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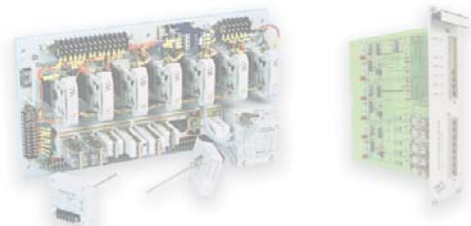


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Form, Fit and Function Electrical Control Panels

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Hall Effect Sensors

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Panel Indicators

Introduction

What is the use of a Magnetic Circuit Breaker?

WHY USE A CIRCUIT BREAKER

Under normal operating conditions, accidents may not appear to be a problem. However, normal operating conditions are not always guaranteed. Under strained or heavy use, a motor and/or another load-generating component within the equipment will draw additional current from the power source; when this happens, the equipment's wires and/or components will overheat and may ultimately burn up.

PREVENT DAMAGE

Power surges and short circuits in unprotected equipment can cause extensive damage to the equipment and to the conductors leading to the equipment.

In addition to protecting the equipment, the entire electrical system including the control switches, wires, and power source must be protected from faults. A circuit protection device should be employed at any point where a conductor size changes. Many electronic circuits and components like transformers have a lower overload withstand threshold level than conductors such as wires and cables. These components require circuit protection devices featuring very fast overload sensing and opening capabilities.

CONSIDERATIONS TO SPECIFY A CIRCUIT BREAKER

Specifying a Circuit Breaker for an application is not a difficult task, but it will require some thought. If electrical and electronic equipment is designed with over-specified circuit protection devices they will be vulnerable to the damaging effects of power surges and the catastrophic results of a fire; while using under-specified circuit protection devices will result in nuisance tripping.

Before specifying a Circuit Breaker, an equipment designer should consider the following:

A - Load characteristics during equipment startup and at normal operation (trip point in amperes and time delay in seconds)

Many types of equipment will produce startup inrush current, or surges. In these cases, circuit breakers with the appropriate time delay should be selected. The time delay specified should slightly exceed the duration of the surge.

B - Applied voltage rating (AC or DC)

C - Number of poles

D - Single phase, multi-phase desired circuit

E - Interrupting (short circuit) capacity:

The short circuit capacity of a circuit protection device should be greater than the circuits available short circuit fault current. Available short circuit current is the maximum RMS current that would be present if all the conductors were to be connected directly to the fault location. In reality, this is not the case. The actual short circuit current is much less than the available short circuit current. The actual short circuit current is reduced due to the combined impedance of the conductors, the size of the transformer and other current restricting components within the circuit.

F - Mounting requirements and position / enclosure size constraints:

The mounting position of a hydraulic/ magnetic circuit breaker is critical to its performance. A standard hydraulic/magnetic circuit breaker should be mounted on a vertical panel as gravity will influence the "must hold" and "must trip" calibration. It is possible to specify the breaker for use in other mounting positions, however, special factory calibration will be required to prevent adverse performance characteristics.

G - Environmental conditions:

The application's environmental conditions must be considered when selecting the proper circuit protection device (e.g. excessive temperature, humidity, severe vibration and shock).

Standards and Features

What are the advantages of Mors-Smitt Hydraulic/Magnetic Circuit Breakers?

RAILWAY STANDARDS

Mors Smitt circuit breakers are designed according to:

IEC 60077	Electrical equipment for rolling stock in railway applications.
EN 50155	Electronic equipment used on rolling stock for railway applications.
EN 45545-2	Fire protection on railway vehicles
NF F16-101/-102	Fire behavior - Railway rolling stock
NF F62-001-1	Railway rolling stock. Magneto-thermic microcircuit-breakers for maximum current for controls and auxiliaries circuits.

Features and Advantages of Mors-Smitt Hydraulic/Magnetic Circuit Breakers

- Designed according to Railway Standards.
- Precision, temperature stable mechanism, not adversely affected by temperature changes in their operating environment.
- Over-current sensing mechanism reacts only to changes of current. No "warm-up" period to slow down its response to overload. No "cool-down" period after overload before it can be reset. Derating considerations due to temperature variations are not normally required and heat-induced nuisance tripping is avoided.
- A common trip linkage between all poles, another safety feature, ensures that an overload in one pole will trip all adjacent poles.
- A trip-free mechanism, a safety feature, makes it impossible to manually hold the contacts closed during overcurrent or fault conditions.
- Standard dimensions, mounting and current ratings provide maximum application versatility.
- Wide range: Current ratings to 125 Amps and rated voltages to 600 VAC are available.
- Series trip, mid-trip, switch only (with or without auxiliary switch), remote shutdown, shunt trip, and dual coil circuit options are offered.

Trip

What Makes a Magnetic Circuit Breaker Trip?

