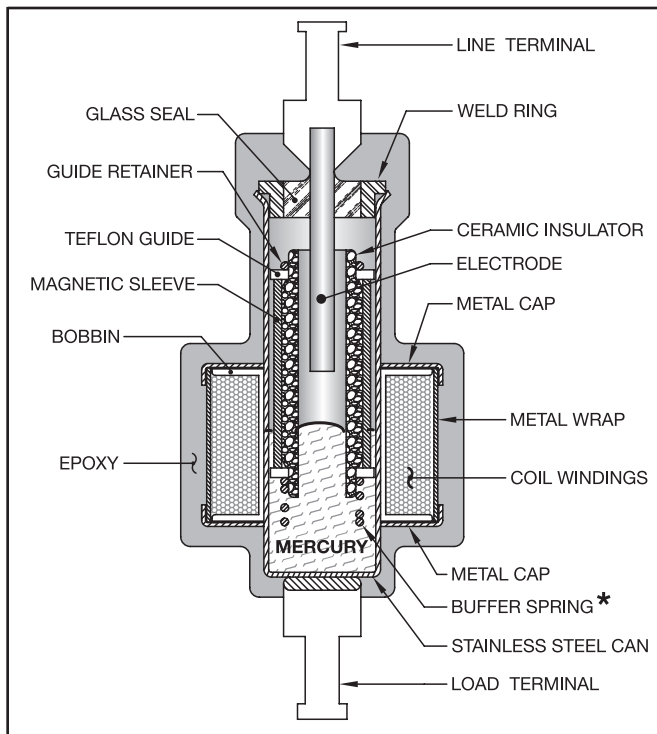
**VOLTAGE WITHSTAND:** The amount of electromotive force (volts) that can be applied to two points before a current will flow (leakage or breakdown.)

**WATT:** A unit of electrical power. One watt is expended when one ampere of direct current flows through a resistance of one ohm. In an AC circuit, the true power in watts is effective volt-amperes multiplied by the circuit power factor. There are 746 watts in one horsepower.

### ABBREVIATIONS

A.C.	Alternating Current	Hg	Mercury
D.C.	Direct Current	Hz	Hertz
M.D.R.	Mercury Displacement Relay	N.C.	Normally Closed
D.P.S.T.	Double Pole Single Throw	N.O.	Normally Open
S.P.S.T.	Single Pole Single Throw	Q	Quick
T.P.S.T.	Triple Pole Single Throw	S	Slow

# MERCURY TO METAL CONTACTORS AND RELAYS



## DESCRIPTION

**MERCURY TO METAL CONTACTOR:** The load terminals are isolated from each other by the glass in the hermetic seal. "The plunger assembly," which includes the ceramic insulator, the magnetic sleeve and related parts, floats on the mercury pool. When the coil is powered causing a magnetic field, the plunger assembly is pulled down into the mercury pool which is in turn displaced and moved up to make contact with the electrode, closing the circuit between the top and bottom load terminal which is connected to the stainless steel can.

## TRAFFIC CONTROL (CONSTANT DUTY)

SP-1132- VOLTAGE- (A or D)

35 AMPS @ 600 VAC

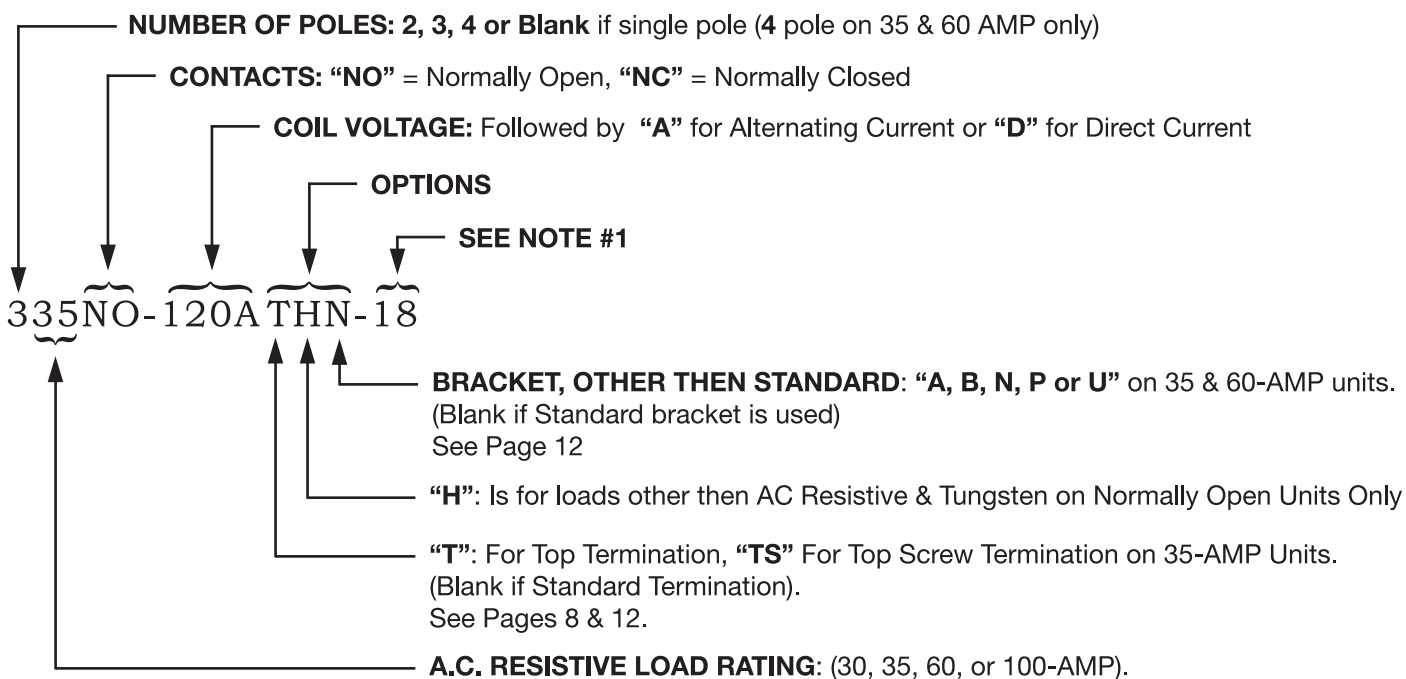
SP-1130- VOLTAGE- (A or D)

60 AMPS @ 480 VAC

\*A return spring replaces the buffer spring for this application

## HOW TO ORDER SPECIFY AS SHOWN BELOW

### EXAMPLE #1



NOTES: 1) Other designations are -1 thru -99. These are suffix numbers, and are reserved for units with dead special detail, construction and/or features. -11 MOV on coil (see page 20), -13 MOV & metal strap, -17 DIN rail mount, -20 DIN rail & metal strap (see page 12), -18 metal strap (see page 9). (See example #2).

### EXAMPLE #2

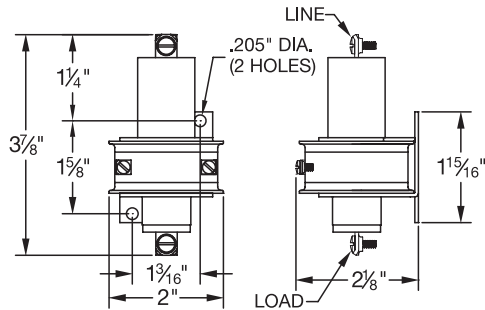
100NO-120AH-6A

The -6A stands for HIGH VOLTAGE contactor. Used in ultraviolet curing ovens and other high voltage applications. See page 11 for ratings.

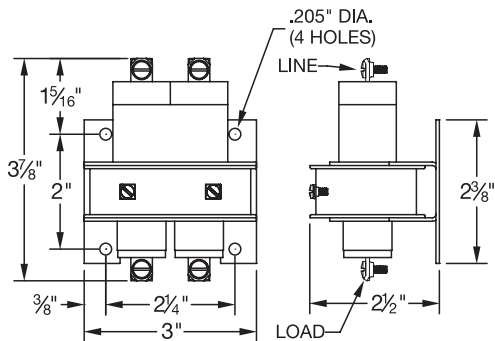
# 30-AMP NORMALLY OPEN CONTACTORS



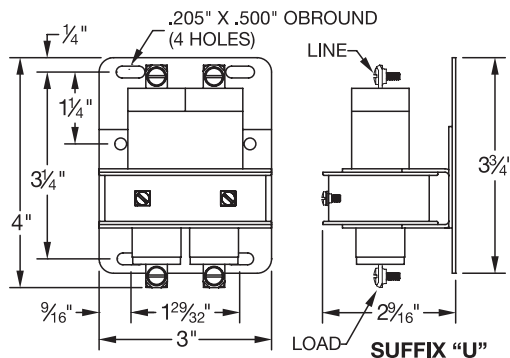
**SINGLE POLE**



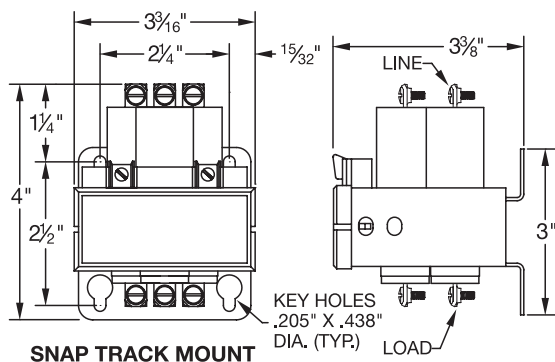
**TWO POLE  
STANDARD MOUNT**



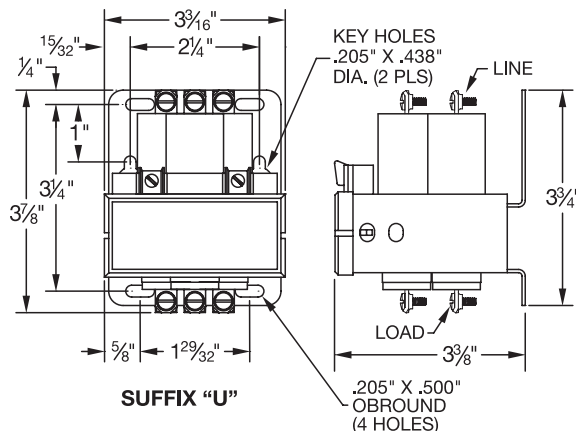
**TWO POLE  
UNIVERSAL MOUNT**



**THREE POLE  
STANDARD MOUNT**



**THREE POLE  
UNIVERSAL MOUNT**



## GENERAL INFORMATION

The 30 Amp model is designed to save space and simplify mounting methods. The standard mounting bracket on the three pole model allows the unit to be mounted in standard 3" snap track channel. If you do not use snap track mounting, the standard three pole bracket has key hole slots for easy mounting in any panel arrangement. The universal three pole mounting bracket has various mounting holes and key hole slots to meet a variety of mounting centers.

The 30 Amp series is a more compact line with a well proven switch which is the heart of mercury relays. It is the same switch design that is in our 35 and 60 Amp encapsulated MDR's, which have withstood the test of time and millions of cycles in many different applications.

## TYPICAL SPECIFICATIONS

- ON NORMALLY OPEN UNITS:  
OPERATE TIME: 50 milliseconds  
RELEASE TIME: 80 milliseconds
- CONTACT RESISTANCE:  
30-AMP=.003 ohm\*
- DIELECTRIC WITHSTAND:  
2500 VAC RMS
- LONGEVITY:  
MILLIONS OF CYCLES
- TEMPERATURE RANGE:  
-35°C TO 85°C
- COIL TERMINALS:  
#6 BINDING HEAD SCREWS
- LOAD TERMINALS:  
#8 BINDING HEAD SCREWS
- UL LISTING: FILE #E62767
- C.S.A.: FILE #LR41198
- TO ORDER SEE PAGE 4

\*AFTER CYCLING UNDER LOAD.



FILE #E-62767



FILE #LR 41198



Catalog No.	Resistance	Current	V.A.	Watts
30NO-24D	180 Ω	133 mA	3.2	3.2
230NO-24D	131 Ω	188 mA	4.5	4.5
330NO-24D	73 Ω	329 mA	7.9	7.9
30NO-24A	28 Ω	316 mA	7.6	2.8
230NO-24A	12.5 Ω	610 mA	14.6	4.7
330NO-24A	7.6 Ω	815 mA	19.6	5.0
30NO-120A	725 Ω	65 mA	7.8	3.1
230NO-120A	317 Ω	118 mA	14.2	4.4
330NO-120A	210 Ω	163 mA	19.6	5.6
30NO-220A	3,150 Ω	27 mA	6.0	2.2
230NO-220A	1,300 Ω	56 mA	12.3	4.1
330NO-220A	728 Ω	86 mA	18.9	5.5

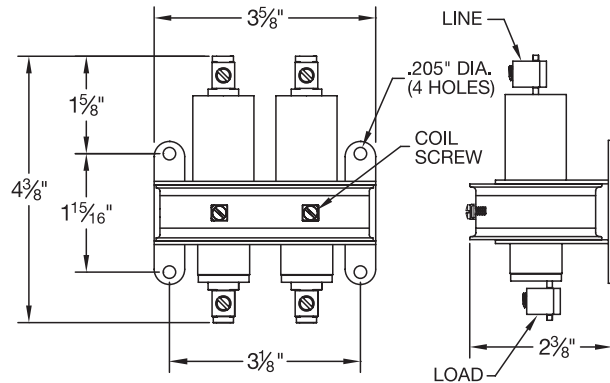
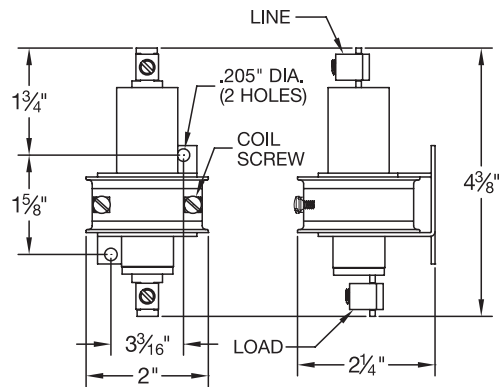
# L35/L60-AMP NORMALLY OPEN CONTACTORS



**SINGLE POLE  
NORMALLY OPEN**



**TWO POLE  
NORMALLY OPEN**



## TYPICAL SPECIFICATIONS

- **ON NORMALLY OPEN UNITS:**  
**OPERATE TIME: 50 milliseconds**  
**RELEASE TIME: 80 milliseconds**
- **CONTACT RESISTANCE:**  
**35-AMP = .003 ohm\***  
**60-AMP = .002 ohm\***
- **DIELECTRIC WITHSTAND:**  
**2500 VAC RMS**
- **LONGEVITY:**  
**MILLIONS OF CYCLES**
- **TEMPERATURE RANGE:**  
**-35°C TO 85°C**
- **COIL TERMINALS:**  
**#6 BINDING HEAD SCREWS**
- **LOAD TERMINALS:**  
**PRESSURE CONNECTORS FOR  
A.W.G. #4-#14 ON 35-AMP AND  
A.W.G. #2-#8 ON 60-AMP UNITS**
- **UL LISTING:**  
**FILE #E62767 FOR L35 AND  
L60-AMP N.O. UNITS 1-2 POLES**
- **C.S.A.:**  
**FILE #LR41198 FOR L35 AND  
L60-AMP N.O. UNITS 1-2 POLES**



FILE #E-62767



FILE #LR 41198



The "L" version of the 35 and 60 amp normally open contactors are designed and manufactured to the same high quality specifications as the standard 35 and 60 amp models. The contactor switch is the same well proven design that has been manufactured since 1975. The mounting centers and physical size are identical to the standard single and two pole 35 and 60 amp molded versions.

The new design provides a cleaner appearance, and is a more economical design. It is available in the single and two pole models only, with top and bottom load terminals or with lead wires. Noted are the typical specifications and UL and CSA file numbers.

