Ground Fault Circuit Protection

- *PB-Series*
- *PD-Series (SmartGuard®)*

Carling Technologies®
Innovative Designs. Powerful Solutions.

Transforming Customer Needs into Customer Solutions

At Carling Technologies, we do much more than manufacture electrical components. We engineer powerful solutions. Working closely with your product team, we can tailor switching and circuit protection solutions that meet your application needs — cost effectively.

Since our founding in 1920, there are few products we haven't turned on, fewer industries that haven't turned to us. With five ISO certified manufacturing locations and technical sales offices worldwide, Carling Technologies now ranks among the world's largest privately owned manufacturers of hydraulic/magnetic circuit breakers, thermal circuit protectors, electrical switches and assemblies, power distribution centers and electronic control systems. In regard to circuit protection, we lead the industry in delivering higher ratings in smaller packages. And what makes all our breakers especially attractive is their superior performance and reliability —— both hallmarks of Carling Technologies .

Our Ground Fault Circuit Protection products are specifically designed for those applications that could benefit from having overload, short circuit & ground fault protection in a single package.

The PB-Series and PD-Series Smartguard can be used to protect several different types of equipment. Applications include:

- generators
- solar photovotaic systems
- marine control panels
- de-icing & snowmelting equipment
- resistance & impedence heating systems
- telecommunications
- stage /theatre lighting
- office machines
- medical equipment
- industrial automation
- industrial control
- UPS Systems
- welders

Customer Care Center

For application assistance, we urge you to consult with our experienced staff in our Customer Care Center. Our Technical and Engineering staff has extensive test, research and development capabilities, and have assisted many customers in solving unique design and application problems with standard or customized products. Please refer to our location listing on the back of this catalog, for contact information for your area.

We look forward to working with you.

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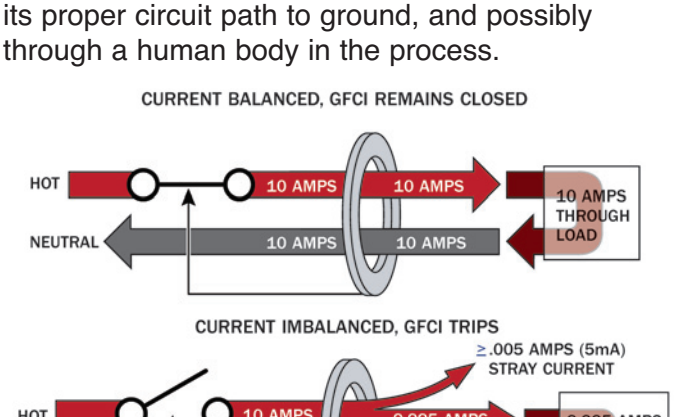
Reduce the risk of fire and shock hazards caused by defects in circuit wiring

Ground fault Circuit Interrupter (GFCI) – Homeowners may be familiar with Ground Fault Circuit Interrupters (GFCI) as an integral part of modern AC electrical receptacles.

GFCIs immediately switch electricity OFF when electricity "leakage" to ground is detected. This leakage is detected as an imbalance in current between the Hot and Neutral AC wiring. The imbalance indicates a ground fault, current leaking from its proper circuit path to ground, and possibly through a human body in the process.



Circuit Breaker + GFCI
The ground fault protection of a GFCI can be combined with the familiar over-current tripping characteristics of a normal circuit breaker in a single device.

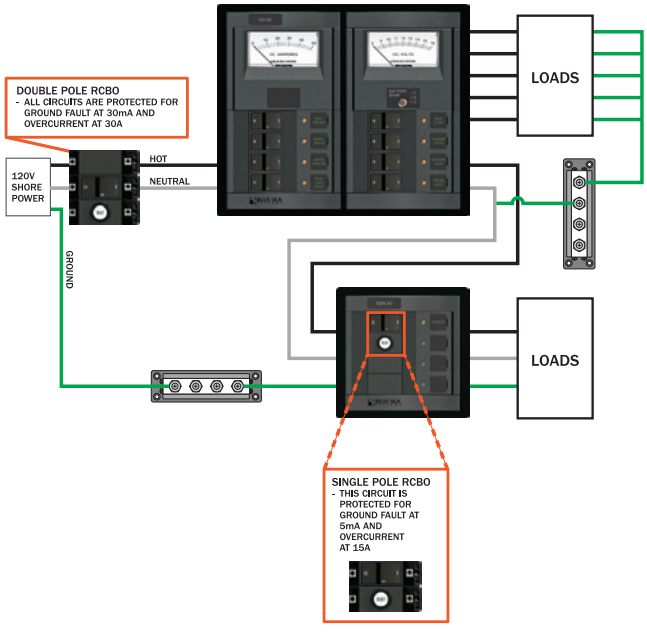
There are two main categories of circuit breaker with GFCI:

- 5mA - suitable for AC branch circuit ground fault protection
- > 5mA, typically 30mA - suitable for AC main circuit ground fault protection

AC Branch Ground Fault Circuit Protection – 5mA Single Circuit Solution
Installed in a power distribution panel to provide a single circuit solution. These single pole devices combine the 5mA ground fault protection function of a GFCI with the over-current tripping characteristics of a typical circuit breaker. Panel mounted GFCIs are much easier to locate than tracking down the multiple locations where GFCIs mounted in receptacles can exist.