STANDARD CONFIGURATION

The most common magnetic circuit breaker configuration is called "Series Trip". It consists of a current sensing coil connected in series with a set of contacts. (Fig. 1)

RATED CURRENT OR LESS

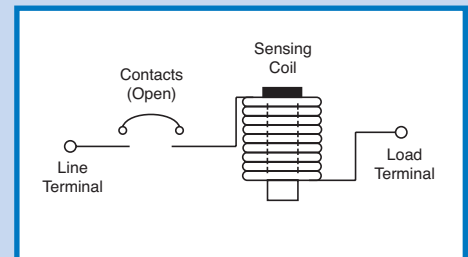
Inside the coil is a non-magnetic delay tube, housing a spring-biased, moving, magnetic core. An armature links the contacts to the coil mechanism, which functions as an electro magnet. When the contacts are open, there is no current flow through the circuit breaker, and no electro-magnetic energy is developed by the coil. When the contacts are closed, current flow begins. (Fig. 2)

MODERATE OVERLOAD WITH INDUCED DELAY

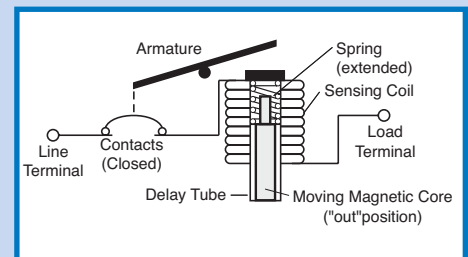
As the normal operating or "rated" current flows through the sensing coil, a magnetic field is created around that coil. When the current flow increases, the strength of the magnetic field increases, drawing the spring-biased, movable, magnetic core toward the pole piece. As the core moves inward, the efficiency of the magnetic circuit is increased, creating an even greater electro-magnetic force. When the core is fully "in", maximum electro-magnetic force is attained, the armature is attracted to the pole piece, unlatching a trip mechanism, thereby opening the contacts. (Fig. 3)

SHORT CIRCUIT CONDITION NO INDUCED DELAY

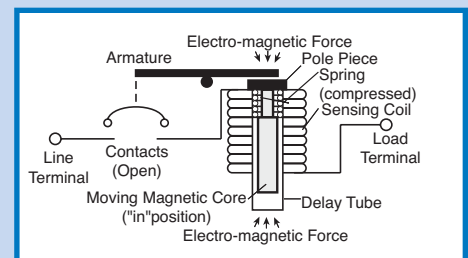
Under short circuit conditions, the resultant increase in electro-magnetic energy is so rapid, that the armature is attracted without core movement, allowing the breaker to trip without an induced delay. This is called "instantaneous trip". It is a safety feature which results in a very fast trip response when most needed. (Fig. 4)



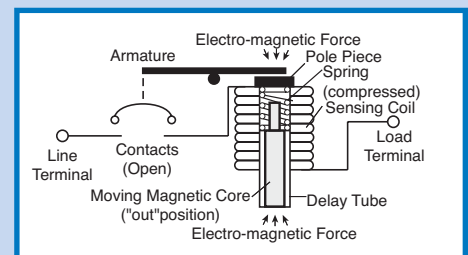
■ Figure 1 - STANDARD CONFIGURATION (SERIES TRIP)



■ Figure 2 - RATED CURRENT OR LESS



■ Figure 3 - MODERATE OVERLOAD WITH INDUCED DELAY



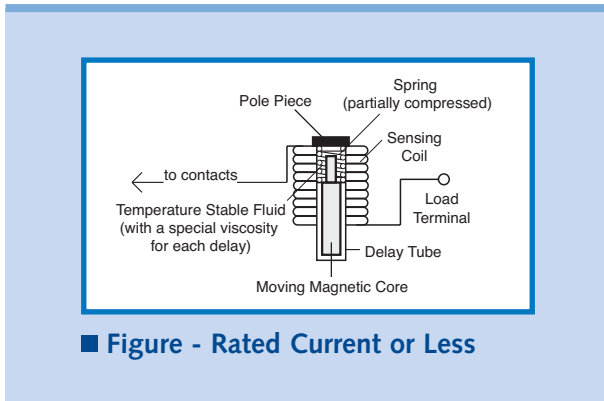
■ Figure 4 - SHORT CIRCUIT CONDITION NO INDUCED DELAY

Time Delays

How are Various Time Delays Obtained?

THE TRIP TIME OF A HYDRAULIC MAGNETIC CIRCUIT BREAKER IS DIRECTLY RELATED TO THE LENGTH OF TIME IT TAKES FOR THE MOVING METAL CORE TO MOVE TO THE FULLY "IN" POSITION.