## COIL DATA L35 AND L60 SERIES.

Catalog No.		Resistance	Current	V.A.	Watts
L35NO-24D	L60NO-24D	188 Ω	135 mA	3.3	3.3
L235NO-24D	L260NO-24D	92 Ω	260 mA	6.2	6.2
L35NO-24A	L60NO-24A	28 Ω	325 mA	7.8	3.0
L235NO-24A	L260NO-24A	10.3 Ω	660 mA	15.8	4.5
L35NO-120A	L60NO-120A	725 Ω	75 mA	9.0	4.0
L235NO-120A	L260NO-120A	350 Ω	115 mA	13.8	4.6
L35NO-220A	L60NO-220A	3,150 Ω	27 mA	5.9	2.2
L235NO-220A	L260NO-220A	1,000 Ω	69 mA	15.2	4.8

\*AFTER CYCLING UNDER LOAD

# 35/60-AMP NORMALLY OPEN CONTACTORS

## HAZARDOUS LOCATION & TRAFFIC CONTROL



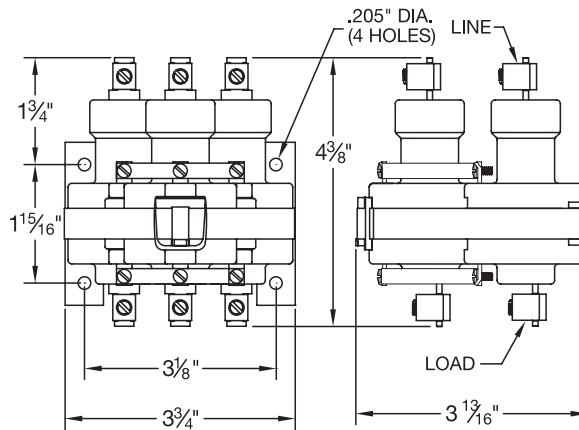
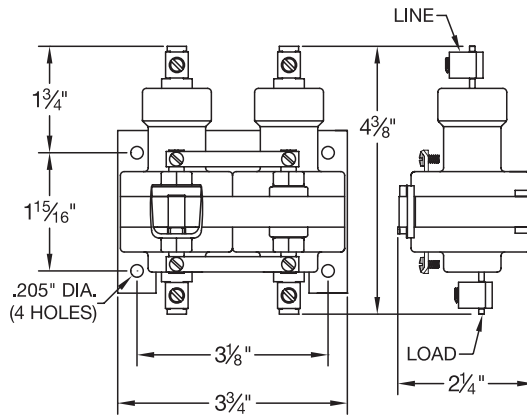
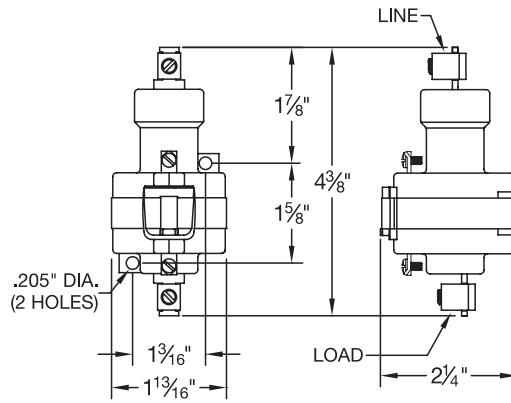
SINGLE POLE—NORMALLY OPEN



TWO POLE—NORMALLY OPEN



THREE POLE—NORMALLY OPEN



### TYPICAL SPECIFICATIONS

- NORMALLY OPEN UNITS:  
OPERATE TIME: 50 milliseconds  
RELEASE TIME: 80 milliseconds
- NORMALLY CLOSED UNITS:  
OPERATE TIME: 30 milliseconds  
RELEASE TIME: 35 milliseconds
- CONTACT RESISTANCE:  
35 AMP = .003 ohm\*  
60 AMP = .002 ohm\*
- TEMPERATURE RANGE:  
-35°C to 85°C
- COIL TERMINALS:  
#6 WIRE BINDING SCREWS
- LOAD TERMINALS:  
PRESSURE CONNECTORS  
4 TO 14 AWG ON 35 AMP  
2 TO 8 AWG ON 60 AMP
- RATINGS:  
SEE PAGE 13 FOR COIL DATA  
SEE PAGE 14 FOR CONTACTS
- UL LISTING: FILE #E-62767 FOR
- C.S.A.: FILE # LR 41198 FOR
- TO ORDER SEE PAGE 4



FILE #E-62767



FILE #LR 41198



### HAZARDOUS LOCATIONS

#### SUFFIX "X"

Available in 1, 2 & 3 Pole Units

UL File E-71867

Auxiliary devices for use in hazardous locations

For CLASS 1, GROUPS A, B, C, & D - Division 2 only.

### TRAFFIC CONTROL (CONSTANT DUTY)

SP-1132- VOLTAGE- (A or D)

35 AMPS @ 600 VAC

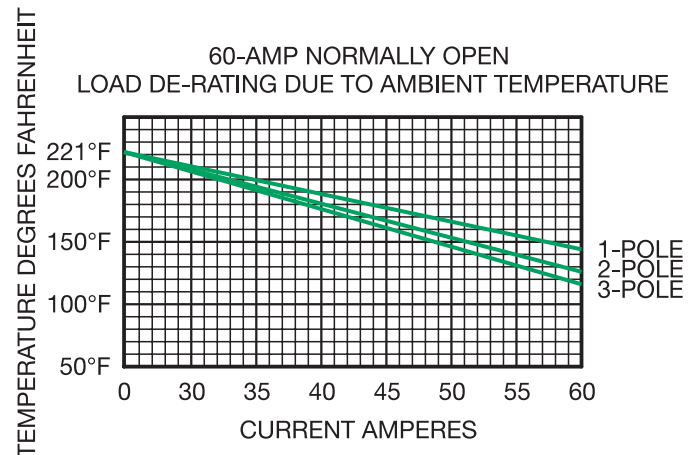
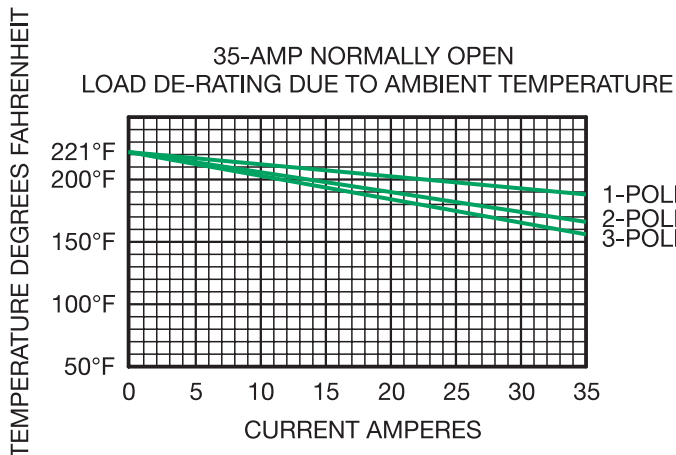
SP-1130- VOLTAGE- (A or D)

60 AMPS @ 480 VAC

A return spring replaces the buffer spring for this application

\* AFTER CYCLING UNDER LOAD

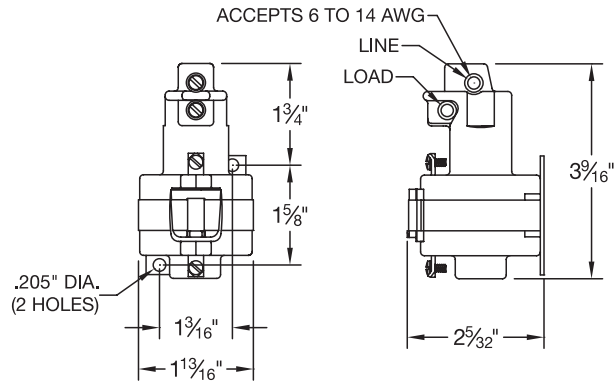
### STANDARD MOUNTING SHOWN - SEE PAGE 12 FOR OPTIONS



# 35 AMP T-TOP CONTACTORS



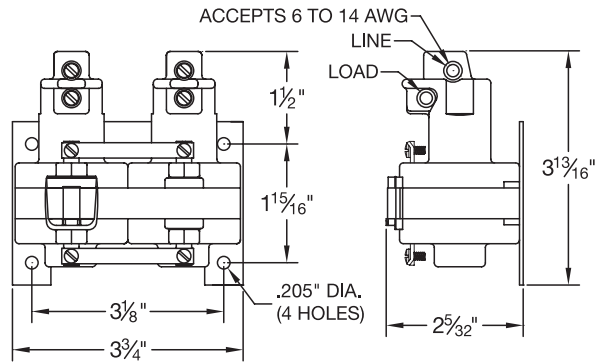
**SINGLE POLE—NORMALLY OPEN**



FILE #E-62767



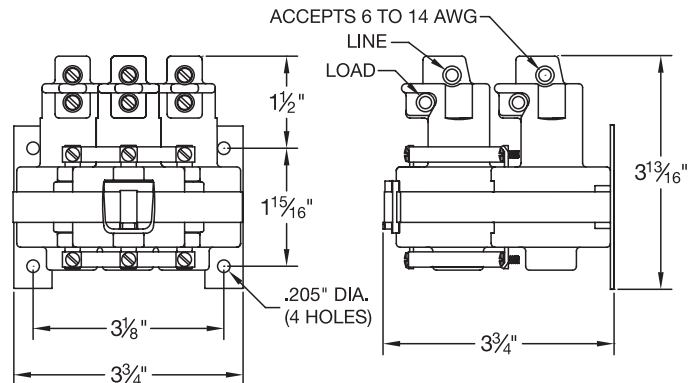
**TWO POLE—NORMALLY OPEN**



FILE #LR 41198

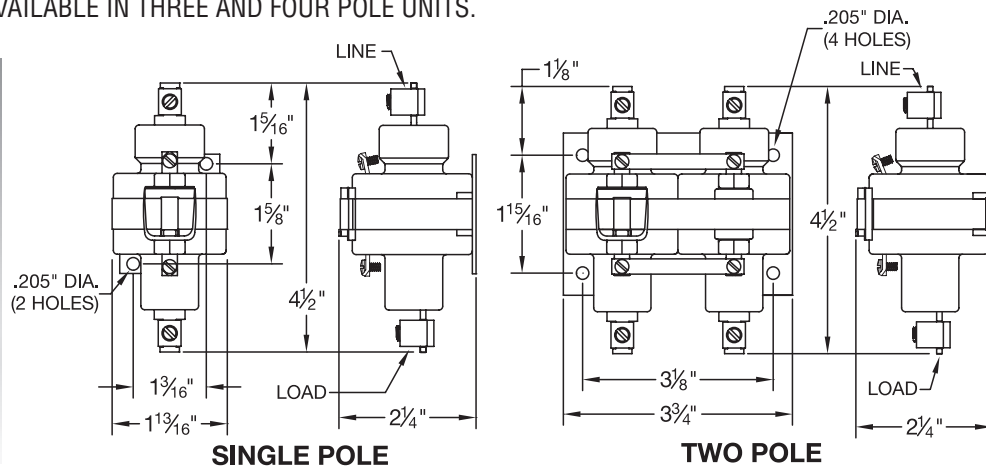


**THREE POLE—NORMALLY OPEN**



# 35/60 AMP NORMALLY CLOSED CONTACTORS

SIMILAR CONSTRUCTION AS THE NORMALLY OPEN UNITS BUT WITH THE COIL POSITIONED CLOSER TO THE TOP OF THE CONTACTOR AND A NORMALLY CLOSED CONTACTOR IN PLACE OF A NORMALLY OPEN CONTACTOR. ALSO AVAILABLE IN THREE AND FOUR POLE UNITS.



FILE #E-62767



FILE #LR 41198

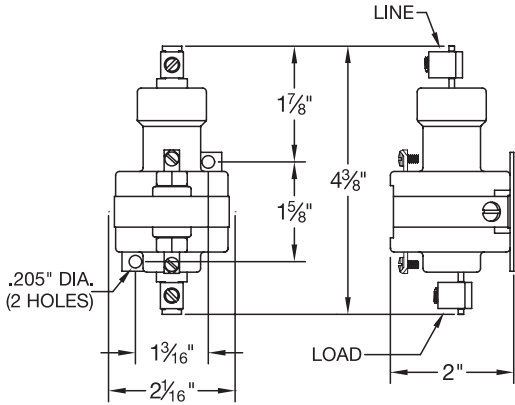


# 35/60 AMP METAL STRAPPED CONTACTORS

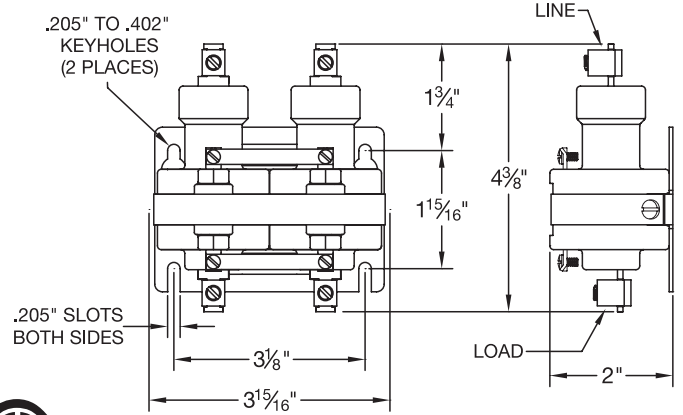
Add suffix -18 to catalog number for metal strap, i.e. 335NO-120A-18