AC Main Ground Fault Circuit Protection – 30mA Whole-System Solution
Ground fault protection also can be applied to an entire AC electrical system. Main circuit breakers with GFCI typically have a 30mA trip level, compared to the 5mA trip level of branch GFCIs. Main circuit breakers with GFCI trip at 30mA instead of 5mA to reduce nuisance trips. These devices are useful in reducing hazards occurring from ground faults in wiring and permanently installed appliances. These types of faults can result in a shock hazard and a fire hazard. Circuit breakers with GFCI should be installed at the AC Main input or as far upstream in the wiring distribution system as possible.

Typical Marine Application:



PB-Series

Overload, short circuit and ground fault protection in a single package!

The PB-series utilizes the hydraulic magnetic principle which provides precise operation and performance even when exposed to extremely hot and/or cold application environments.

The new PB-Series, AC Residual Current Circuit Breaker with Overcurrent Protection (RCBO), combines the ground fault protection of a GFCI with the familiar overcurrent tripping characteristics of a normal circuit breaker.

The PB-Series is suitable for:

- AC branch ground fault protection - a single circuit solution
- AC main ground fault protection for a boat's entire AC electrical system
- Portable generator ground fault protection

Key Benefits of the PB-Series:

- Increases safety around boats and marinas
- Protects against electrical shock hazards in areas near water
- Protects against defects in the wires & conductors
- Reduces fire and shock hazards from defects in permanently installed appliances such as water heaters, battery chargers, lighting fixtures, etc.
- Detects lower level ground faults which do not trip ordinary circuit breakers, but can lead to fires, and shock hazards for boating occupants

Innovative Features

These precision mechanisms are temperature stable and are not adversely affected by temperature changes in their operating environment. As such, derating considerations due to temperature variations are not normally required, and heat-induced nuisance tripping is avoided.

- Overload, short circuit and ground fault protection in a single package
- Handle style actuators and rocker style acuguard"
- Wiping Contacts - Mechanical linkage with two-step actuation – cleans contacts, provides high, positive contact pressure & longer contact life
- A trip-free mechanism, a safety feature, makes it impossible to manually hold the contacts closed during overload or fault conditions.
- A common trip linkage between all poles, another safety feature, ensures that an overload in one pole will trip all adjacent poles.
- Front panel mounting

Agency Certifications

UL Listed

UL Standard 489	Circuit Breakers, Molded Case, (Guide DIVQ, File E129899)
UL Standard 1077	Supplementary Protectors
UL Standard 943	Class A Ground Fault Circuit Interruptors
UL Standard 1053	Ground Fault Sensing and Relaying Equipment
UL Standard 1500	Ignition Protection

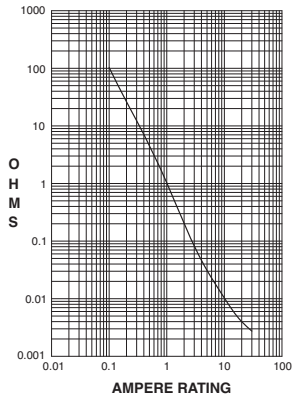
Electrical

Table A: UL Listed configurations and performance capabilities as Circuit Breakers

PB-SERIES TABLE A					
CIRCUIT CONFIGURATION	VOLTAGE			CURRENT RATING (AMPS)	INTERUPPTING CAPACITY (AMPS)
	MAX RATING VOLTS	FREQUENCY HERTZ	PHASE		
SERIES	120/240	60	1	.10 -30	5000

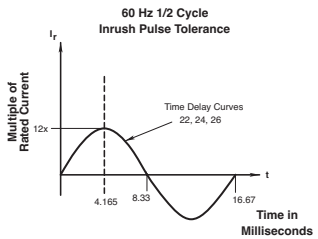
Electrical

Maximum Voltage	120/240VAC 60 Hz
Current Ratings	Standard current coils: 0.100, 0.250, 0.500, 0.750, 1.00, 2.50, 5.00, 7.50, 10.0, 15.0, 20.0, 25.0 & 30.0 amps. Other ratings available, see ordering scheme.
Insulation Resistance	Minimum of 100 Megohms at 500 VDC.
Dielectric Strength	UL, CUL - 1500 V 60 Hz for one minute between all electrically isolated terminals. PB-Series circuit breakers comply with the 8mm spacing and 3750V 60 Hz dielectric requirements from hazardous voltage to operator accessible surfaces and between adjacent poles
Impedance	Values from Line to Load Terminal.