If the delay tube is filled with air, the core will move rather quickly, and the breaker will trip quickly. This is characteristic of the Ultrashort Delay Curves (Fig. 1). Solid state devices, which cannot tolerate even short periods of current overload, should use Instantaneous Curves (Fig. 2). These curves have no intentional time delay.



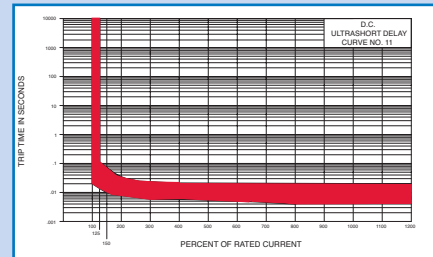
When the delay tube is filled with a light viscosity (temperature stable) fluid, the core's travel to the full "in" position will be intentionally delayed. This results in the slightly longer Medium Delays (Fig. 3), which are used for general purpose applications.

When a heavy viscosity fluid is used, the result will be a long delay, such as figure 4. These curves are commonly used in motor applications to minimize the potential for nuisance tripping during lengthy motor start-ups.

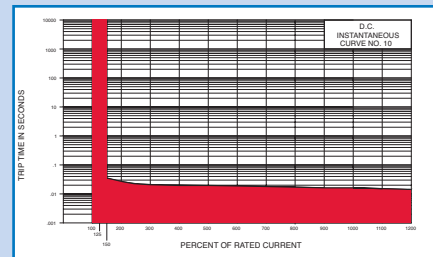
By use of magnetic "shunt" plates within the magnetic circuit, it is possible to divert magnetic flux resulting in higher "inrush withstanding capability" (or high inrush delays). These delays disregard short duration, high pulse surges (typically 8ms or less and up to 25x rated current), characteristic of transformers, switching power supplies and capacitive loads (Fig. 5).

We offer a wide variety of delay curves (ac, dc, dual loads ac/dc and high-inrush) per circuit breaker series. See the datasheet for the available options per series.

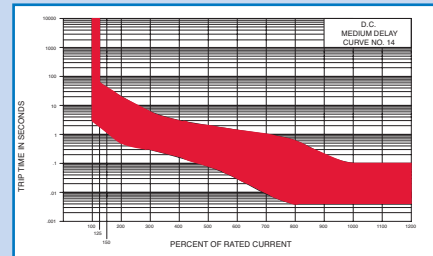
Time delay curves (examples)



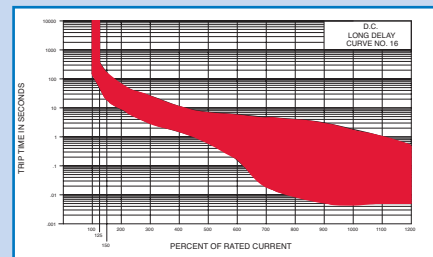
■ Figure 1 - ULTRASHORT DELAY CURVE



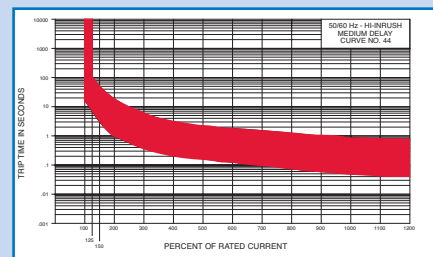
■ Figure 2 - INSTANTANEOUS CURVE



■ Figure 3 - MEDIUM DELAY CURVE



■ Figure 4 - LONG DELAY CURVE



■ Figure 5 - HI-INRUSH MEDIUM DELAY CURVE

Circuit Options

What Circuit Options are Available?

SERIES TRIP

A basic two terminal device is usually used as a combination power switch and overload protector. The contacts and current sensing coil are connected in series with the line and load terminals. (Fig. 1)

SERIES TRIP WITH AUXILIARY SWITCH

Same as a Series Trip except with the addition of a S.P.D.T. snap-action switch, which is electrically isolated, but mechanically linked to the movement of the main breaker contacts. This switch is commonly used to remotely signal the status of the breaker (ON or OFF/TRIPPED). (Fig. 2)

Series Trip is also available with Alarm Switch.

SERIES MID-TRIP WITH ALARM SWITCH

Similar to "Series Trip with Auxiliary Switch" except the S.P.D.T. auxiliary switch is actuated only upon electrical trip of the breaker. Upon electrical trip, the "N.O." contact closes and the "N.C." contact opens. This can be used to remotely signal the "TRIPPED" status of the breaker. Also, upon electrical trip, the handle moves to the "MID" position as opposed to the "full OFF" position typical of other breakers. This gives a specific visual panel indication of a "TRIPPED" breaker as compared to one which is merely turned OFF. (Fig. 2)

Series Mid-Trip is also available without Auxiliary Switch.