**SINGLE POLE—NORMALLY OPEN**



**TWO POLE—NORMALLY OPEN**



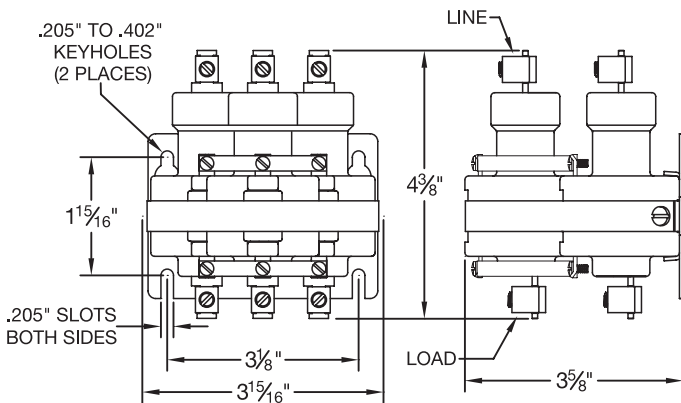
FILE #E-62767



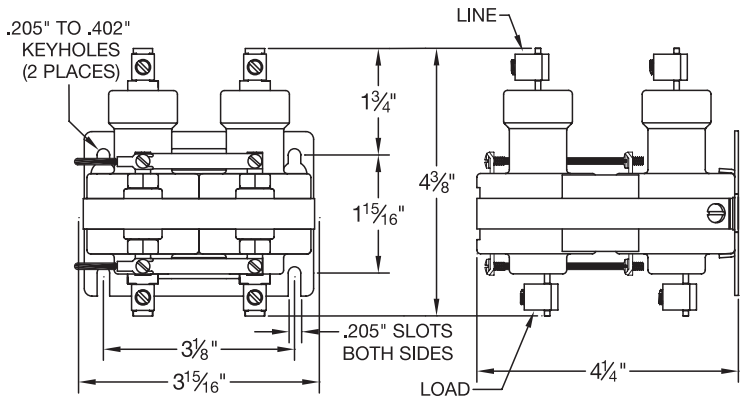
FILE #LR 41198



**THREE POLE—NORMALLY OPEN**



**FOUR POLE—NORMALLY OPEN**



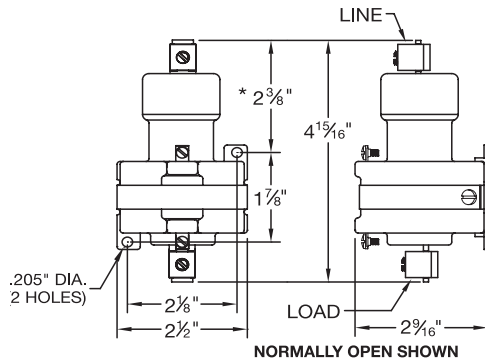
# 100-AMP CONTACTORS



**NORMALLY OPEN UNIT**



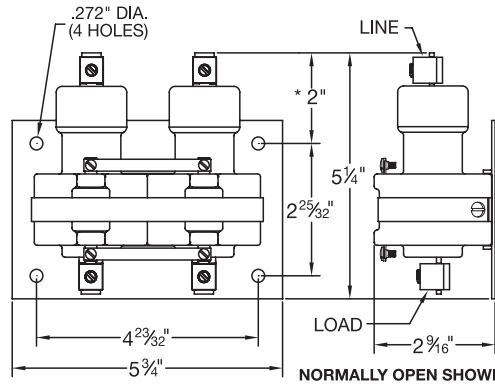
**NORMALLY CLOSED UNIT**



\* THIS DIMENSION IS 1 3/8" FOR NORMALLY CLOSED SINGLE POLE UNITS



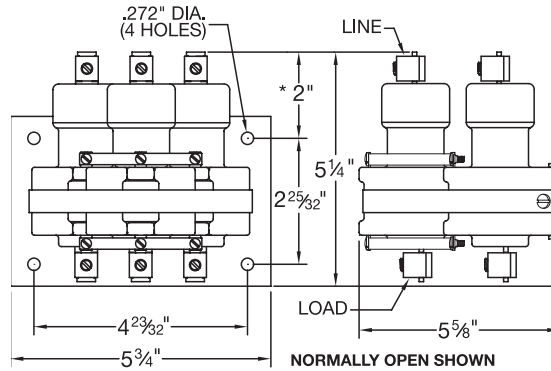
**TWO POLE—NORMALLY OPEN**



\* THIS DIMENSION IS 1 5/16" FOR NORMALLY CLOSED TWO POLE UNITS



**THREE POLE—NORMALLY OPEN**

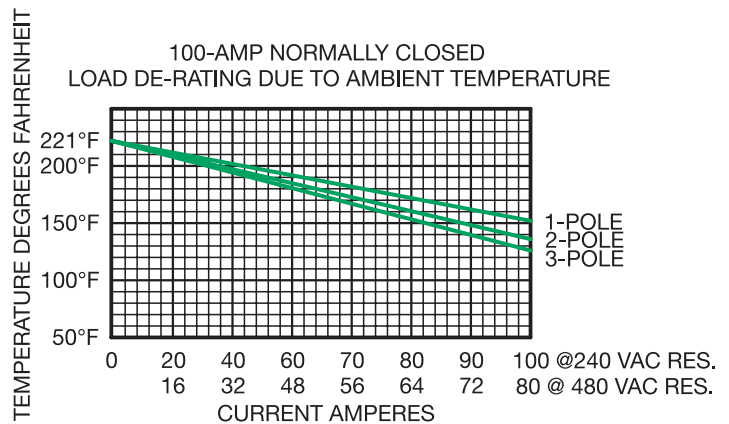
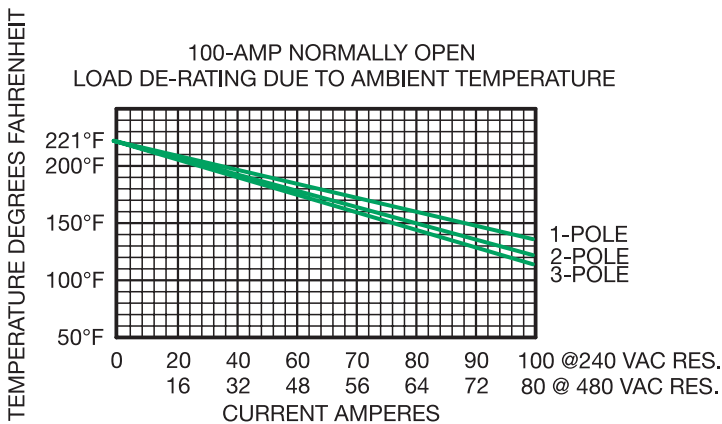


\* THIS DIMENSION IS 1 5/16" FOR NORMALLY CLOSED THREE POLE UNITS

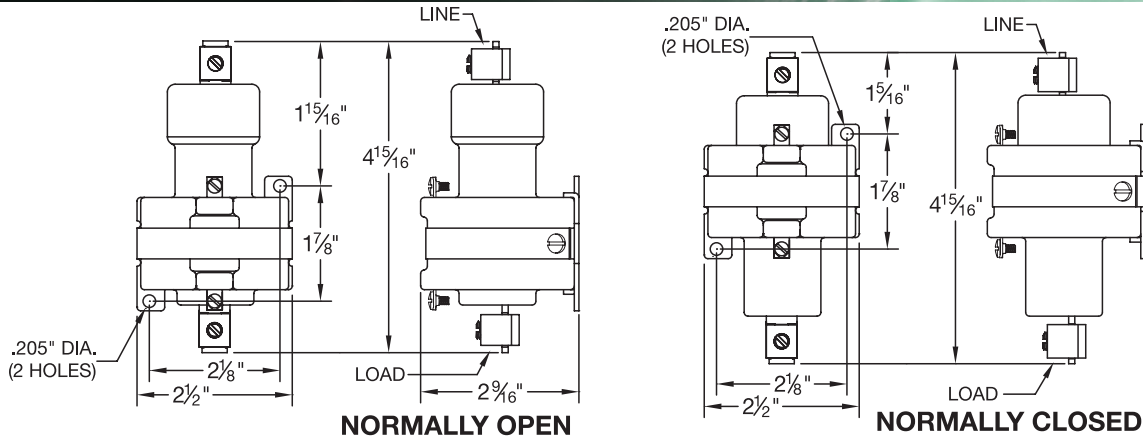
## TYPICAL SPECIFICATIONS

- ON NORMALLY OPEN UNITS:  
OPERATE TIME: 50 milliseconds  
RELEASE TIME: 80 milliseconds
- ON NORMALLY CLOSED UNITS:  
OPERATE TIME: 45 milliseconds  
RELEASE TIME: 60 milliseconds
- CONTACT RESISTANCE:  
.001 ohm\*
- DIELECTRIC WITHSTAND:  
2500VAC RMS
- LONGEVITY:  
MILLIONS OF CYCLES
- TEMPERATURE RANGE:  
-35°C TO 85°C
- COIL TERMINALS:  
#6 BINDING HEAD SCREWS
- LOAD TERMINALS:  
PRESSURE CONNECTORS.  
STANDARD ACCEPTS A.W.G. #2 to #8.  
FOR A.W.G. #1 to #8,  
ADD SUFFIX -5 TO CATALOG NUMBER (i.e. 100NO-120A-5)
- RATINGS:  
Derate over 240VAC Res.  
See Page 13 for Coil Data.  
See Page 14 for Contacts.  
- TO ORDER SEE PAGE 4.

**S100NO - SERIES**  
AVAILABLE IN 1, 2 & 3 POLES  
RATINGS: 100 AMPS @ 480 VAC  
SEE PAGE 14 FOR RATINGS



# HIGH VOLTAGE CONTACTORS



For UV Curing, and Various High Voltage applications. Available in Single Pole, Normally Open, and Normally Closed Units. The coils utilize 6-32 Wire Binding Screws, and the Contacts use Compression type terminals for #2 thru #8 AWG wire.

### RATINGS ARE:

10 AMPS @ 3500 VAC  
 15 AMPS @ 2500 VAC  
 AC INDUCTIVE Power Factor .7 or Greater.

### COIL DATA

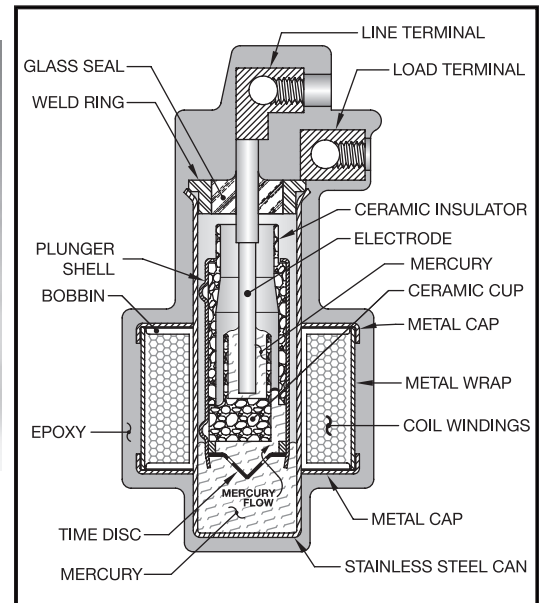
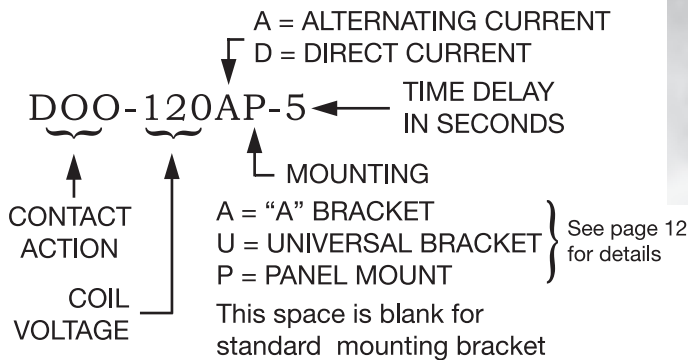
Catalog Number	Coil Voltage	Resistance	Current Draw	Wattage	V.A.
100NC-24D-6A	24 VDC	121 Ω	198 mA	4.8	4.8
100NC-120A-6A	120 VAC	380 Ω	125 mA	5.9	15.0
100NC-220A-6A	220 VAC	1,400 Ω	76 mA	8.1	16.7
100NO-12DH-6A	12 VDC	16 Ω	750 mA	9.0	9.0
100NO-24AH-6A	24 VAC	16 Ω	760 mA	9.2	18.2
100NO-24DH-6A	24 VDC	65 Ω	370 mA	8.9	8.9
100NO-120AH-6A	120 VAC	380 Ω	158 mA	9.5	19.0
100NO-220AH-6A	220 VAC	1,400 Ω	90 mA	11.3	19.8

# TIME DELAY RELAYS

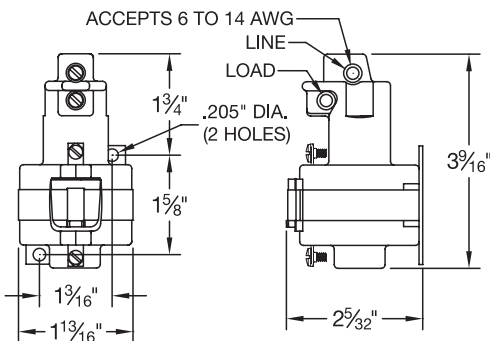
MDI's Time Delay CONTACT ACTION is designated as follows:

- DOO: Delay on operate, normally open
- DORO: Delay on operate and release, normally open
- DRO: Delay on release, normally open
- DORC: Delay on operate and release, normally closed
- DRC: Delay on release, normally closed

**HOW TO ORDER** Specify as shown below

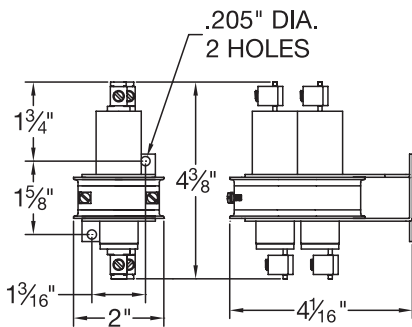


**TIME DELAY RELAYS** Are available with delays of up to 15 seconds on normally open units, and 4 seconds on normally closed units. The timing limitation depends on the contact action required. A time delay function is accomplished in this unit by sizing a hole in the time disc that will control the rate of the mercury flow. This controls the time it will take from the instant the coil is powered until the mercury pools make contact with each other, closing the circuit between the load terminals. Typical contact ratings 10 AMP @ 120 VAC. Pilot duty rating 720 VA. Common coil voltages are available. Standard load terminals are compression type. Coil terminals use #6 binding head screws.



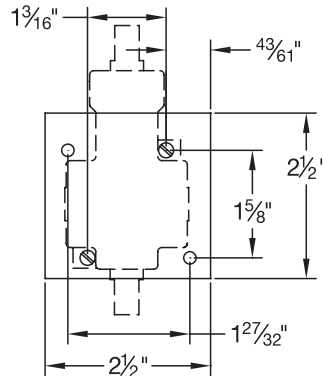
# OPTIONAL TERMINATIONS AND MOUNTING PLATES

## OPTIONAL 35 & 60 AMP CONTACTORS & TIMER MOUNTING PLATES



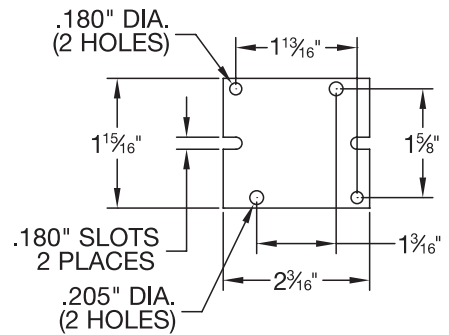
### SP-1214

2" wide, narrow mount two pole 30 amp. catalog number SP-1214 followed by the coil voltage, then "D" for DC.  
Example: SP-1214-120A



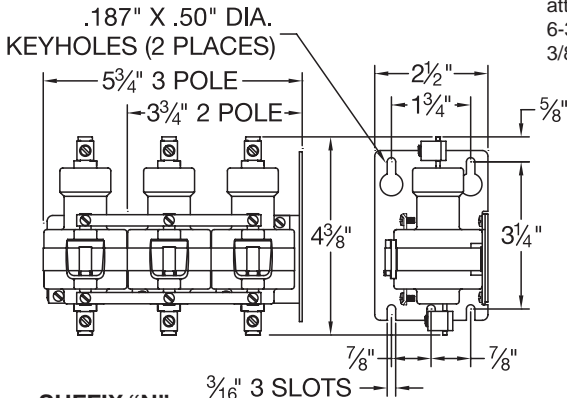
### "P" PANEL MOUNT

For 35, 60-amp or standard timer; with standard mounting bracket. The standard mounting bracket attaches to the panel with two 6-32 screws. Material: 3/8" thick phenolic.



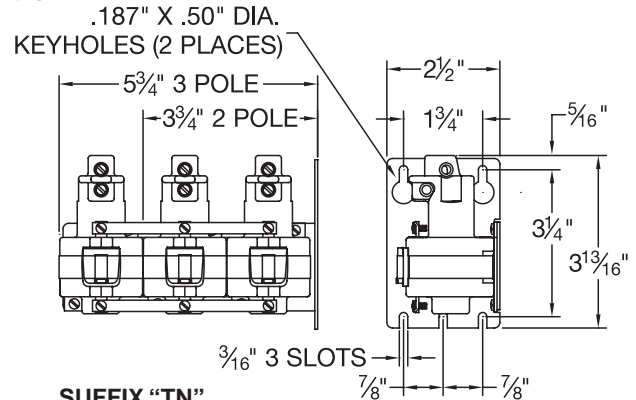
### "U" UNIVERSAL BRACKET

For single pole, 35 and 60-amp units, and for timers. This is the standard bracket for hybrid timers. Material: 16-ga. plated steel.



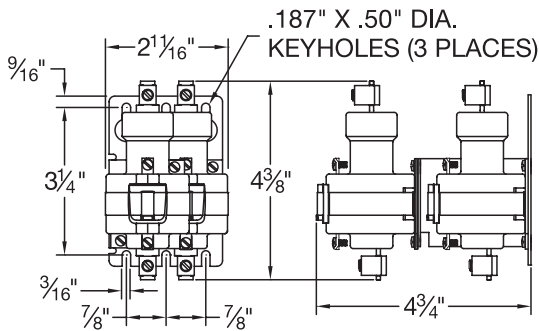
### SUFFIX "N"

Narrow two or three pole 35 or 60 amp units only



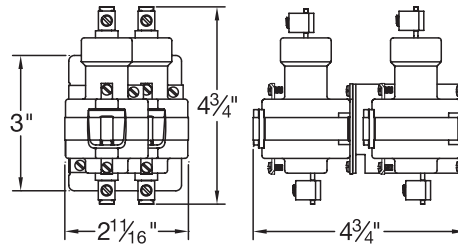
### SUFFIX "TN"

Two or Three Pole 35 AMP Only. Load terminals on top for shorter overall height.



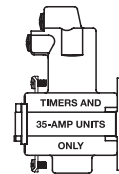
### SUFFIX-19

Two pole 35 or 60 amp narrow mounted, front facing, off set, for panel mounting.



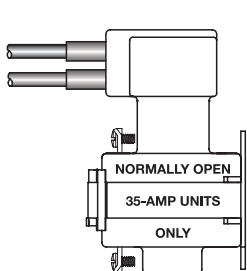
### SUFFIX-"NB"

Two pole 35 or 60 amp narrow mounted, front facing, off set, for snap track mounted



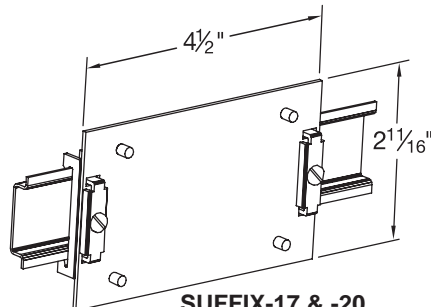
### TS (Top Screws)

Designated by the letters "TS" in the catalog number suffix. For timers and 35-amp units. Dimensions same as T-Top (see page 8).