CURRENT (AMPS)	TOLERANCE (%)
0.10 - 5.0	15%
5.1 - 20.0	25%
20.1 - 30.0	35%

Pulse Tolerance Curve



Leakage To Ground

Standard Must Trip Leakage Current Ratings	5 & 30 milliamps. 5± 1mA for UL943, other leakage ratings test to UL1053. For other ratings, consult factory.
Trip Time	300 ms Max. @ 100%, 40ms Max. @ 500% of must trip leakage current.
Test Button	On unit face along side of actuator.

Mechanical

Endurance	10,000 ON-OFF operations @ 6 per minute; with rated Current and Voltage.
Trip Free	All PB-Series Circuit Breakers will trip on overload or ground fault, even when Handle is forcibly held in the ON position.
Trip Indication	The operating Handle moves positively to the OFF position when an overload or ground fault causes the breaker to trip.

Physical

Number of Poles	1 - 3 poles, where the third pole is neutral
Internal Circuit Config.	Series Trip
Weight	Approximately 65 grams/pole. (Approximately 2.32 ounces/pole.)
Standard Colors	Housing- Black; Actuator - See Ordering Scheme.

Environmental

Designed and tested in accordance with requirements of specification MIL-PRF- 55629 and MIL-STD-202 as follows:

Shock	Withstands 100 Gs, 6ms, sawtooth while carrying rated current per Method 213, Test Condition "I". 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 per Method 204C, Test Condition A. Instantaneous and ultrashort curves tested at 90% of rated current.
Moisture Resistance	Method 106D, i.e., ten 24-hour cycles @ + 25°C to +65°C, 80-98% RH.
Salt Spray	Method 101, Condition A (90-95% RH @ 5% NaCl Solution, 96 hrs).
Thermal Shock	Method 107D, Condition A (Five cycles @ -55°C to +25°C to +85°C to +25°C).
Operating Temperature	-35° C to +65° C
Corrosion	Tested per UL943 FMG Test. 3 weeks @ 30°C 75% RH, 100ppb H_2S, 20ppb Cl_2, 200ppb NO_2

PB	A	–	B	A	–	24	–	620	–	2	B	A	–	A	G
1 Series	*2 System Voltage/Poles*		*3 Circuit*	*4 Actuator*		*5 Frequency & Delay*		*6 Current Rating*		*7 Terminal*	*8 Actuator Color*	*9 Mounting/ Barriers*		*10 Trip Level*	*11 Agency Approval*

1 SERIES
PB

2 SYSTEM VOLTAGE / POLES
A 120 VAC single phase, one pole
B 120/240 VAC single phase, two pole
C 120/240 VAC single phase with switched neutral, three pole

3 CIRCUIT
B Series Trip (Current)

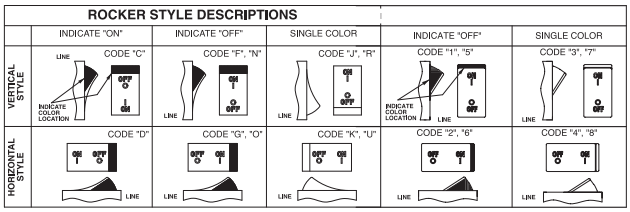
4 ACTUATOR[1]
Handle
A one per pole
B one per multipole unit

Two Color Curved Visi-Rocker
C Indicate ON, vertical legend
D Indicate ON, horizontal legend
F Indicate OFF, vertical legend
G Indicate OFF, horizontal legend

Single Color Curved Rocker
J Vertical legend
K Horizontal legend

Two Color Flat Visi-Rocker
1 Indicate OFF, vertical legend
2 Indicate OFF, horizontal legend

Single Color Flat Rocker
3 Vertical legend
4 Horizontal legend



5 FREQUENCY & DELAY
22 60Hz Short
24 60Hz Medium
26 60Hz Long

6 CURRENT RATING (AMPERES)

210	0.100	**285**	0.850	**450**	5.000	**712**	12.500
215	0.150	**290**	0.900	**455**	5.500	**613**	13.000
220	0.200	**295**	0.950	**460**	6.000	**614**	14.000
225	0.250	**410**	1.000	**465**	6.500	**615**	15.000
230	0.300	**512**	1.250	**470**	7.000	**616**	16.000
235	0.350	**415**	1.500	**475**	7.500	**617**	17.000
240	0.400	**517**	1.750	**480**	8.000	**618**	18.000
245	0.450	**420**	2.000	**485**	8.500	**620**	20.000
250	0.500	**522**	2.250	**490**	9.000	**622**	22.000
255	0.550	**425**	2.500	**495**	9.500	**624**	24.000
260	0.600	**527**	2.750	**610**	10.000	**625**	25.000
265	0.650	**430**	3.000	**710**	10.500	**630**	30.000
270	0.700	**435**	3.500	**611**	11.000		
275	0.750	**440**	4.000	**711**	11.500		
280	0.800	**445**	4.500	**612**	12.000		