SERIES TRIP WITH REMOTE SHUTDOWN

For "dump" circuit or "panic" circuit applications. Same as a Series Trip but with an additional (self-interrupting) "voltage coil" pole (usually of opposite polarity) for remote shutdown. In the example, a momentary voltage pulse to Pole 2 will shut down both Pole 1 and Pole 2. Because the voltage coil in Pole 2 is self-interrupting, no additional components, such as auxiliary switches, are required in that circuit. (Fig. 3)

DUAL COIL WITH REMOTE SHUTDOWN

Similar to "Series Trip with Remote Shutdown" except an extra pole is NOT required. A Dual Coil breaker has two coils in the space normally occupied by a single coil. A current coil is used for overload protection and the instant trip voltage coil can be used for remote shutdown.

The Dual Coil options is the "Shunt Trip Dual Coil", a three terminal device with one side of the voltage coil internally connected to the primary circuit. (Fig. 4)

The other side of the voltage coil is connected to an external third terminal on the bottom of the breaker. This circuit option uses line voltage for dual coil activation, saving wiring costs and resulting in a self-protecting voltage coil.

SWITCH ONLY

Same as a Series Trip, but without a sensing coil. Provides low cost, heavy-duty switch capability when overload protection is not needed. "Switch Only" is available with and without an auxiliary switch. (Fig. 5)

SHUNT TRIP

A three terminal device similar to "Series Trip", but with the addition of a third terminal between the contacts and the coil. This circuit is usually used to control two separate loads (A&B) from the same power source, while sensing overload current in only one load (B). It should be noted that overload protection is not provided in the load (A) circuit, and if needed, must be provided by other means. Also, the sum of the current in circuit A & B must not exceed the contact rating of the device. (Fig. 6)

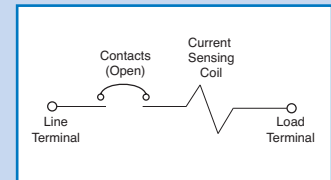


Fig. 1 - SERIES TRIP

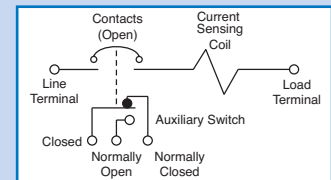


Fig. 2 - SERIES TRIP WITH AUXILIARY SWITCH

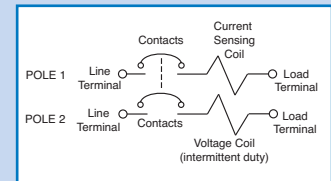


Fig. 3 - SERIES TRIP WITH REMOTE SHUTDOWN

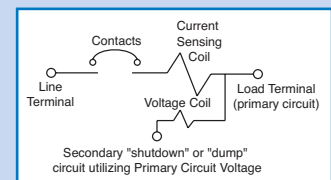


Fig. 4 - SHUNT TRIP DUAL COIL

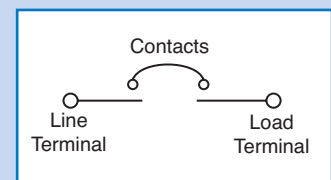


Fig. 5 - SWITCH ONLY

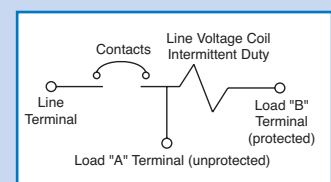


Fig. 6 - SHUNT TRIP

Selection Guide

MCB Serie	Rated current	Max. number of poles	Maximum voltage	Maximum interrupting capacity	Internal circuit configuration*	Mounting	Connection	Page
AR	0,1 - 50 A	6	80 VDC 277 VAC 50/60 Hz	3000 A at 65 VDC 5000 A at 277 VAC	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Front	Rear	5-8
CR	0,1 - 100 A	6	125 VDC 277 VAC 50/60 Hz 400 VAC 50/60Hz (>2P)	3000 A at 65 VDC 5000 A at 277 VAC	1, 2, 3, 4, 7, 8, 9, 10	Front	Rear	5-8
DR	0,1 - 50 A	4	80 VDC 277 VAC 50/60 Hz	5000 A at 65 VDC 5000 A at 277 VAC	1, 7	Front/Rear DIN rail	Top-Botom	5-8
ER	0,1 - 100 A	6	150 VDC 277 VAC 50/60 Hz 600 VAC 50/60Hz (>2P)	5000 A at 125 VDC 6000 A at 240 VAC	1, 2, 7, 8, 9	Front/Rear	Rear/ Top-Botom	5-8
PDR	0,1 - 50 A	4	480 VAC "STAR" 277 VAC 50/60 Hz	2000 A at 480 VAC 5000 A at 208 VAC		Front/Rear DIN rail	Top-Botom	5-9
RBR	CR	0,1 - 100 A	125 VDC 277 VAC 50/60 Hz 400 VAC 50/60Hz (>2P)	3000 A at 65 VDC 5000 A at 277 VAC	1, 2, 3, 4, 7, 8, 9, 10	Front	Rear	5-9
	DR	0,1 - 50 A	80 VDC 277 VAC 50/60 Hz	5000 A at 65 VDC 5000 A at 277 VAC	1, 7	Front/Rear DIN rail	Top-Botom	5-9