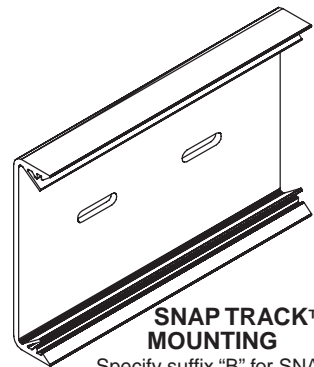
### L-1 (Leaded)

Designated by the letters "L-1" in the catalog number suffix. For normally open 35-amp units. Height 3-3/16" other dimensions same as standard (page 8).



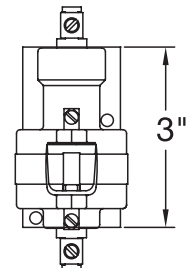
### SUFFIX-17 & -20

Din rail mount 35mm symmetrical for 35 and 60 AMP units.



### SNAP TRACK™ MOUNTING

Specify suffix "B" for SNAP TRACK mount on single, two and three pole 35 and 60 amp series and single and two pole 30 amp series. SNAP TRACK mount is standard on three pole 30 amp without suffix.



### "B" BRACKET

For single pole 35 and 60-amp units, and for timers. Mounts into standard 3" snap-track. Material is 16-ga. plated steel.

# COIL DATA PER POLE RATINGS ON STANDARD COILS

CATALOG NUMBER	VOLTAGE	RESISTANCE (D.C. OHMS)	CURRENT (MILLIAMPERES)	VOLT AMPERES (V/A)	POWER (WATTS)
30 AMP SERIES (SEE PAGE 5)	SEE PAGE 5	SEE PAGE 5	SEE PAGE 5	SEE PAGE 5	SEE PAGE 5
35NO-24A	24 VAC	50 Ω	242 mA	5.8 V/A	2.9 W
35NO-120A	120 VAC	1,250 Ω	53 mA	6.4 V/A	3.5 W
35NO-208A	208 VAC	3,400 Ω	30 mA	6.2 V/A	3.1 W
35NO-220A	220 VAC	4,800 Ω	28 mA	6.2 V/A	3.8 W
35NO-277A	277 VAC	7,900 Ω	20 mA	5.5 V/A	3.2 W
35NO-480A	480 VAC	20,000 Ω	12 mA	5.9 V/A	3.0 W
35NO-6D	6 VDC	13 Ω	462 mA	2.8 V/A	2.8 W
35NO-12D	12 VDC	36 Ω	333 mA	4.0 V/A	4.0 W
35NO-24D	24 VDC	176 Ω	136 mA	3.3 V/A	3.3 W
35NO-48D	48 VDC	636 Ω	75 mA	3.6 V/A	3.6 W
35NO-125D	125 VDC	3,400 Ω	37 mA	4.6 V/A	4.6 W
35NO-250D	250 VDC	14,800 Ω	17 mA	4.2 V/A	4.2 W
35NC-24A	24 VAC	36 Ω	310 mA	7.4 V/A	3.5 W
35NC-120A	120 VAC	860 Ω	65 mA	7.8 V/A	3.6 W
35NC-220A	220 VAC	3,400 Ω	31 mA	6.8 V/A	3.3 W
35NC-12D	12 VDC	36 Ω	333 mA	4.0 V/A	4.0 W
35NC-24D	24 VDC	176 Ω	136 mA	3.3 V/A	3.3 W
35NC-48D	48 VDC	560 Ω	86 mA	4.1 V/A	4.1 W
35NC-125D	125 VDC	3,400 Ω	37 mA	4.6 V/A	4.6 W
60NO-24A	24 VAC	50 Ω	259 mA	6.2 V/A	3.4 W
60NO-120A	120 VAC	1,250 Ω	48 mA	5.8 V/A	2.9 W
60NO-208A	208 VAC	3,400 Ω	30 mA	6.2 V/A	3.1 W
60NO-220A	220 VAC	4,800 Ω	27 mA	5.9 V/A	3.5 W
60NO-277A	277 VAC	7,900 Ω	19 mA	5.3 V/A	2.9 W
60NO-480A	480 VAC	20,000 Ω	12 mA	5.8 V/A	2.9 W
60NO-12D	12 VDC	36 Ω	333 mA	4.0 V/A	4.0 W
60NO-24D	24 VDC	176 Ω	136 mA	3.3 V/A	3.3 W
60NO-48D	48 VDC	636 Ω	75 mA	3.6 V/A	3.6 W
60NO-125D	125 VDC	3,400 Ω	37 mA	4.6 V/A	4.6 W
60NO-250D	250 VDC	14,800 Ω	17 mA	4.3 V/A	4.3 W
60NC-24A	24 VAC	36 Ω	325 mA	7.8 V/A	5.3 W
60NC-120A	120 VAC	860 Ω	69 mA	8.3 V/A	4.1 W
60NC-220A	220 VAC	3,400 Ω	34 mA	7.5 V/A	3.9 W
60NC-277A	277 VAC	7,900 Ω	26 mA	7.3 V/A	5.5 W
60NC-12D	12 VDC	36 Ω	333 mA	4.0 V/A	4.0 W
60NC-24D	24 VDC	140 Ω	171 mA	4.1 V/A	3.3 W
60NC-48D	48 VDC	560 Ω	86 mA	4.1 V/A	4.1 W
60NC-125D	125 VDC	3,400 Ω	37 mA	4.6 V/A	4.6 W
100NO-24A	24 VAC	16 Ω	646 mA	15.5 V/A	6.7 W
100NO-120A	120 VAC	380 Ω	137 mA	16.4 V/A	7.1 W
100NO-220A	220 VAC	1,400 Ω	73 mA	16.1 V/A	7.5 W
100NO-277A	277 VAC	2,400 Ω	55 mA	15.2 V/A	7.3 W
100NO-480A	480 VAC	6,300 Ω	35 mA	16.8 V/A	7.7 W
100NO-24D	24 VDC	65 Ω	369 mA	8.9 V/A	8.9 W
100NO-48D	48 VDC	350 Ω	137 mA	6.6 V/A	6.6 W
100NO-125D	125 VDC	2,400 Ω	52 mA	6.5 V/A	6.5 W
100NC-24A	24 VAC	16 Ω	515 mA	12.4 V/A	4.2 W
100NC-120A	120 VAC	380 Ω	110 mA	13.2 V/A	4.6 W
100NC-208A	220 VAC	1,400 Ω	55 mA	11.4 V/A	4.2 W
100NC-240A	240 VAC	1,685 Ω	49 mA	11.8 V/A	4.0 W
100NC-480A	480 VAC	6,300 Ω	27 mA	13.0 V/A	4.6 W
100NC-12D	12 VDC	28 Ω	433 mA	5.2 V/A	5.2 W
100NC-24D	24 VDC	121 Ω	198 mA	4.8 V/A	4.8 W
100NC-48D	48 VDC	380 Ω	126 mA	6.1 V/A	6.1 W
100NC-125D	125 VDC	2,400 Ω	52 mA	6.5 V/A	6.5 W

- NOTES: 1. Inrush current = 1.5 times the steady state current. (No inrush on DC coils).  
2. Minimum operation voltage is 90% of nominal voltage.  
3. All AC voltages are 50/60 Hz.  
4. For other coils voltages contact the factory  
5. Ratings shown are per pole. (Coils are in parallel).

# MERCURY CONTACTOR RATINGS

RATINGS ARE IN AMPS UNLESS OTHERWISE SPECIFIED

		30 NO	35 NO	35 NO (H) 35 NC	60 NO	60 NO (H) 60 NC	100 NO S100NO	100 NO (H) 100 NC	S100 NO (H)	
A.C. RESISTIVE	240 V	30	35	35	60	60	100	100	100	
	480 V	30	35	35	60	60	80	100	100	
	600 V	30	35	-	48	-	70	80	80	
A.C. INDUCTIVE P.F. .4 OR GREATER	120 V	-	-	25	-	30	-	100		
	240 V	-	-	15	-	20	-	100		
GENERAL PURPOSE P.F. .7 OR GREATER	240 V	-	-	35	-	60	-	100	100	
	480 V	-	-	35	-	60	-	80	100	
D.C. RESISTIVE HEATING	48 V	-	-	35	-	60	-	100		
	125 V	-	-	16	-	40	-	50		
	250 V	-	-	12	-	20	-	30		
TUNGSTEN LAMP	120 V	30	35	35	60	60	100	100		
MOTOR LOADS	SINGLE PHASE	120 V	-	1 H.P.	2 H.P.	-	3 H.P.	-	7.5 H.P.	
		240 V	-	1 H.P.	3 H.P.	-	5 H.P.	-	10 H.P.	
	THREE PHASE	240 V	-	-	5 H.P.	-	7.5 H.P.	-	15 H.P.	
		480 V	-	-	7.5 H.P.	-	10 H.P.	-	20 H.P.	

KEY:  SHADED AREA FOR UL LISTING AND/OR COMPONENT RECOGNITION.  
 - NOT RECOMMENDED FOR THIS TYPE OF LOAD.

## SOLID STATE RELAY RATINGS

CATALOG NUMBER	HPR48A25 HPR48D25	HPR48A50 HPR48D50	HPR48A75 HPR48D75	3PSS60A75
Rated operational current AC51 @ Ta=25°C AC53a @ Ta=25°C	25 AMPS rms 5 AMPS rms	50 AMPS rms 15 AMPS rms	75 AMPS rms 20 AMPS rms	75 AMPS rms 20 AMPS rms
Minimum operational current	150 mA rms	250 mA rms	400 mA rms	400 mA rms
Rep. overload current t=1 s	< 55 A rms	< 125 A rms	< 150 A rms	< 150 A rms
Non-rep. surge current t = 10 ms	325 A <sub>p</sub>	600 A <sub>p</sub>	1150 A <sub>p</sub>	1150 A <sub>p</sub>
Off-state leakage current	< 3 mA rms	< 3 mA rms	< 3 mA rms	< 3 mA rms
I <sub>t</sub> for fusing t = 10 ms	525 A2s	1800 A2s	6600 A2s	6600 A2s
On-state voltage drop	1.6 V rms	1.6 V rms	1.6 V rms	1.6 V rms
Critical dV/dt off-state	1000 V/μs	1000 V/μs	1000 V/μs	500 V/μs

CATALOG NUMBER	SS20AE SS20AU SS20DE SS20DU	SS30AU SS30DU	SS50AE SS50AU SS50DE SS50DU	SS70AU SS70DU
Rated operational current AC51 @ Ta=25°C AC53a @ Ta=25°C	20 AMPS rms 5 AMPS rms	30 AMPS rms 15 AMPS rms	50 AMPS rms 30 AMPS rms	70 AMPS rms 30 AMPS rms
Minimum operational current	350 mA rms	150 mA rms	150 mA rms	150 mA rms
Rep. overload current t=1 s	< 35 A rms	< 125 A rms	< 200 A rms	< 200 A rms
Non-rep. surge current t = 10 ms	250 A <sub>p</sub>	400 A <sub>p</sub>	1900A <sub>p</sub>	1900A <sub>p</sub>
Off-state leakage current	< 3 mA rms	< 3 mA rms	< 3 mA rms	< 3 mA rms
I <sub>t</sub> for fusing t = 10 ms	310 A2s	1800 A2s	1800 A2s	1800 A2s
On-state voltage drop	1.6 V rms	1.6 V rms	1.6 V rms	1.6 V rms
Critical dV/dt off-state	500 V/μs	500 V/μs	500 V/μs	500 V/μs

# SOLID STATE RELAYS

**Models: 3PSS60A75 S (Standard Din-rail) Industrial, 3-Phase SS**  
**3PSS60A75 R (Retro Fit)**



- 3-phase Solid State Relay
- Zero switching
- Rated operational current: 3 x 75 AMPS
- Rated operational voltage: 600 VAC
- Control voltage 24-50 VDC/24-275 VAC
- Integral snubber network
- Built-in varistor
- IP 10 back-of-hand protection
- LED indication of control input
- Heat Sink and 24 VDC Fan Included



## Product Description

A Solid State Relay family designed to switch various loads such as heating elements, motors and transformers. The relay is capable of switching voltages up to 600 VAC rms. The built-in varistor is for heavy industrial applications. For higher reliability and load cycle capability three semiconductor power units are bonded directly to the substrate.

## Tested and Approved

3 Pole 50 AMPS @ 480 VAC @ -30°C to 50°C 3-Phase  
 2 Pole 75 AMPS @ 480 VAC @ -30°C to 50°C 3-Phase \*  
 51°C to 80°C derates @ 10 AMPS per decade  
 \*For 2 Pole usage, use L1 & L3

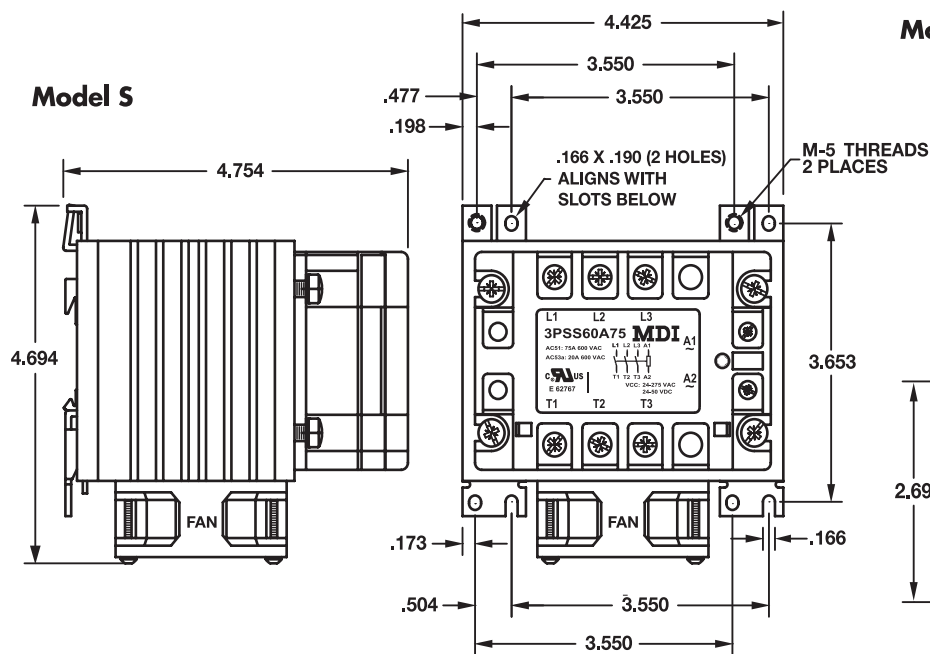
## General Specifications

Operational voltage range	42-660 VAC	45 to 65 Hz
Blocking voltage	1600 <sub>p</sub> V	
Over voltage category III	Pollution degree	3
Operating temperature	-30° to 80°C (-22° to 158°F)	
Storage temperature	-40° to 100°C (-40° to 212°F)	
Input to output isolation voltage	≥ 4000 VAC rms	
Output to case isolation voltage	≥ 4000 VAC rms	
Heat Sink Fan requires	70 mA @ 24 VDC	
Markings	cULUS CE	

## Input Specifications

Control voltage range	24-275 VAC/24-50 VDC
Pick-up voltage	18 VAC/20 VDC
Drop-out voltage	9 VAC/DC
Input current	≤ 15 mA
Response time pick-up (Power output = 50 Hz)	20 ms
Response time drop-out (Power output = 50 Hz)	30 ms

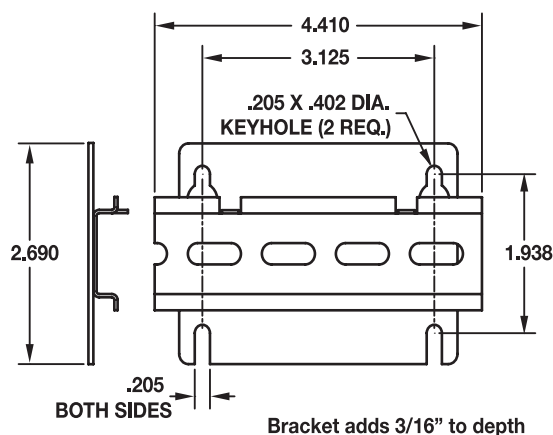
All data specified at Ta=25°C



## Model R

Includes Retro Fit Back Plate

For direct replacement with standard 2 & 3 pole Mercury Relays. Using the same mounting holes.