7 TERMINAL[2]
1[3] Push-On 0.250 Tab (Q.C.)
2 Screw 8-32 w/upturned lugs
3 Screw 8-32 (Bus Type)
4 Screw 10-32 w/upturned lugs
5 Screw 10-32 (Bus Type)
B Screw M5 w/upturned lugs
C Screw M4 w/upturned lugs
E Screw M4 (Bus Type)
H Screw M5 (Bus Type)

8 ACTUATOR COLOR & LEGEND

	I-O	ON-OFF	Dual	Legend Color
White	**A**	**B**	**1**	Black
Black	**C**	**D**	**2**	White
Red	**F**	**G**	**3**	White
Green	**H**	**J**	**4**	White
Blue	**K**	**L**	**5**	White
Yellow	**M**	**N**	**6**	Black
Gray	**P**	**Q**	**7**	Black
Orange	**R**	**S**	**8**	Black

9 MOUNTING/BARRIERS

	MOUNTING STYLE	BARRIERS
	Threaded Insert, 2 per pole	
A	6-32 X 0.195 inches	yes
B	ISO M3 x 5mm	yes

10 LEAKAGE CURRENT TRIP LEVEL - MAX. TRIP CURRENT
A 5 mA (Class A GFCI)[4,5,6]
E 30 mA (ELCB)

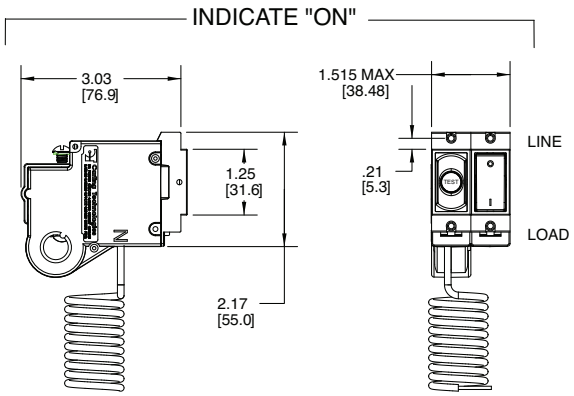
11 AGENCY APPROVAL[3]
G UL489 Listed, CSA Certified
C UL1077
I UL1077, UL1500[7]

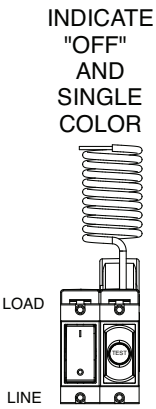
Notes:
1 Actuator Code:
A: Handle tie pin spacer(s) and retainers provided unassembled with multi-pole units.
B: Handle location as viewed from front of breaker:2 pole - left pole 3 pole - center pole
2 Screw Terminals are recommended on ratings greater than 20 amps.
3 UL & CSA up to 30 amps, but not recommended over 20 amps.
4 Available with leakage current trip level - Max trip current code E, and agency approval C.
5 6mA per UL943, available with agency approval code 6.
6 30mA per UL1053, available with agency approval codes C & 6.
7 UL1500 only available with 30mA trip level.