(*) Internal circuit configurations

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Series Trip without auxiliary switch 2. Series Trip with auxiliary switch 3. Series Mid-Trip without alarm switch 4. Series Mid-Trip with alarm switch 5. Series Strip with remote shutdown (on special request) | <ol style="list-style-type: none"> 6. Dual Coil with remote shutdown 7. Switch Only without auxiliary switch 8. Switch Only with auxiliary switch 9. Shunt Trip (current coil) 10. Shunt Trip (voltage coil) |
|---|---|

Circuit Breakers

Circuit Breakers

AR - Series



CR - Series



DR - Series



ER - Series



Electrical	AR - Series	CR - Series	DR - Series	ER - Series
Maximum Voltage	277 VAC - 50/60 Hz 80VDC	400 VAC - 50/60Hz 277 VAC - 50/60 Hz 125 VDC	277 VAC - 50/60 Hz 80VDC	600 VAC - 50/60Hz 277 VAC - 50/60 Hz 150 VDC
Current Ratings	0,1 to 50 A	0,1 to 100 A	0,1 to 50 A	0,1 to 100 A
Standard Voltage Coils	6 VDC, 12 VDC; 120 VDC	6 VDC, 12 VDC; 120 VDC	6 VDC, 12 VDC; 120 VDC	
Auxiliary Switch Rating (SPDT)	10,1 A - 250 VAC, 1 A - 65 VDC 0,5 A - 80 VDC, 0,1 A - 125 VAC (with gold contacts)	10,1 A - 250 VAC, 1 A - 65 VDC 0,5 A - 80 VDC 0,1 A - 125 VDC 0,1 A - 125 VAC (with gold contacts)		10,1 A - 250 VAC, 1 A - 65 VDC 0,5 A - 80 VDC 0,1 A - 125 VDC 0,1 A - 125 VAC (with gold contacts)
Insulation Resistance	Min.: 100 Megohms at 500 VDC	Min.: 100 Megohms at 500 VDC	Min.: 100 Megohms at 500 VDC	Min.: 100 Megohms at 500 VDC
Dielectric Strength	1500 VAC for one minute between all electrically isolated terminals.	5000 VAC for one minute between all electrically isolated terminals.	1960 VAC for one minute between all electrically isolated terminals.	2200 VAC for one minute between all electrically isolated terminals.
Maximum interrupting capability	3000 A @ 65 VDC 3500 A @ 65 VDC (with fuse backup) 3000 A @ 250 VAC 5000 A @ 277 VAC (with fuse backup)	10000 A @ 80 VDC; 120 VAC 5000 A @ 125 VDC 6000 A @ 240 VAC	5000 A @ 65 VDC 5000 A @ 277 VAC (with fuse backup) 3000 A @ 250 VAC	5000 A @ 125 VDC 5000 A @ 600 VAC 6000 A @ 240 VAC 10000 A @ 600 VAC (w. fuse backup)
Physical & Mechanical				
Number of Poles	1 - 6 Poles	1 - 6 Poles	1 - 4 Poles	1 - 6 Poles
Internal Circuit Configurations (*)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1, 2, 3, 4, 7, 8, 9, 10	1, 7	1, 2, 7, 8, 9
Weight	Approx. 65 grams/pole. (2.32 oz)	Approx.112 grams/pole (3.95 oz)	Approx.128 grams/pole (4.57 oz)	Approx.252 grams/pole (9 oz)
Endurance	10,000 ON-OFF operations @ 6 per minute; with rated Current & Voltage.	10,000 ON-OFF operations @ 6 per minute; with rated Current & Voltage.	10,000 ON-OFF operations @ 6 per minute; with rated Current & Voltage.	10,000 ON-OFF operations @ 6 per minute; with rated Current & Voltage.
Environmental				
Shock	Withstands 100 Gs, 6 ms, sawtooth while carrying rated current. Instantaneous and ultra-short curves tested @ 90% of rated current.	Withstands 100 Gs, 6 ms, sawtooth while carrying rated current. Instantaneous and ultra-short curves tested @ 90% of rated current.	Withstands 100 Gs, 6 ms, sawtooth while carrying rated current. Instantaneous and ultra-short curves tested @ 90% of rated current.	Withstands 100 Gs, 6 ms, sawtooth while carrying rated current. Instantaneous and ultra-short curves tested @ 90% of rated current.
Vibration	Withstands 0.060" excursion from 10-55 Hz, and 10 Gs 55-500 Hz, at rated current. Instantaneous and ultrashort curves tested at 90% of rated current.	Withstands 0.060" excursion from 10-55 Hz, and 10 Gs 55-500 Hz, at rated current. Instantaneous and ultrashort curves tested at 90% of rated current.	Withstands 0.060" excursion from 10-55 Hz, and 10 Gs 55-500 Hz, at rated current. Instantaneous and ultrashort curves tested at 90% of rated current.	Withstands 0.060" excursion from 10-55 Hz, and 10 Gs 55-500 Hz, at rated current. Instantaneous and ultrashort curves tested at 90% of rated current.
Moisture Resistance	Ten 24-hour cycles @ +25°C to +65°C, 80-98% RH.56 days @ +85°C, 85% RH.	Ten 24-hour cycles @ +25°C to +65°C, 80-98% RH.56 days @ +85°C, 85% RH.	Ten 24-hour cycles @ +25°C to +65°C, 80-98% RH.56 days @ +85°C, 85% RH.	Ten 24-hour cycles @ +25°C to +65°C, 80-98% RH.56 days @ +85°C, 85% RH.
Salt Spray	90-95% RH @ 5% NaCl Solution, 96 hrs.	90-95% RH @ 5% NaCl Solution, 96 hrs.	90-95% RH @ 5% NaCl Solution, 96 hrs.	90-95% RH @ 5% NaCl Solution, 96 hrs.
Thermal Shock	Five cycles @ -55°C to +25°C to +85°C to +25°C.	Five cycles @ -55°C to +25°C to +85°C to +25°C.	Five cycles @ -55°C to +25°C to +85°C to +25°C.	Five cycles @ -55°C to +25°C to +85°C to +25°C.
Operating Temperature	-40° C to +85° C	-40° C to +85° C	-40° C to +85° C	-40° C to +85° C