# SOLID STATE RELAYS *Continued*

## Type HPR48 Industrial, 1-Phase ZS (IO) w. LED and Built-in Varistor



- Zero switching
- Direct copper bonding (DCB) technology
- LED indication
- Built-in varistor 480 V
- Clip-on IP 20 protection cover
- Self-lifting terminals
- Housing free of moulding mass
- Blocking voltage: 1200V<sub>p</sub>
- Opto-isolation: > 4000 VAC rms
- 2 input ranges: 4-32 VDC and 20-280 VAC/22-48 VDC
- Operational ratings: Up to 75 AMPS rms
- Rated voltage: 480 VAC rms



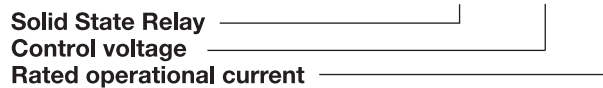
### Product Description

The industrial, 1-phase relay with anti parallel thyristor output is the most widely used industrial SSR due to its multiple application possibilities. The relay can be used for resistive, inductive and capacitive loads. The zero switching relay switches ON when the sinusoidal curve crosses zero and switches OFF when the current crosses

The instant-on relay with DC control input can be used for phase control. The built in varistor secures transient protection for the heavy industrial applications, and the LED indicates the status of the control input. The clip on cover is securing touch protection to IP 20. Protected output terminals can handle cables up to 16mm<sup>2</sup> (6 AWG).

### Ordering Key

**HPR48 A 25**



### Type Selection

Control voltage	Rated operation current
A: 20-280 VAC/22-48 VDC	25: 25 AMPS rms
D: 4-32VDC	50: 50 AMPS rms
	75: 75 AMPS rms

### General Specifications

HPR48...

Operational voltage range	42 to 530 VAC rms
Blocking voltage	≥ 1200 V <sub>p</sub>
Zero voltage turn-on	≤ 10V
Operational frequency range	45 to 65Hz
Power factor	> 0.5 @ 480 VAC rms
Markings	cULus CE

### Input Specifications

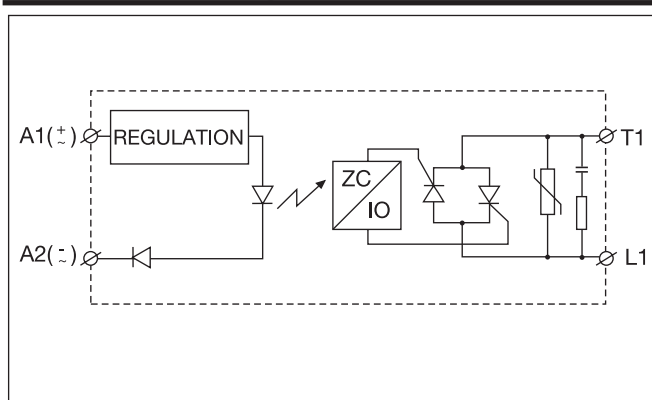
HPR..D.. HPR..A..

Control voltage range	4 - 32 VDC	20 - 280 VAC 22 - 48 VDC
Pick-up voltage @ Ta = 25°C	3.5 VDC	18 VAC/DC
Reverse voltage	32 VDC	-
Drop out voltage	1.2 VDC	6 VAC/DC
Input current @ max voltage	≤ 12 mA	≤ 20 mA
Response time pick-up	≤ 1/2 cycle	≤ 12 ms
Response time drop-out	≤ 1/2 cycle	≤ 40 ms

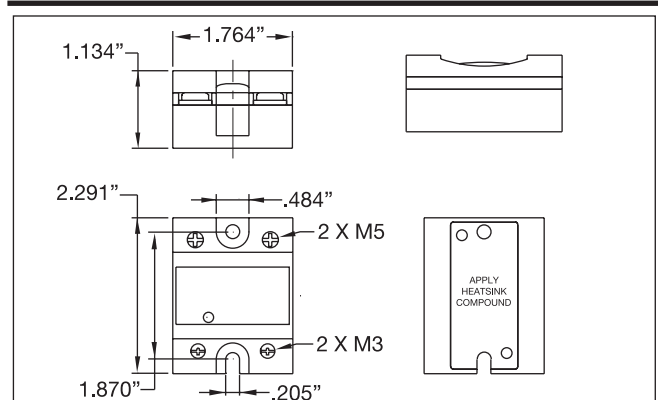
### Thermal Specifications

	HPR...25	HPR...50	HPR...75
Operating temperature range	-20° to 70°C (36° to 126°F)	-20° to 70°C (36° to 126°F)	-20° to 70°C (36° to 126°F)
Storage temperature range	-40° to 100°C (72° to 180°F)	-40° to 100°C (72° to 180°F)	-40° to 100°C (72° to 180°F)
Junction temperature	≤ 125°C (225°F)	≤ 125°C (225°F)	≤ 125°C (225°F)
R <sub>th</sub> junction to case	≤ 0.80K/W	≤ 0.50K/W	≤ 0.35K/W
R <sub>th</sub> junction to ambient	≤ 20.0K/W	≤ 20.0K/W	≤ 20.0K/W

### Functional Diagram



### Dimensions





# SOLID STATE RELAYS *Continued*

## Heatsink Data (load current versus ambient temperature)

### HPR...25

Load current [A]	Thermal resistance [K/W]						Power dissipation [W]
	20	30	40	50	60	70°C	
	68	86	104	122	140	158°F	T <sub>A</sub>
25.0	2.70	2.34	1.98	1.61	1.25	0.89	28
22.5	3.10	2.69	2.28	1.86	1.45	1.04	24
20.0	3.61	3.13	2.65	2.18	1.70	1.23	21
17.5	4.26	3.70	3.14	2.59	2.03	1.47	18
15.0	5.14	4.47	3.80	3.14	2.47	1.80	15
12.5	6.38	5.56	4.73	3.91	3.09	2.27	12
10.0	8.25	7.19	6.14	5.08	4.02	2.97	9
7.5	11.4	9.94	8.49	7.04	5.59	4.14	7
5.0	17.7	15.4	13.2	11.0	8.74	6.51	4
2.5	-	-	-	-	18.2	13.6	2

Ambient temp.

Junction to ambient thermal resistance, R <sub>th j-a</sub>	< 20.0	K/W
Junction to case thermal resistance, R <sub>th j-c</sub>	< 0.80	K/W
Case to heatsink thermal resistance, R <sub>th c-s</sub>	< 0.20	K/W
Maximum allowable case temperature	100 (212)	C (F)
Maximum allowable junction temperature	125 (257)	C (F)

### HPR...50

Load current [A]	Thermal resistance [K/W]						Power dissipation [W]
	20	30	40	50	60	70°C	
	68	86	104	122	140	158°F	T <sub>A</sub>
50.0	1.03	0.86	0.70	0.53	0.37	0.20	61
45.0	1.27	1.09	0.90	0.71	0.52	0.33	53
40.0	1.54	1.32	1.10	0.89	0.67	0.45	46
35.0	1.85	1.59	1.34	1.08	0.82	0.57	39
30.0	2.26	1.95	1.65	1.34	1.03	0.72	33
25.0	2.85	2.47	2.08	1.70	1.32	0.94	26
20.0	3.73	3.24	2.75	2.26	1.77	1.27	20
15.0	5.22	4.54	3.86	3.19	2.51	1.83	15
10.0	8.21	7.16	6.11	5.05	4.00	2.95	10
5.0	17.2	15.0	12.9	10.7	8.51	6.33	5

Ambient temp.

Junction to ambient thermal resistance, R <sub>th j-a</sub>	< 20.0	K/W
Junction to case thermal resistance, R <sub>th j-c</sub>	< 0.50	K/W
Case to heatsink thermal resistance, R <sub>th c-s</sub>	< 0.20	K/W
Maximum allowable case temperature	100 (212)	C (F)
Maximum allowable junction temperature	125 (257)	C (F)

## Isolation

Rated isolation voltage Input to output 4000 VAC rms

Rated isolation voltage Output to case 4000 VAC rms

## Heatsink Selection

Heatsink	Thermal resistance...	...for power dissipation
HS 45CD	2.70K/W	> 60W
HS 45BD	2.00K/W	> 60W
Consult MDI	> 0.25K/W	N/A

### HPR...75

Load current [A]	Thermal resistance [K/W]						Power dissipation [W]
	20	30	40	50	60	70°C	
	68	86	104	122	140	158°F	T <sub>A</sub>
75.0	0.91	0.78	0.65	0.52	0.39	0.26	77
67.5	1.10	0.96	0.81	0.66	0.51	0.36	68
60.0	1.34	1.17	1.00	0.83	0.66	0.49	59
52.5	1.60	1.40	1.20	1.00	0.80	0.60	50
45.0	1.93	1.68	1.44	1.20	0.96	0.72	42
37.5	2.38	2.08	1.78	1.49	1.19	0.89	34
30.0	3.06	2.68	2.30	1.91	1.53	1.15	26
22.5	4.21	3.68	3.16	2.63	2.10	1.58	19
15.0	6.51	5.70	4.88	4.07	3.26	2.44	12
7.5	13.5	11.77	10.09	8.41	6.73	5.04	6

Ambient temp.

Junction to ambient thermal resistance, R <sub>th j-a</sub>	< 20.0	K/W
Junction to case thermal resistance, R <sub>th j-c</sub>	< 0.35	K/W
Case to heatsink thermal resistance, R <sub>th c-s</sub>	< 0.10	K/W
Maximum allowable case temperature	100 (212)	C (F)
Maximum allowable junction temperature	125 (257)	C (F)

# SOLID STATE RELAYS *Continued*



## 20, 30, 50 & 70 AMP RELAYS WITH INTEGRATED HEATSINKS

- AC Semiconductor contactor
- Zero switching
- Direct-Copper bonding (DCB) technology
- LED indication
- Cage Clamp terminals
- 2 input ranges: 4-32 VDC & 24-274 VAC/24-48 VDC
- Operational ratings: 20-70 AMPS AC rms @ 600 VAC
- Non-repetitive voltage: Up to 1200 Vp
- Opto isolation: > 4000 VAC rms
- Operating temperature: -30° to +80°C
- Junction temperature: 125°C on 20, 30 & 70 AMP
- Junction temperature: 120°C on 50 AMP

## SELECTION GUIDE

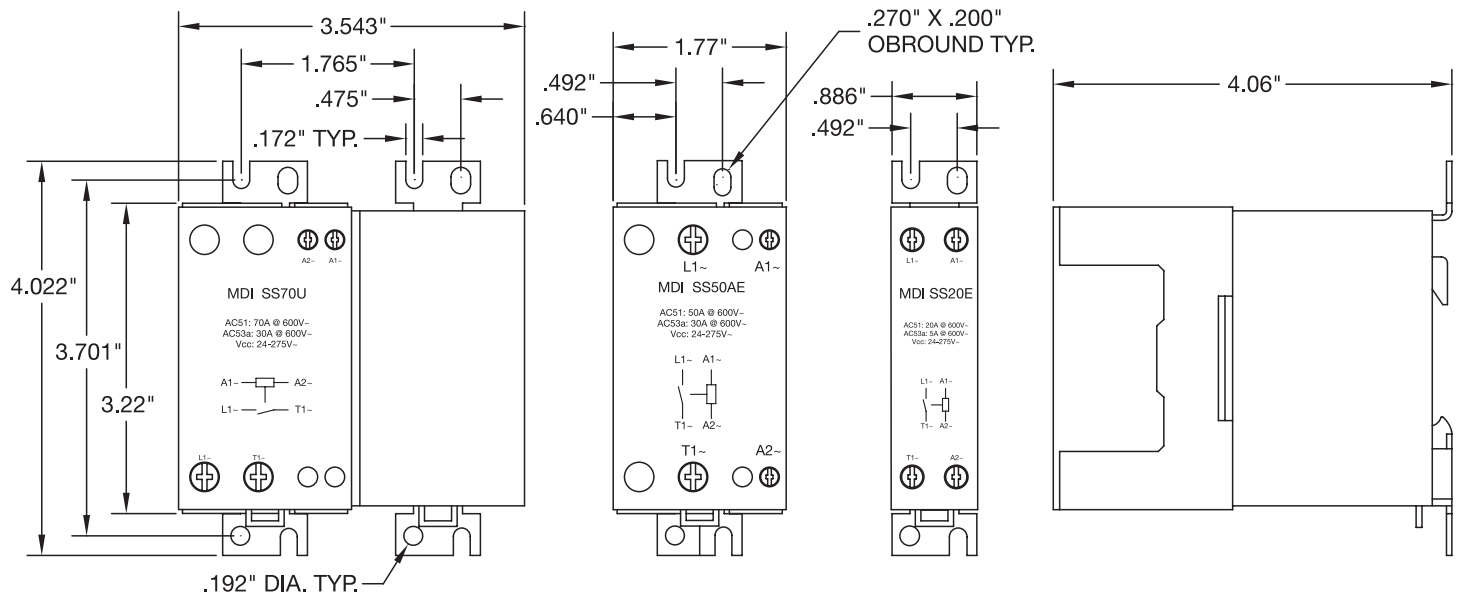
MODEL	CURRENT VOLTAGE	RATED CURRENT
SS20AE	24-275 VAC 24-48 VDC	20 AMP
SS20AU	24-275 VAC 24-48 VDC	20 AMP
SS20DE	4-32 VDC	20 AMP
SS20DU	4-32 VDC	20 AMP
SS30AU	24-275 VAC 24-48 VDC	30 AMP
SS30DU	4-32 VDC	30 AMP
SS50AE	24-275 VAC 24-48 VDC	50 AMP
SS50AU	24-275 VAC 24-48 VDC	50 AMP
SS50DE	4-32 VDC	50 AMP
SS50DU	4-32 VDC	50 AMP
SS70AU	24-275 VAC 24-48 VDC	70 AMP
SS70DU	4-32 VDC	70 AMP

**PRODUCT DESCRIPTION:** MDI Solid State Relays are advantageous in industrial heating applications requiring high cycle rates. These relays have integral heat sinks and are ready to mount on chassis or DIN-rail.

The standard housing dimensions enable straightforward replacement of alternative products and allow for two standard

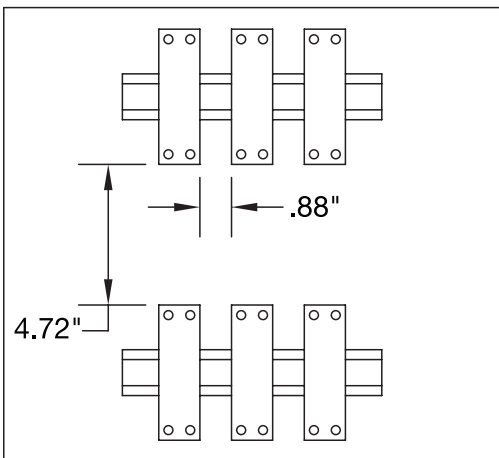
terminal configurations. Cage clamp terminals are used to ensure secure load connection.

An LED indicates the status of the control input. The superior heat-transfer efficiency combined with a robust power management system makes this a high reliability product that can meet the most stringent functional requirements.