TIME DELAY VALUES

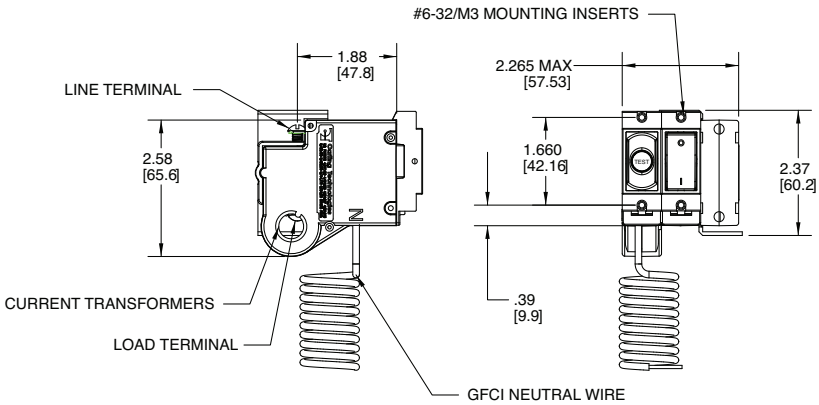
	PERCENT OF RATED CURRENT									
	DELAY	100%	125%	150%	200%	400%	600%	800%	1000%	1200
TRIP TIME (SECONDS)	20	No Trip	May Trip	.040 MAX	.035 MAX	.030 MAX	.025 MAX	.020 MAX	.017 MAX	.015 MAX
	22	No Trip	.700 - 12.0	.350 - 4.00	.130 - 1.30	.027 - .220	.008 - .130	.004 - .090	.004 - .045	.004 - .040
	24	No Trip	10.0 - 160	6.00 - 60.0	2.20 - 20.0	.300 - 3.00	.050 - 1.30	.007 - .500	.005 - .060	.005 - .040
	26	No Trip	50.0 - 700	32.0 - 350	10.0 - 90.0	1.50 - 15.0	.500 - 7.00	.020 - 3.00	.006 - 2.00	.005 - 1.00

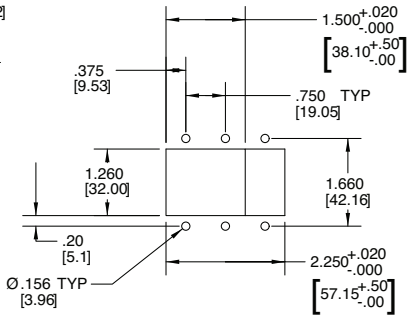
NOTES:
Other time delay values available, consult factory.
Delay Curves 21,22,24,26: Breakers to hold 100% and must trip at 125% of rated current and greater within the time limit shown in this curve.
Delay Curve 20: Breakers to hold 100% and must trip at 150% of rated current and greater within the time limit shown in this curve.
All Curves: Curve data shown represents breaker response at ambient temperature of 77°F (25°C) with no preloading. Breakers are mounted in standard wall-mount position.
The minimum inrush pulse tolerance handling capability is 12 times the rated current. These values are based on a 60 Hz 1/2 cycle, 8.33 ms pulse.





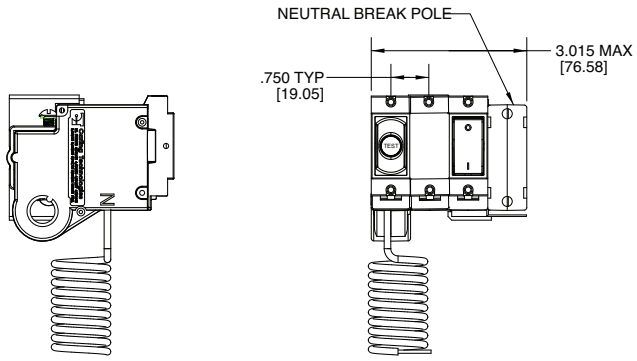
1-POLE 120 VAC VERSION





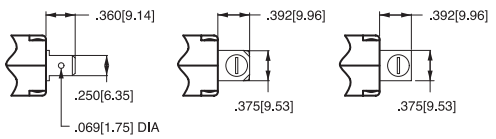
2-POLE 120/240 VAC VERSION

PANEL CUTOUT



2-POLE 120/240 VAC WITH NEUTRAL BREAK

TERMINAL DIMENSIONAL DETAIL & RATING



TAB (Q.C.)
30 AMP

UPTURN LUG
#8-32 30 AMP
#10-32 30 AMP
M5 30 AMP
M4 30 AMP

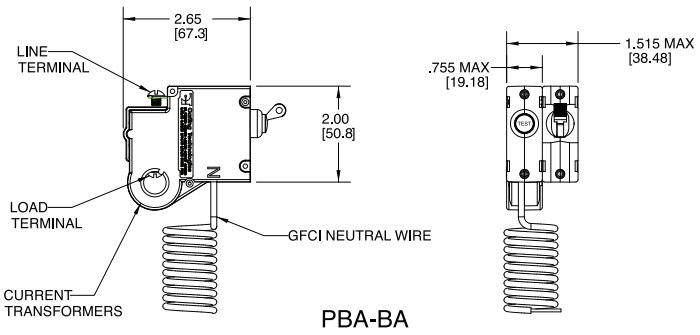
BUS
#8-32 30 AMP
#10-32 50 AMP

TABLE A
TIGHTENING TORQUE SPECIFICATIONS

THREAD SIZE	TORQUE
#6-32 & M3 MOUNTING HARDWARE	7-9 IN-LBS [0.8-1.0 NM]
#8-32 & M4 THREAD TERMINAL SCREW	12-15 IN-LBS [1.4-1.7 NM]
#10-32 & M5 THREAD TERMINAL SCREW	15-20 IN-LBS [1.7-2.3 NM]

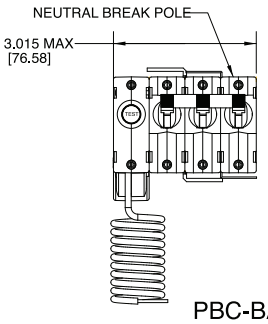
Notes:
1 All dimensions are in inches [millimeters].
2 Tolerance ±.020 [.51] unless otherwise specified.