(*) Internal circuit configurations

1. Series Trip without auxiliary switch
2. Series Trip with auxiliary switch
3. Series Mid-Trip without alarm switch
4. Series Mid-Trip with alarm switch
5. Series Strip with remote shutdown (on special request)
6. Dual Coil with remote shutdown
7. Switch Only without auxiliary switch
8. Switch Only with auxiliary switch
9. Shunt Trip (current coil)
10. Shunt Trip (voltage coil)

Ground Fault Protection Device

■ PDR - Series



General description	General description
	The PDR is an equipment ground fault protection device that combines hydraulic/magnetic circuit breaker, overload and short circuit protection and ground fault protection. This breaker senses and guards against faults to ground using a state of the art integrated circuit. This technology detects faults. When a fault occurs, the breaker trips and an LED illuminates. The LED gives a clear indication that the trip occurred as a result of leakage. This protection helps prevent serious equipment damage and fire.
Electrical	
Maximum Voltage	AC, 480 WYE/277VAC, 50/60Hz
Current Ratings	1 to 50 A (See datasheet)
Insulation Resistance	Min.: 100 Megohms at 500 VDC
Dielectric Strength	1960 VAC for one minute between all electrically isolated terminals.
Maximum interrupting capability	5000 A @ 208 VAC 2000 A @ 480 VAC (WYE connected)
Leakage to ground	
Standard Must Trip Leakage	7, 10, 15, 30, 50 & 100 milliamps. For other ratings, consult factory.
Current Ratings	
Trip Time	300 ms Max. @ 100%, 40ms Max. @ 500% of must trip leakage current.
Test Button	On breaker face above actuator.
Leakage Trip Indicator	Red LED on breaker face above actuator.
Physical & Mechanical	
Number of Poles	2, 3 & 4 Poles
Length	106.7 mm (4.2 inches) (included switched or unswitched neutral)
Width	2-pole: 76.2 mm (3.0 inches) 3-pole: 95.3 mm (3.75 inches) 4-pole: 114.3 mm (4.5 inches)
Depth	63.5mm (2.5 inches)
Weight	2-pole: 453.6 g (16.0 oz.) 3-pole: 606.7 g (21.4 oz.) 4-pole: 762.6 g (26.9 oz.)
Mounting	Front Panel or Standard 35mm Symmetrical DIN Rail (35 x 7.5 or 35 x 15mm per DIN EN5002).
Termination	Box Lug
Endurance	10,000 ON-OFF operations @ 6 per minute; with rated Current & Voltage.