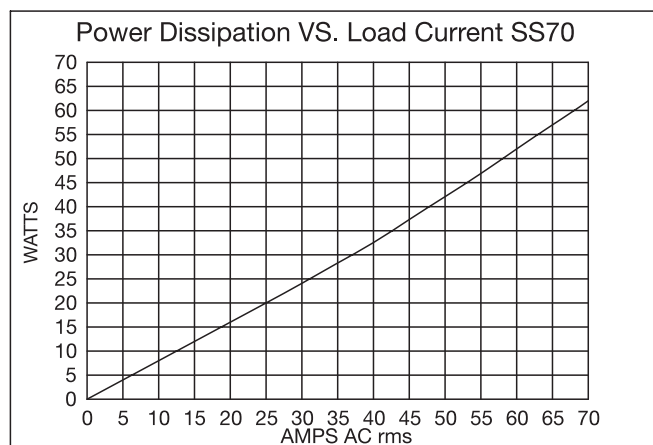
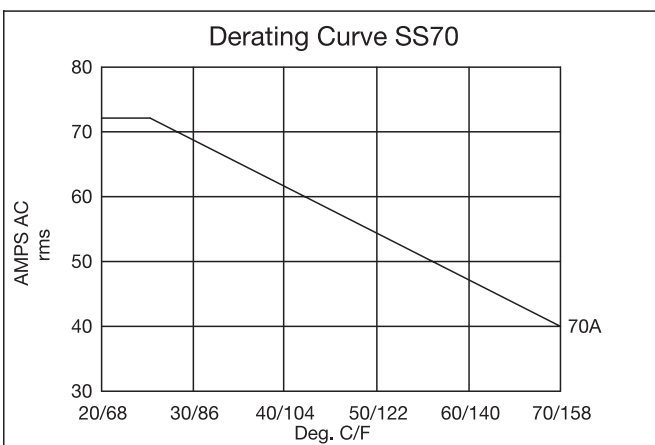
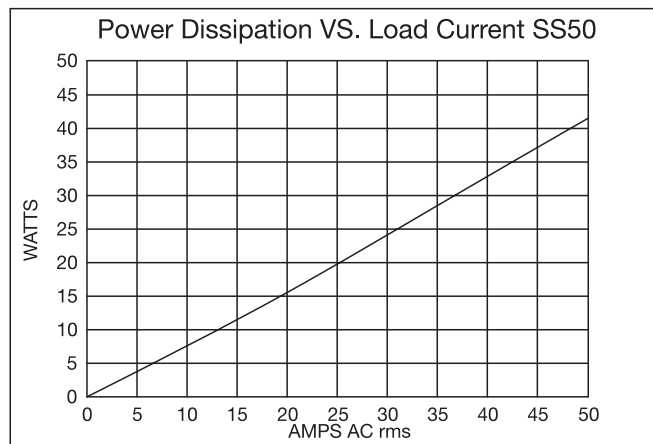
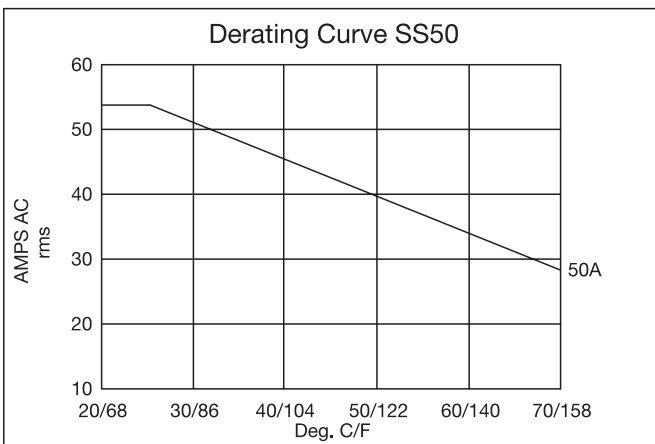
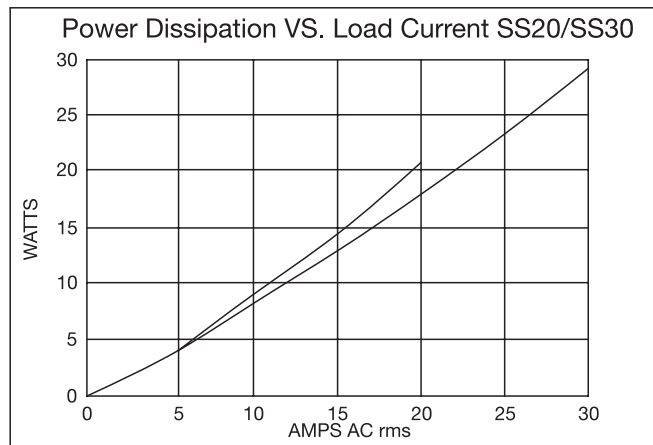
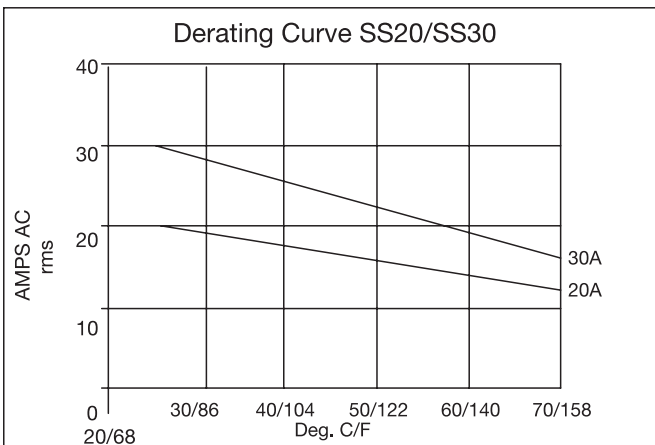
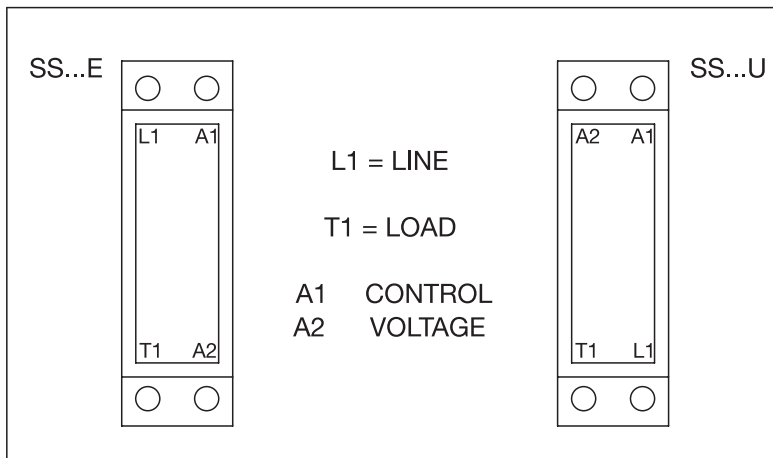


# PANEL, TERMINAL INFORMATION & DERATING CHARTS

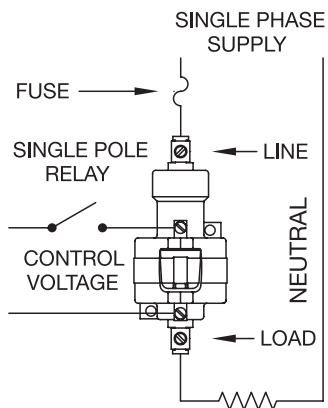
## Panel mounting



## Terminal Layout

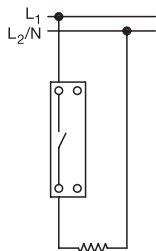


## MERCURY CONTACTORS

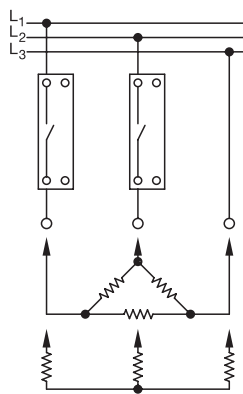
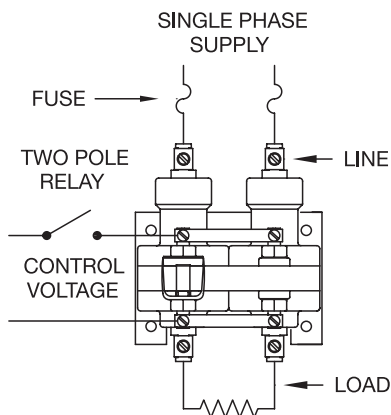


## SOLID STATE

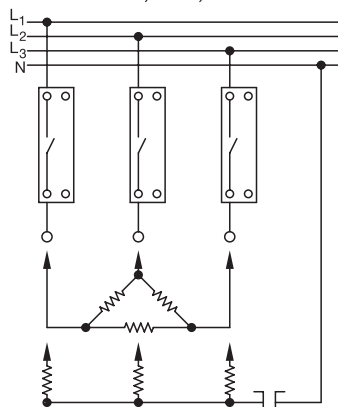
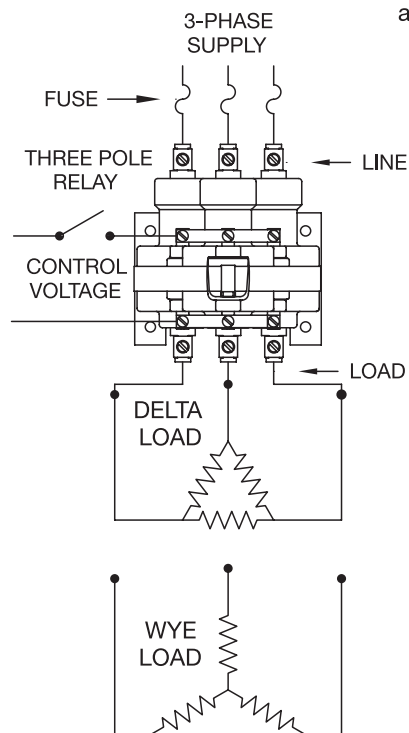
Single pole relay application  
Line-Neutral, Line-Line



2 single pole relays in 3-phase application  
Delta and star connection (economy switch)



3 single pole relays in 3-phase application  
Delta, Star, Star with neutral



M.O.V.

## Proper Fusing is Required

1. While MDI Mercury contactors handle high inrush, such as lamps, mercury contactors are susceptible to damage by short circuit currents, and should be fused to minimize short circuit fault currents. UL class RK-1 and class J fuses and semiconductor I<sup>2</sup>t fuses more effectively protect relays. These are low current-peak fuses designed to limit short circuit currents. Regardless, when there is a short circuit, relay operations should be closely monitored afterward because of the possibility of concealed damage that could cause the relays to behave inconsistently.

### -RECOMMENDED-

250 VOLT	600 VOLT
KTN-R	KTS-R
JJN/A3T	JJS
	JKS/A4J
	KTK-R

- For sizing of relay see below
- For data on standard coils see pages 5,6, 11, & 13.
- MDI RELAYS must mount vertically, ±10°.
- Control line can be protected with metal oxide varistors (MOV). Use suffix -11.
- Disconnect power before installing or servicing. Observe all electrical and safety codes and ordinances such as national electric code (NEC) and the occupational safety and health act (OSHA).

## TORQUE SPECIFICATIONS

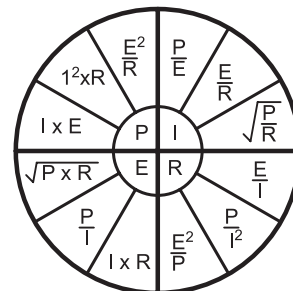
- For coils 8 in. Lb. max.
- For line and load terminals see ratings labels.

### SIZING RELAY

To find AMPS per pole  
3 Ø Balanced Heater loads  

$$\text{AMPS per pole} = \frac{\text{KW} \times 1,000}{\text{VOLTS} \times 1.732}$$
 Or multiply the kilowatts times the appropriate factor

3 Ø AC	FACTORS
208 V	2.776
220 V	2.624
240 V	2.406
277 V	2.084
480 V	1.203
600 V	0.962



### MOV CHART

FOR	SIEMENS	HARRIS	C.K.E.	M.D.I.
24 VOLTS	S14K30	V47ZA7	-	PM-567-5
120 VOLTS	S20K130	V150LA20B	Z150LA20B	PM-567-1
220 VOLTS	S20K275	V275LA40B	Z275LA40B	PM-567-2
277 VOLTS	S20K385	V320LA20B	Z320LA20B	PM-567-3

# INDOOR WATER ALARM

## WITH BATTERY BACKUP

**SP-3000 ALARM** - BBLA INDOOR ALARM WITH **XF2OY1500** MECHANICAL FLOAT

**SP-3100 ALARM** - BBLA INDOOR ALARM WITH **AS2OY1500** MERCURY FLOAT



The BBLA alarm system is designed to monitor liquid levels in sump basins, holding tanks, lift stations tanks and many other non-potable water and wastewater applications. Comes individually boxed with Cable tie and Instruction sheet.

Auxiliary contacts with common, normally open and normally closed terminals are available behind a panel, on the lower right side, held in place by two #1 Phillips head screws. The barrier terminal screws are Phillips/Standard slot combo head type.

The BBLA is design to sound a piezo horn and illuminate a red light to notify of an alarm situation. There is a green line voltage power indicator light to show that the unit is functioning, as well as a silence switch to turn horn off while fixing the alarm (the red alarm light will remain on until the alarm conditions are remedied).

### SPECIFICATIONS

- Dimensions	7" X 4" X 2 1/2"
- Enclosure	NEMA 1 thermoplastic (external mounting feet)
- Horn	85 dB
- Weight	1 1/3 pounds
- Voltage	Primary: 120 VAC, Secondary 12 VAC, 60 Hz (Alarm condition 2.5 Watts max)
- Power cord	6 feet 120 VAC (NEMA 5-15P)
- External block connection	Float connection. DO NOT APPLY POWER! Class Two Output, 12 VAC
- Auxiliary contacts	120 VAC, 5 AMPS max 60 Hz
- Battery Back Up	9 Volt

# OUTDOOR TANK ALARM

**SP-4000 ALARM** - OTA OUTDOOR ALARM WITH **NF2OW1500** MECHANICAL FLOAT

**SP-4100 ALARM** - OTA OUTDOOR ALARM WITH **CG2OY1500** MERCURY FLOAT



The OTA alarm system is designed to monitor liquid levels in sump basins, holding tanks, lift stations tanks and many other non-potable water and wastewater applications. Comes individually boxed with Cable tie and Instruction sheet.

This alarm comes in a Type 4X non-metallic enclosure with external mounting feet and a gasketed door for outdoor use. It has a large red illuminating beacon, front cover mounted piezo, with Test and Silence push button switches.

The OTA is design to sound an audible piezo horn and illuminate the red beacon light to notify of an alarm situation. There is a silence switch to turn the piezo horn off while fixing the alarm (the red alarm light will remain on until the alarm conditions are remedied).

### SPECIFICATIONS

- Dimensions	8" X 4 1/2" X 4 1/4"
- Enclosure	Type 4X non-metallic enclosure rated for indoor or outdoor use
- Piezo Horn	85 dB
- Weight	2 pounds
- Voltage	Primary: 120 VAC, Secondary 12 VAC, 60 Hz 6 Watts max.
- Power cord	6 feet 120 VAC (NEMA 5-15P)
- Float connection	External block connection

# HOW TO ORDER LIQUID LEVEL CONTROL FLOATS

## BASIC SWITCH SERIES

### MERCURY

#### A - TS-1

1 AMP @ 120 VAC Pilot Duty 10°

#### B - WATS-1

1 AMP @ 120 VAC Pilot Duty 90°

#### C - TS-10

13 AMPS @ 120 VAC / 5 AMPS @ 240 VAC 10°

#### D - NATS-20

13 AMPS @ 120 VAC / 6 AMPS @ 240 VAC 30°

#### E - WATS-20

13 AMPS @ 120 VAC / 6 AMPS @ 240 VAC 90°

### MECHANICAL

#### G - 1/2 H.P. 13/15 AMPS 90°

#### H - 1 and 2 H.P. 15 AMPS 90°

#### K - 10 AMPS Pilot Duty Narrow Angle Tetherless

#### L - 1 & 2 H.P. 25 AMPS 90°

#### N - 10 AMPS Pilot Duty Narrow Angle 35°

#### P - 1/2 H.P. Narrow Angle 25°

#### R - 1/2 H.P. Narrow Angle Tetherless

#### S - Small 5 AMPS 120/250 VAC 90°

#### X - Small 5 AMPS 120/250 VAC Narrow Angle 15°

## FLOAT SIZE & STANDARD COLOR CODE

NORMALLY OPEN	NORMALLY CLOSED	BASIC SWITCH SERIES
<b>S</b> -SMALL MERCURY BLACK ABS ONLY	<b>S</b> -SMALL MERCURY BLACK ABS ONLY	<b>A &amp; B SERIES</b>
<b>M</b> -MERCURY BLACK HIPS ONLY	<b>B</b> -MERCURY YELLOW HIPS ONLY	<b>C, D, &amp; E SERIES</b>
<b>F</b> -SMALL MECHANICAL BLACK ABS ONLY	<b>F</b> -SMALL MECHANICAL BLACK ABS ONLY	<b>S &amp; X SERIES</b>
<b>DOUBLE THROW F</b> -SMALL MECHANICAL BLACK ABS ONLY		
<b>F</b> -MECHANICAL BLACK HIPS & ABS	<b>Y</b> -MECHANICAL YELLOW <b>W</b> -MECHANICAL WHITE ABS ONLY	<b>G, H, K, L, P &amp; R SERIES</b>
<b>DOUBLE THROW G</b> -MECHANICAL GREEN ABS ONLY		<b>G, H, K, P &amp; R SERIES</b>
<b>82°C/180°F</b> <b>R</b> -MECHANICAL RED ABS ONLY	<b>82°C/180°F</b> <b>B</b> -MECHANICAL BLUE ABS ONLY	<b>G, H, K, L, P &amp; R SERIES</b>
<b>105°C/221°F</b> <b>T</b> -MECHANICAL TEEL POLYCARB/ABS ONLY	<b>105°C/221°F</b> <b>T</b> -MECHANICAL TEEL POLYCARB/ABS ONLY	<b>G, P &amp; R SERIES</b>

## TERMINATION AND LABEL DESIGNATION

**00** - Standard skive (See Fig 4)

Recognized: No Label

**C1** - 120 VAC Series plug (See Fig 1)

Listed: Label on 6' min. cord

**F1** - 120 VAC Series plug (See Fig 1)

Listed: Label on Float - 6' min. cord

**R1** - 120 VAC Series plug (See Fig 1)

Recognized: No Label - 6' min. cord

**C2** - 240 VAC Series plug (See Fig 2)

Listed: Label on 6' min. cord

**F2** - 240 VAC Series plug (See Fig 2)

Listed: Label on Float - 6' min. cord

**R2** - 240 VAC Series plug (See Fig 2)

Recognized: No Label - 6' min. cord

**03** - 3 Pin barrel plug (See Fig 3)

Recognized: No Label

**F0** - Standard skive (See Fig 4)

Recognized: Label on Float

**GOLD PLATED MECHANICAL  
FLOAT SWITCHES AVAILABLE  
INTRINSICALLY SAFE  
RATINGS: 160 µA TO 100 mA**

# GF10W1000W

### FLOAT MATERIAL

- 1 - High Impact Polystyrene for 60°C/140°F (HIPS)
- 2 - Acrylonitrile Butadiene Styrene for 82°C/180°F (ABS)
- 3 - ABS/Poly carbonate 105°C/221°F (PC/ABS)

### CORD LENGTH

From 01 to 50 feet. Lengths are in even foot increments.