TYPICAL 1-POLE 120 VAC VERSION



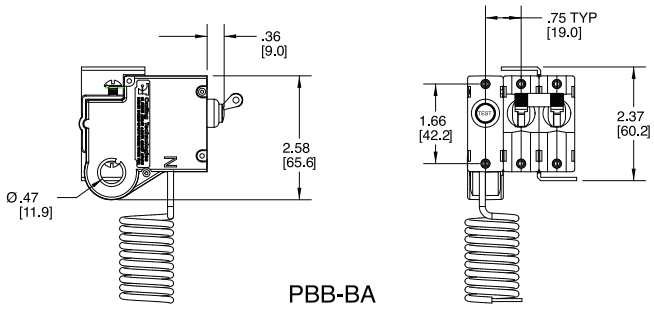
PBA-BA

TYPICAL 2-POLE
120/240VAC
WITH NEUTRAL BREAK
VERSION

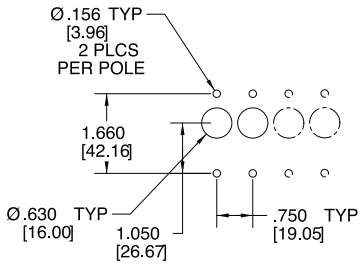


PBC-BA

TYPICAL 2-POLE 120/240 VAC VERSION



PBB-BA

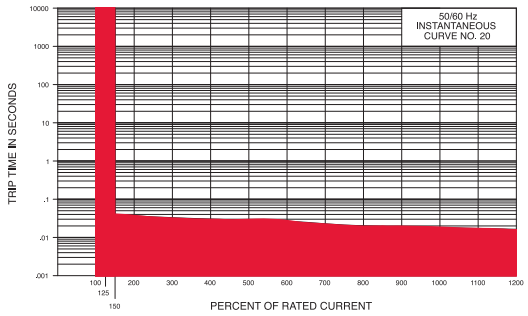


PANEL CUTOUT

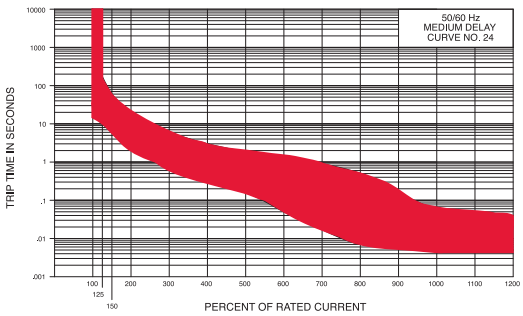
Notes:
1 All dimensions are in inches [millimeters].
2 Tolerance ±.020 [.51] unless otherwise specified.