Remote Operated Circuit Breakers

■ RBR - Series

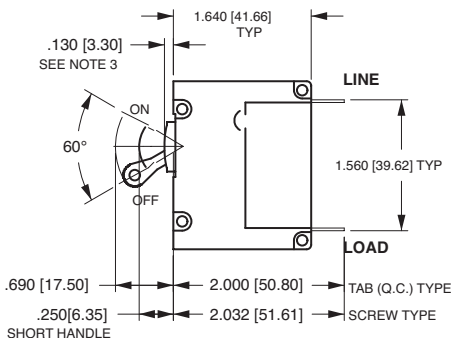
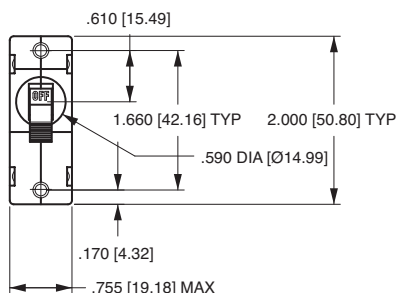


General description	General description
	<i>Remote operated hydraulic/magnetic circuit breakers consist of a custom designed remote operator module (housed within a circuit breaker molding), coupled to a CR-Series or DR-Series hydraulic/magnetic circuit breaker. The complete package can be easily mounted into existing panel designs.</i>
	The Mors Smitt remote operated circuit breaker combines the convenience of remote ON, OFF and Reset capability, with the safety and accuracy of a standard magnetic current sensing device, thus allowing operation of the breaker from various locations in a system, facility or site (while not sacrificing the ability to manually operate the breaker if required). With the RBR, service, diagnostics, load shedding and power distribution control functions can now be performed in areas that were previously unattended, inaccessible or unsafe. The RBR module allows remote operation of the CR-Series panel mount breaker, or the DR-Series DIN rail mount breaker (up to 3 poles) through hard wiring with a single pole, double throw switch connected to a standard power source, or more sophisticated relay and modem networks. The RBR module can be mounted to either side of the host breaker, while occupying only the width of a standard CR-Series pole. Several interface methods are available. Remote physical actuation of the host circuit breaker is achieved by connecting the RBR module's handle with the breakers. Being based on the CR-Series breaker, the RBR allows easy adaptation into existing panel designs. In addition, its' compact size allows efficient use of space for new design applications. With the RBR, Mors Smitt has designed a versatile, compact and reliable solution in a hydraulic/magnetic circuit breaker or switch only device that can be operated both manually and remotely.
RBR Motor Specification	
Voltage input	12 VDC to 80 VDC.
Start current	< 1A
Switching time	< 2 seconds

Circuit Breakers

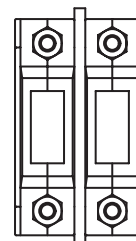
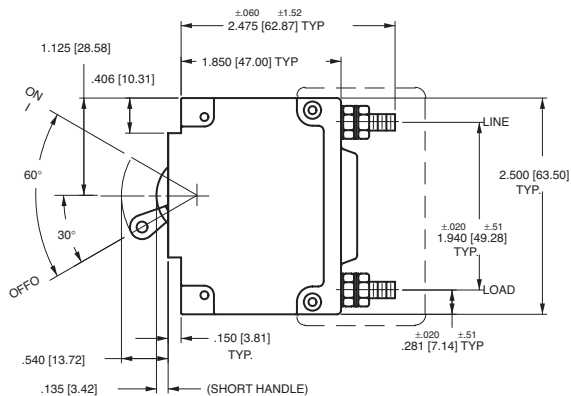
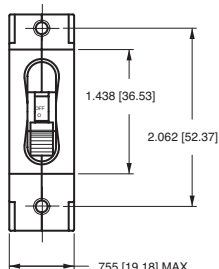
Dimensions

AR - Series

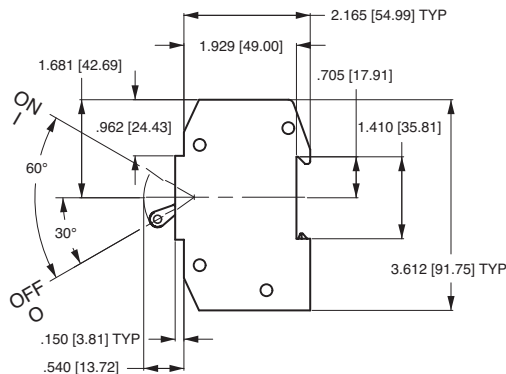
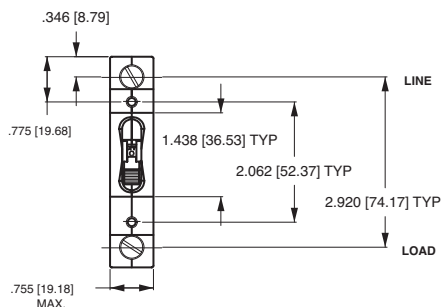


TAB (Q.C.) TYPE TERMINALS IN SERIES TRIP CIRCUIT CONFIGURATION SHOWN. FOR OTHER CONFIGURATIONS, SEE CIRCUIT AND TERMINAL DIAGRAMS.