### CORD TYPE AND MATERIAL

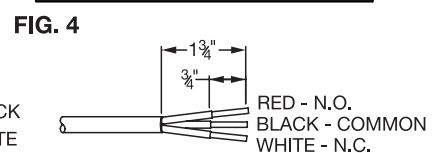
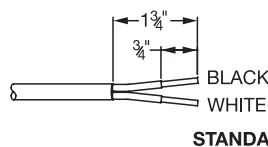
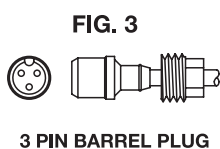
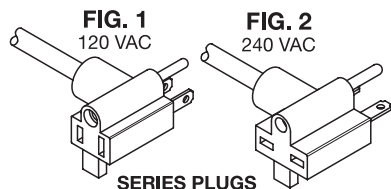
- Y** - 18 Gauge - Chlorinated polyethylene CPE Jacketed (SJOW)
- W** - 16 Gauge - Chlorinated polyethylene CPE Jacketed (SJOW)
- U** - 14 Gauge - Chlorinated polyethylene CPE Jacketed (SJOW)
- T** - 16 Gauge - Teflon TFE Jacketed
- P** - 12 Gauge - Chlorinated polyethylene CPE Jacketed (SJOW)
- N** - 16 Gauge - Chlorinated polyethylene CPE Jacketed (SJOOW)
- L** - 16 Gauge - Chlorinated polyethylene CPE Jacketed (SOOW)

### CONTACTS

- O** - Normally Open
- C** - Normally Closed
- D** - Double Throw

### OPTIONAL

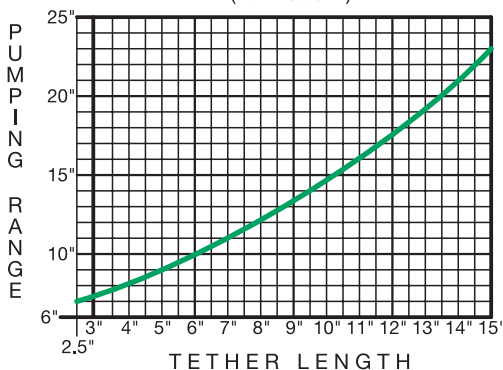
- B** - Individually boxed
- W** - External weighted
- BW** - Individually boxed and Externally weighted
- C** - Capillary Blocks
- T** - Cable Tie Tether



## Installation Instructions

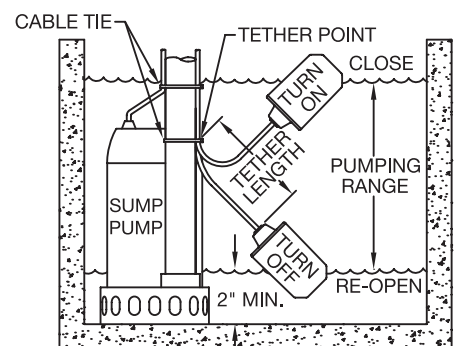
### Tether Data

For CPE jacketed cord  
(16-2 SJOW)



1. Attach cord, using a cable tie, to any convenient rigid surface as illustrated. This is known as the tether point. Do not tighten until both turn-on and turn-off levels are established.
2. To adjust greater distance between turn-on and turn-off, increase cord length between tether point and float. For less distance between turn-on and turn-off decrease cord
3. Make sure the float is at least 2 inches above pump base, in the turn-off position, before tightening cable tie at the tether point.
4. Plug piggy-back switch cord (Series Plug) into grounded outlet, then plug into piggy-back switch cord, and check for proper operation.

### Typical Normally Open (Pump Down) Application



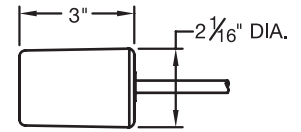
# LIQUID LEVEL CONTROL FLOATS

## Mercury Floats

**C Series**  
10° Narrow Angle Operation  
13 AMPS @ 120 VAC  
5 AMPS @ 240 VAC  
with 16 GA. cord

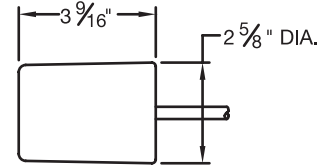
**A Series**  
10° Narrow Angle Operation  
1 AMP @ 120 VAC

**B Series**  
90° Operating Angle  
1 AMP @ 120 VAC



**D Series**  
30° Operating Angle  
13 AMPS @ 120 VAC  
6 AMPS @ 240 VAC  
with 16 GA. cord

**E Series**  
90° Operating Angle  
13 AMPS @ 120 VAC  
6 AMPS @ 240 VAC  
with 16 GA. cord

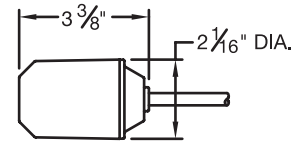


## Mechanical Floats

**G Series**  
90° Operating Angle  
1/2 H.P. @ 120/240 VAC  
15 AMPS @ 120/240 VAC w/ 14 GA. cord  
13 AMPS @ 120/240 VAC w/ 16 GA. cord  
58.8 AMPS overload

**S Series**  
90° Operating Angle  
5 AMPS @ 120/240 VAC  
5 AMPS @ 30 VDC

**X Series**  
15° Narrow Operating Angle  
5 AMPS @ 120/240 VAC  
5 AMPS @ 30 VDC



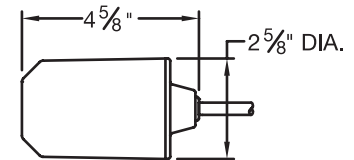
**L Series**  
90° Operating Angle  
1 H.P. @ 120 and 2 H.P. @ 240 VAC  
25 AMPS @ 120/240 VAC with 12 GA. cord

**H Series**  
90° Operating Angle  
1 H.P. @ 120 and 2 H.P. @ 240 VAC  
15 AMPS @ 120/240 VAC with 14 GA. cord  
96 AMPS overload

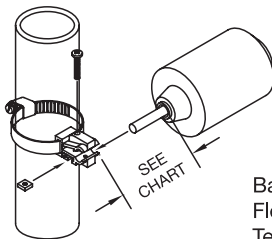
**K Series**  
Tetherless with Internal Weight  
Narrow Angle Operation  
10 AMPS @ 120/240 VAC  
1/4 H.P. @ 120/240 VAC  
34.8 AMPS overload

**P Series**  
25° Narrow Angle Operation  
1/2 H.P. @ 120/240 VAC  
15 AMPS @ 120/240 VAC with 14 GA. cord  
13 AMPS @ 120/240 VAC with 16 GA. cord  
58.8 AMPS overload

**N Series**  
35° Narrow Angle Operation  
10 AMPS @ 120/240 VAC  
1/4 H.P. @ 120/240 VAC  
34.8 AMPS overload



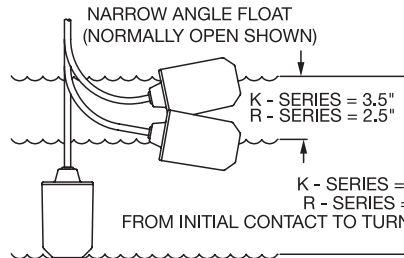
**R Series**  
Tetherless with Internal Weight  
Narrow Angle Operation  
1/2 H.P. @ 120/240 VAC  
15 AMPS @ 120/240 VAC with 14 GA. cord  
13 AMPS @ 120/240 VAC with 16 GA. cord  
58.8 AMPS overload



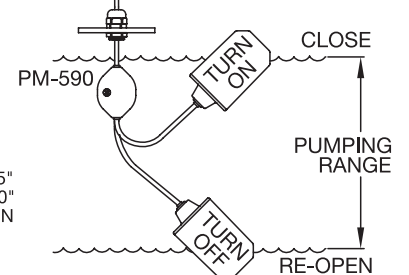
12-2	7 1/2 INCHES
14-3	5 INCHES
14-2	4 INCHES
16-3	4 INCHES
18-2, 18-3, 16-2	3 1/2 INCHES
WIRE GAUGE	MINIMUM LENGTH

Based on SJOW cord @ 65° F.  
Flexibility of wire varies  
Test in actual application to verify

### TETHERLESS INTERNALLY WEIGHTED



### EXTERNAL WEIGHT



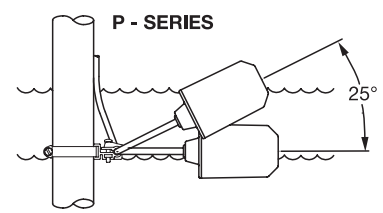
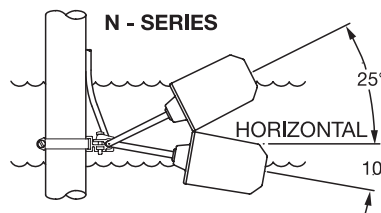
**MDI Tether Clamp** is a nice and simple way to mount your float switch to a pipe, either with a cable tie or pipe clamp. It can be used on 12-2 to 18-2 cords (14-3 to 18-3 with the 3 conductor cord).

**TC** (Includes the clamp, bolt and nut)

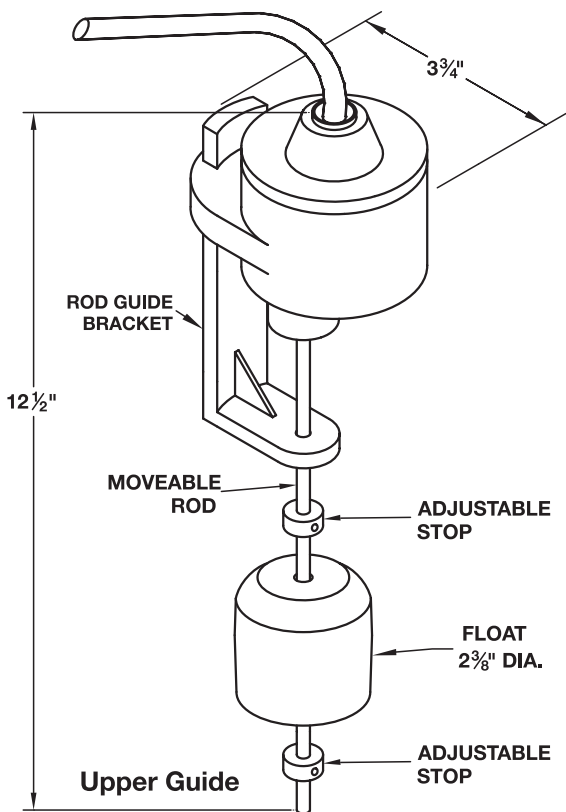
**TC-1** (Includes the clamp, bolt, nut and 2 1/2" max. Pipe clamp)

**TC-2** (Includes the clamp, bolt, nut and 3 1/2" max. pipe clamp)

**TC-10** (Includes the clamp, bolt, nut and 14" cable tie)



# VERTICAL LIQUID LEVEL CONTROL SWITCH



## NUMBERING SYSTEM

VS - 012 03 R9 L - 01  
**A B C D E**

**A** - Length of cord in inches

**B** - Termination; Standards are:

- 00 - 1 3/4" ROJ & 3/4" Strip, or Skive (Standard)
- R1 - Piggyback 120 VAC Component Recognized
- C1 - Piggyback 120 VAC W/ Listed Cord Label
- R2 - Piggyback 240 VAC Component Recognized
- C2 - Piggyback 240 VAC W/ Listed Cord Label
- 03 - 3-Pin Barrel Plug Component Recognized
- C3 - 3-Pin Barrel Plug W/ Listed Cord Label

**C** - Rod Length

- Rod length in inches (9" is standard)
- Rods available up to 24"

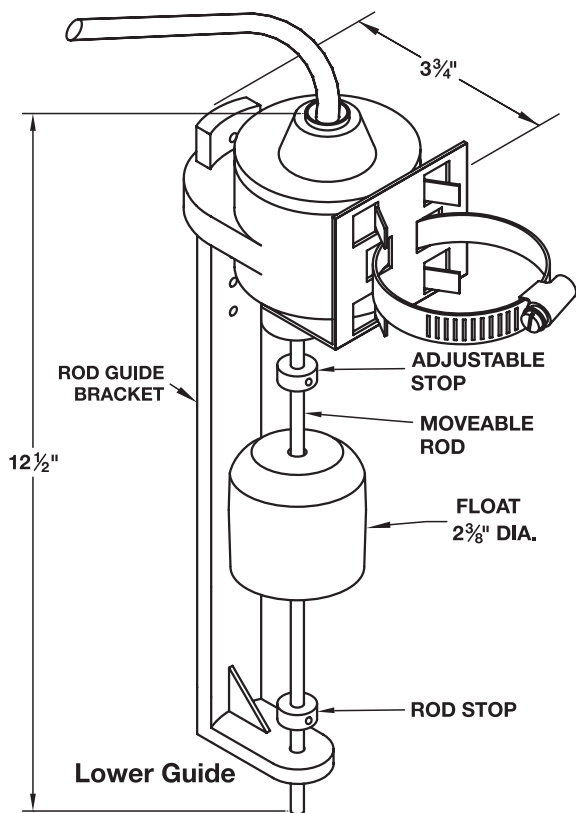
**D** - Rod Guide

- L - Lower rod guide
- U - Upper rod guide

**(Optional)**

**E** - With or without Bracket, or mounting system

- 01 - Pipe Clamp & Stainless Steel Bracket
- 02 - Pipe Clamp & Plastic Bracket



## VS SERIES SUMP PUMP SWITCH

**RATINGS:** 10 AMPS / 1/2 H.P. @ 120/240 V 50/60 Hz.

**PUMPING RANGE:** ADJUSTABLE UP TO 6 INCHES (WITH STANDARD 9" ROD LENGTH).

**MATERIALS:** ENCLOSURE AND GUIDE IS ABS PLASTIC. FLOAT IS BLACK POLYPROPYLENE

**MOUNTING:** STANDARD MOUNTING HOLES FOR #8 SCREWS ON 2.06 INCH CENTERS ARE LOCATED UNDER HOUSING.

**OPTIONAL PIPE MOUNT BRACKET** ALLOWS FOR MOUNTING TO STANDARD SIZE SUMP DISCHARGE PIPING.

**OTHER OPTIONS:** 15 AMPS 3/4 H.P. @ 120/240 VAC  
 NORMALLY CLOSED & DOUBLE THROW  
**CONTACT THE FACTORY**

W/ Stainless Steel Pipe Clamp (-01)



FILE #E-93774 FILE #E-93774 FILE #LR 41198



# TWIN FLOAT CONTROL

## PRODUCT DESCRIPTION:

The Twin Float pump switch consists of two floats, each float contains a mercury switch. One of the two floats contains a heavy-duty relay, which enables the floats to function in series. The relay eliminates pump chatter in turbulent conditions.

The unit is well suited for narrow & deep sump pump pits. On the N.O. (Pump Down) model, the pump is turned on when activated by the top float switch. The pump stays on until the bottom float switch turns it off, this allows a pumping range of about 48" with the standard 54" cord length on the bottom float. This can be extended almost indefinitely with longer cords.