Time Delay Curves

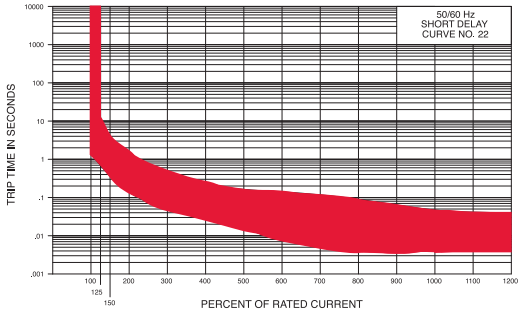
Instantaneous



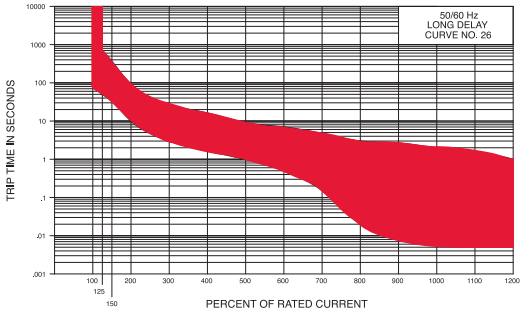
Medium



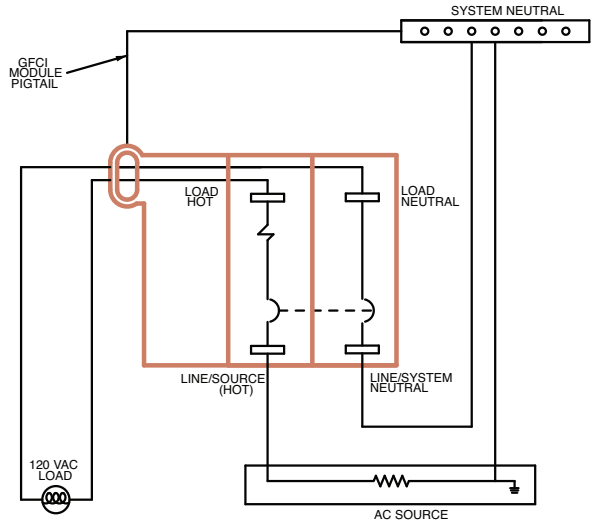
Short



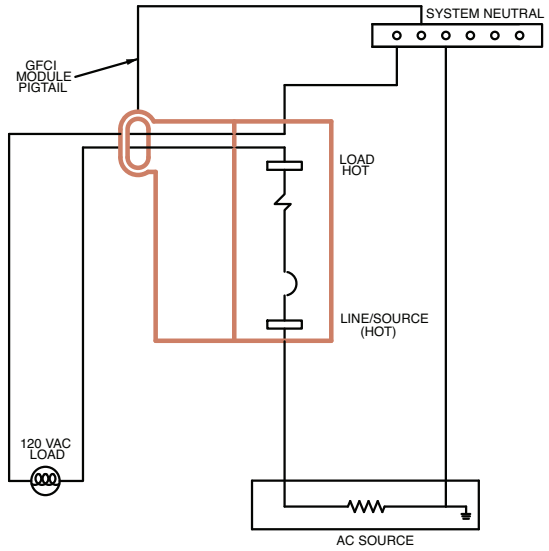
Long



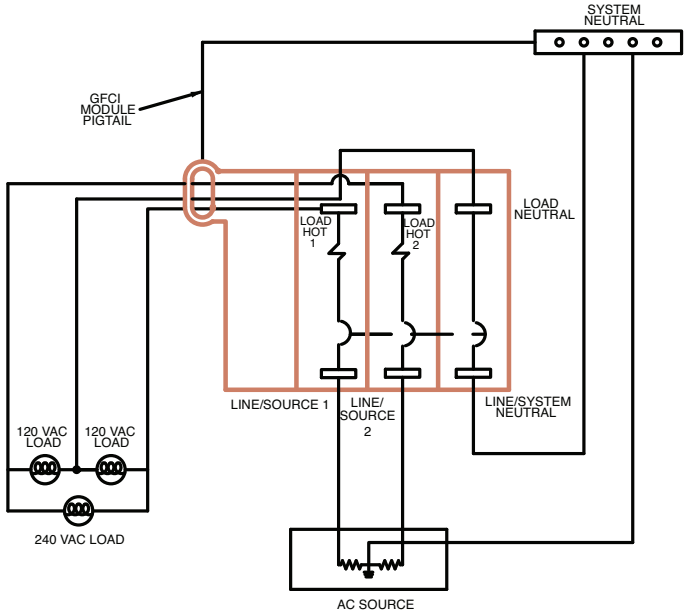
120VAC with Switched Neutral



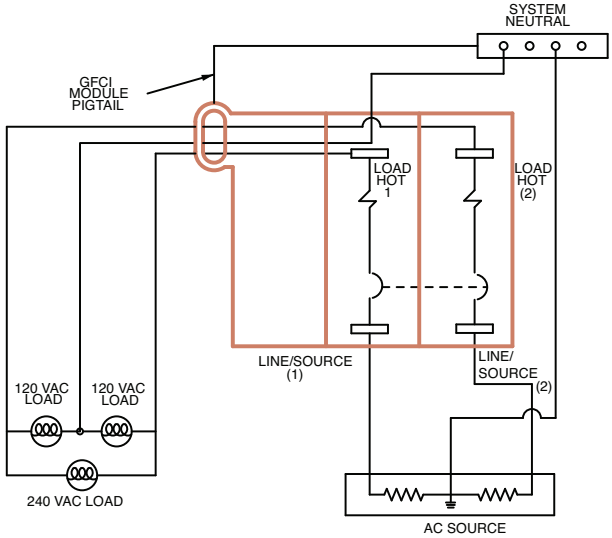
120VAC without Switched Neutral



120/240VAC with Switched Neutral



120/240VAC without Switched Neutral



SmartGuard® PD-Series

Overload, short circuit and equipment ground fault protection in a single package!

Today's high tech equipment demands high tech protection. Our SmartGuard Equipment Leakage Circuit Breaker (ELCB) provides that protection, in one attractive, space-saving package.