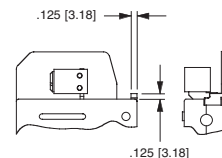
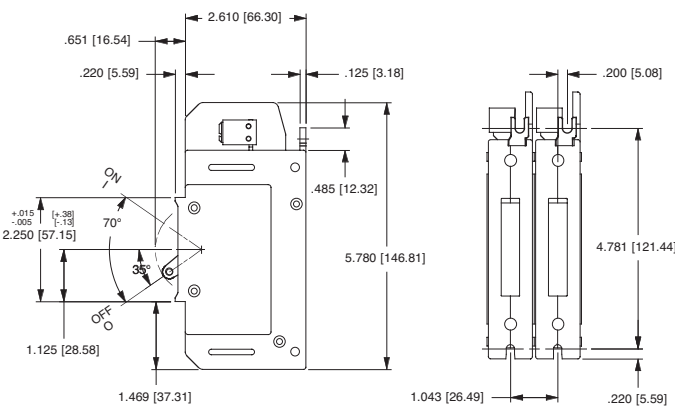
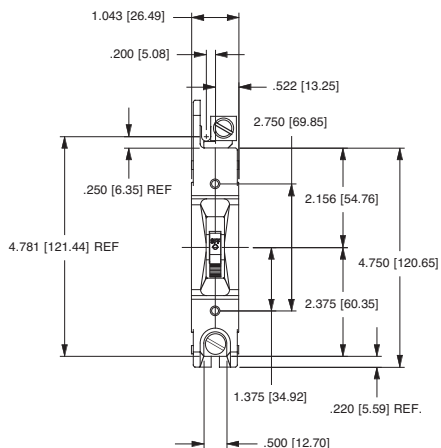
CR - Series



DR - Series

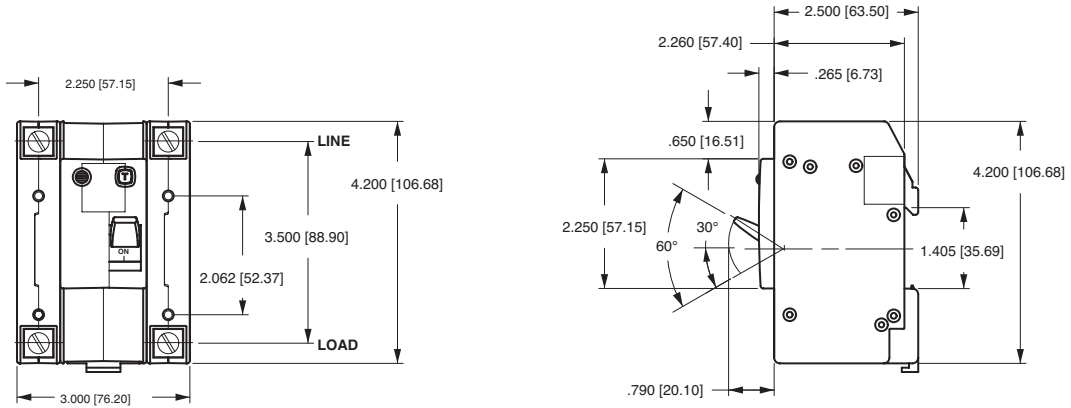


ER - Series

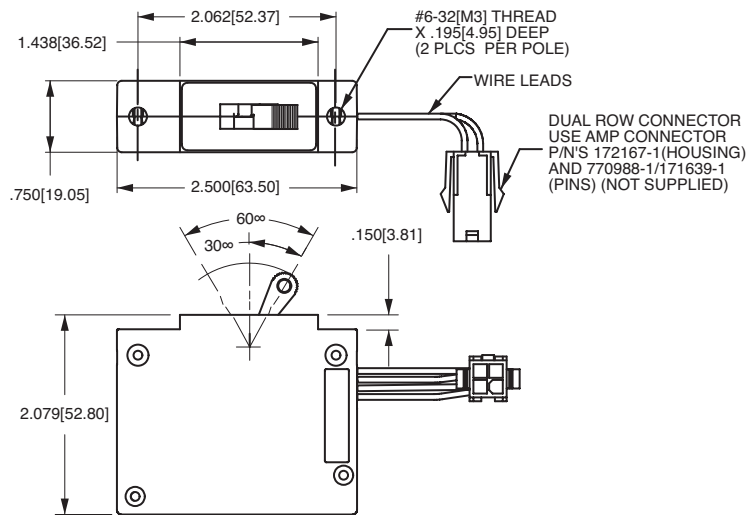


Dimensions

PDR - Series



RBR - Series



CONNECTOR WITH LEADS