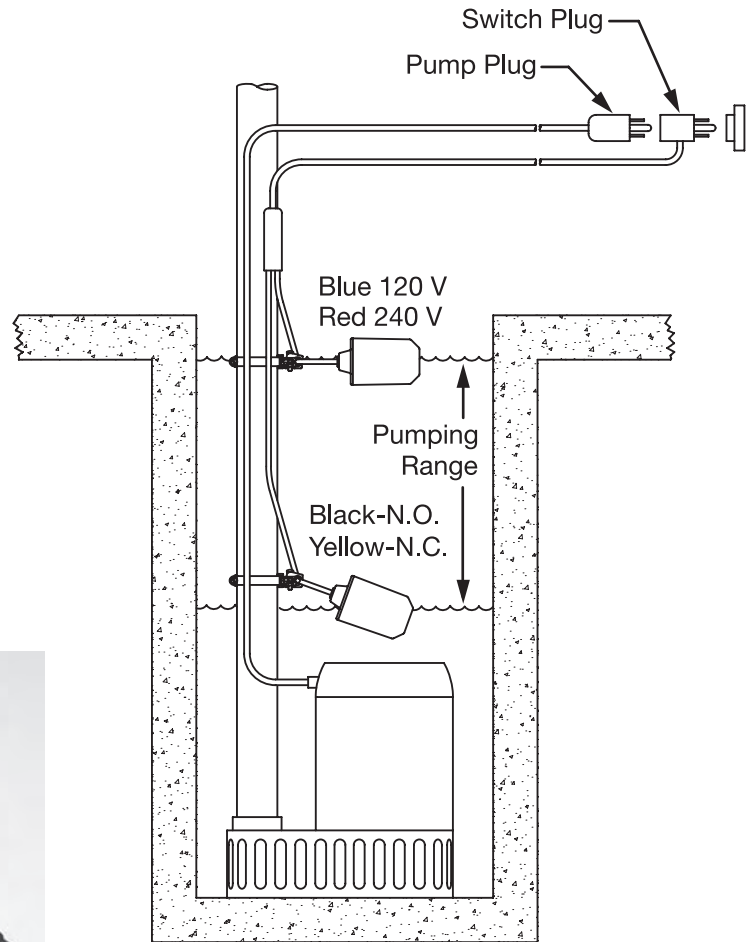


### Ratings:

15 AMPS @ 120/240 VAC  
 1 H.P. @ 120 VAC  
 2 H.P. @ 240 VAC

### Standard colors:

Top float color indicates voltage  
 Blue float - 120 VAC  
 Red float - 240 VAC  
 Bottom float color indicates action  
 Graphite - Pump Down (Normally Open)  
 Yellow - Pump Up (Normally Closed)



## NUMBERING SYSTEM

TFD 1 - 054 - U 15 01  
**A B C D E F**

### A - Switch Action

D - Pump Down (Normally Open)  
 U - Pump Up (Normally Closed)

### B - Voltage

1 - 120 VAC  
 2 - 240 VAC

### C - Bottom Float Cord Length

6" increments, min. length 12"  
 54" is our standard length

### D - Cord Types

U - 14 AWG CPE jacketed SJOW cord

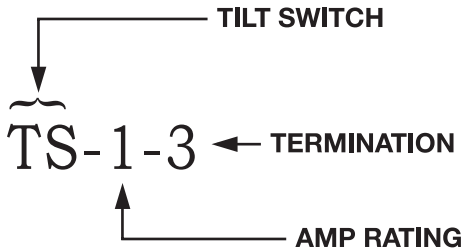
### E - Power Cord Length in Feet

### F - Power Cord (14 AWG PVC)

00 - Standard Skive  
 01 - 120 VAC, 15 AMP piggyback (B must = 1)  
 02 - 240 VAC, 15 AMP piggyback (B must = 2)

# HOW TO ORDER

Specify as shown below.



## MOUNTING CLIPS

PART NO.	FOR
PM-348-36	TS-1, TS-1-L1
PM-348-44	TS-10, TS-10-L1
PM-348-50	TS-1C-L1
PM-348-62	TS-10C-L1, TS-20C-L1



**CASED UNIT**  
"C" for cased unit this space is blank for uninsulated units

## TERMINATION

All leaded and cased tilt switches come with silicone rubber mercury switch lead wire, except TOS-12

## \*TERMINATION WIRE LENGTHS

- L1 = 6" Leads
- L2 = 12" Leads
- L3 = 18" Leads
- L4 = 24" Leads

(CONTINUES IN 6" INCREMENTS)

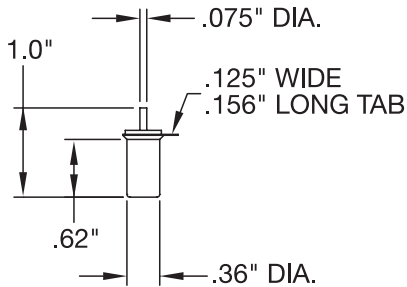
For lead wire or lengths other than the above contact the factory

**For Mercury Free Switches Contact the Factory**

# SWITCHES

**TS-1** Tilt Switch 10°

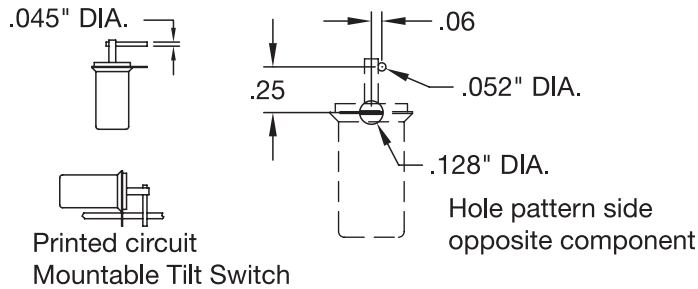
**WATS-1** Wide Angle Tilt Switch 90°



**TS-1-3**

**WATS-1-3**

Printed circuit mountable Tilt Switch



**TS-1-6**

**WATS-1-6**

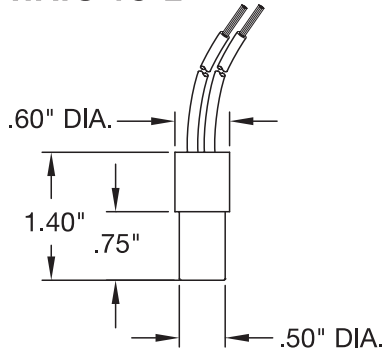


## RATINGS

**TS-1 & WATS-1** 1 AMP @ 120 VAC / 1 AMP @ 28 VDC

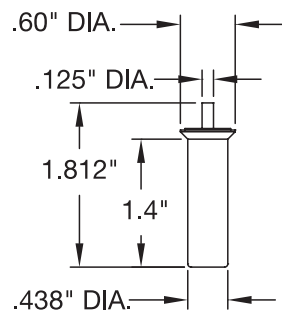
**TS-1C-L\***

**WATS-1C-L\***



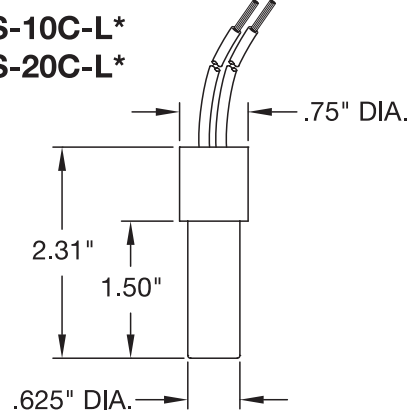
**TS-10** Tilt Switch 10°

**TS-20** Tilt Switch 10°



**TS-10C-L\***

**TS-20C-L\***



**RATINGS TS-10** 10 AMPS @ 120 VAC

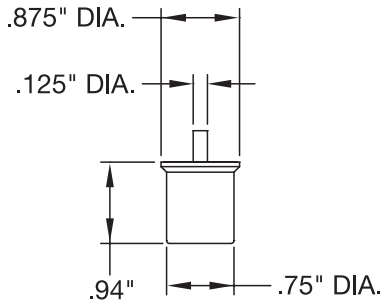
**TS-20** 20 AMPS @ 120 VAC

**NATS-20**

Narrow Angle Tilt Switch 30°

**WATS-20**

Wide Angle Tilt Switch 90°



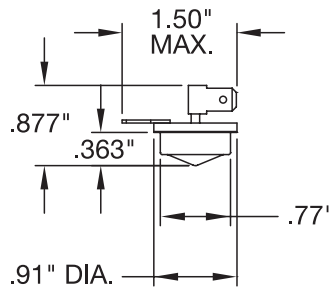
**RATINGS**

**NATS-20 & WATS-20**

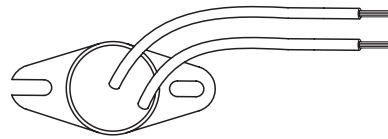
13 AMPS @ 120 VAC  
6 AMPS @ 240 VAC

**TOS-12-2**

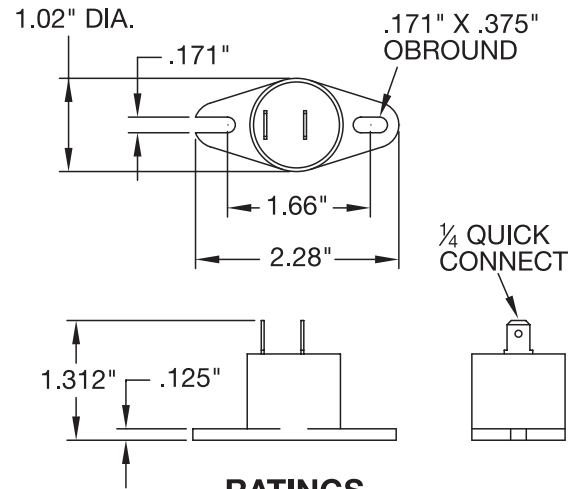
Tip Over Switch 25°



**TOS-12C-L\***



**TOS-12C-8**

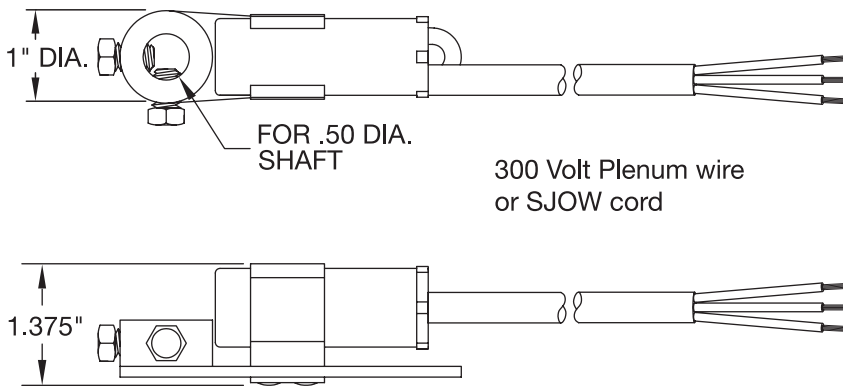


**RATINGS**

**TOS-12**

12 AMPS @ 120 VAC  
25° Tip Over Angle  
  
15° & 45° TOS-12 &  
Mercury Free Available  
Contact the factory

**Damper Arm Tilt Switch**



**RATINGS**

1 AMP @ 120 VAC / 1 AMP @ 28 VDC

**SP-1162-L\_**

SPDT - 18 AWG Plenum wire

**SP-1335-L\_**

SPDT - 18 AWG SJOW Cord

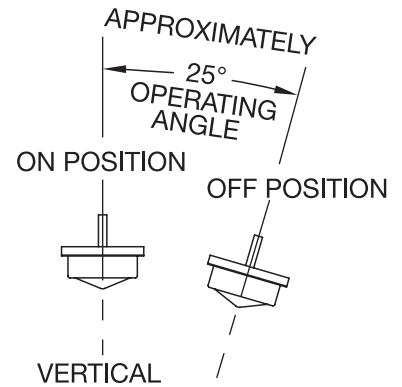
**CORD LENGTHS**

- L1 = 6" LEADS
- L2 = 12" LEADS
- L3 = 18" LEADS
- L4 = 24" LEADS

(CONTINUES IN 6" INCREMENTS)

**TOS-12**

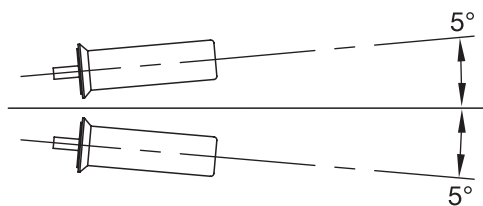
Omni Directional  
Operating Angle



**WATS-1**

**WATS-20**

Operating Angle

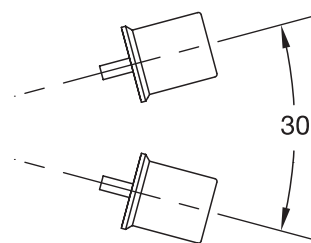


**TS-1, TS-10, TS-20**

Operating Angle  
Recommended operating angle  
for good switch open and closure  
conditions.

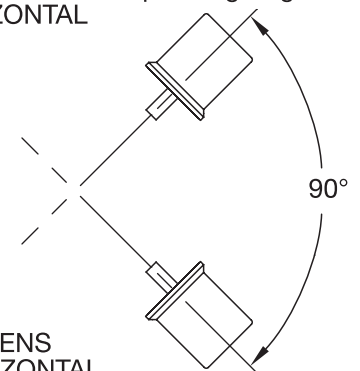
**NATS-20**

Operating Angle



SWITCH CLOSSES  
ABOVE HORIZONTAL

SWITCH OPENS  
BELOW HORIZONTAL



# TYPICAL APPLICATIONS

## FOR MDI'S MERCURY DISPLACEMENT CONTACTORS

### LIGHTING

Auditorium Lighting  
Beacons and Search Lights  
Copy Equipment  
Dimmer Controls  
Display Signs  
Emergency Lighting  
Flood Lights  
High Intensity Lamps  
Hospital Lighting  
Lighting Test Panels  
Mercury Vapor Lamps  
Parking Lots  
Photography Lighting  
Scoreboards  
Sodium Vapor Lamps  
Stage Lighting  
Street Lighting  
Surgical Lighting Control  
Tower Lights  
Traffic Signal  
Tungsten Lamps

### GENERAL APPLICATIONS

Air Conditioning  
Alarm Systems  
Automatic Door Closers  
Battery Chargers  
Blue Print Machines  
Copiers  
Computer Power Supplies

Corrosive Locations  
Dusty, Oil Locations  
Dry Cleaning Equipment  
Energy Management Systems  
Farm Incubators and Brooders  
Low Voltage Switching  
Marking and Engraving Equipment  
Motor Starting  
Soldering Systems  
Surgical Equipment  
Telephone Switching  
Test Panels  
Vapor Degreasers  
X-Ray Machine Controls

### ELECTRIC HEATERS

Baseboard Heaters  
Blow Molding  
Cabinet Heaters  
Chemical Tank Heaters  
Curing Furnaces  
Drying Ovens  
Duct Heaters  
Film Packaging  
Glass Furnaces  
Heat Lamps  
Heat Sealing Machines  
Induction Heater  
Industrial Ovens  
Infrared Heaters  
Ink Drying

Ink Heating  
Injection Molding Machines  
Kilns  
Lab Ovens  
Packaging Equipment  
Plastic Extruders  
Pool Heaters  
Quartz Heaters  
Radiant Heaters  
Roof Top Heating  
Shrink Tunnels  
Unit Heaters  
Vacuum Forming

### FOOD INDUSTRY EQUIPMENT

(Heaters)  
Baking Ovens  
Coffee Urns  
Deep Fryers  
Dishwashers  
Electric Grills  
Electric Ranges  
Pizza Ovens  
Steam Generators

### SPECIALTY APPLICATIONS

Capacitor Discharge Systems  
Hazardous Locations  
Mining Equipment  
Phase Converters  
Tower Control

### WARRANTY

Mercury Displacement Industries, Inc., warrants its products to be free from defects in material or workmanship for one year, and will replace any units with such defects. Warranty is void if units are improperly applied. Mercury Displacement Industries, Inc. shall not be liable for special or consequential damages.

For Mercury Free Switches  
Contact MDI Inc.

1-800-634-4077 or [www.mdious.com](http://www.mdious.com)

TO RECYCLE USED CONTACTORS, TILT SWITCHES & MERCURY FLOATS, RETURN TO MDI

# MDI

MERCURY DISPLACEMENT INDUSTRIES, INC.

Post Office Box 710 - U.S. 12 East - Edwardsburg, Michigan 49112-0710

PHONE (269) 663-8574 - FAX (269) 663-2924

1-800-MDI-4077 - 1-800-634-4077

[www.mdious.com](http://www.mdious.com)