SmartGuard is an equipment ground fault protection device that functions as a standard high-quality Carling hydraulic/magnetic circuit breaker, offering customized overload and short circuit protection. In addition, this breaker senses and guards against faults to ground using a state of the art integrated circuit developed by Carling. This new technology detects faults and 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.

Innovative Features

These precision mechanisms are temperature stable and are not adversely affected by temperature changes in their operating environment. As such, derating considerations due to temperature variations are not normally required, and heat-induced nuisance tripping is avoided.

- Overload, short circuit and ground fault protection in a single package
- Handle style actuators with optional "handleguard"
- Wiping Contacts - Mechanical linkage with two-step actuation – cleans contacts, provides high, positive contact pressure & longer contact life
- A trip-free mechanism, a safety feature, makes it impossible to manually hold the contacts closed during overload or fault conditions.
- A common trip linkage between all poles, another safety feature, ensures that an overload in one pole will trip all adjacent poles.
- Front panel or DIN rail mounting options
- "State of the art" integrated circuit developed by Carling
- Equipment leakage sensitivity from 10 to 100 milliamps
- Integral push-to-test button and LED "tripped" indicator
- Immediate reset after fault has been cleared

Agency Certifications

UL Recognized

UL Standard 1077	Component Recognition Program as Equipment Leakage Circuit Interrupter and, Protectors, Supplementary (FTTJ2, File E177510).
UL Standard 943	Tested as Ground Fault Circuit Interrupters for Equipment Protection.

CSA Certified

Component Equipment Leakage Current Interrupter with Supplementary Protector, under Class C22.2,No. 144-M91, FIle LR47848-50

TUV Certified

IEC 947-2 and appendix B: Circuit Breakers incorporating Residual Current Protection. Complies with waveform requirements of IEC 1008-1, Type A.

Electrical

Table A: Lists UL Recognized & CSA Certified configurations and performance capabilities as a Component Supplementary Protector.

PD-SERIES TABLE A: COMPONENT SUPPLEMENTARY PROTECTOR & EARTH LEAKAGE CURRENT INTERRUPTEF

CIRCUIT CONFIGURATION	VOLTAGE			CURRENT RATING		INTERRUPTING CAPACITY (AMPS)	LEAKAGE CURRENT
	MAX RATING VOLTS	FREQUENCY HERTZ	PHASE	FULL LOAD AMPS	GENERAL PURPOSE AMPS	UL / CSA WITHOUT BACKUP FUSE	MUST - TRIP RATING (MILLIAMPS)
SERIES	120/208	50/60	1	1-50	---	5000	7-100
	120/208	50/60	3	1-50	---	5000	7-100
	208-240	50/60	3	1-50	---	2000	7-100
	480Y	50/60	3	1-30	30.1-50	2000	7-100

Table B: Lists TUV Certified configurations and performance capabilities as a Circuit breaker incorporating residual current protection.

PD-SERIES TABLE B: CIRCUIT BREAKER WITH RESIDUAL CURRENT PROTECTION

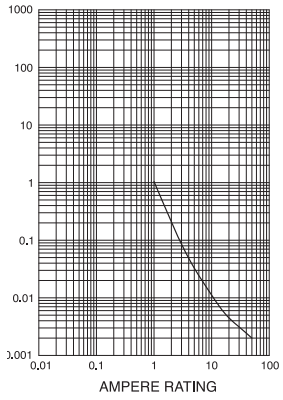
CIRCUIT CONFIGURATION	VOLTAGE			CURRENT RATING	LEAKAGE CURRENT	INTERRUPTING CAPACITY (AMPS)		
	MAX RATING VOLTS	FREQUENCY HERTZ	PHASE	FULL LOAD AMPS	MUST - TRIP RATING (MILLIAMPS)	ULTIMATE S/C BREAKING CAPACITY (Icu)	SERVICE S/C BREAKING CAPACITY (Ics)	RESIDUAL S/C MAKE/BREAK CURRENT (IΔm)
SERIES	120-240	50/60	1	1-50	7-100mA	5000	3750	1250
	200-240	50/60	3	1-50	7-100mA	2667	2000	1000
	380-415	50/60	3 -Y	1-50	7-100mA	2000	2000	1000
	380-415	50/60	1	1-50	7-100mA	2000	2000	1000

Electrical

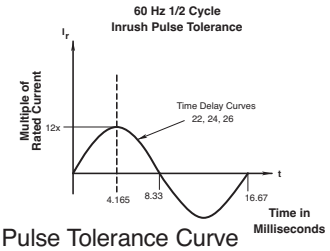
Maximum Voltage AC, 480 WYE/277 VAC, 50/60 Hz

Standard Current Ratings	1.00, 2.50, 5.00, 7.50, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0 & 50.0 amps. For other ratings, consult factory.
Insulation Resistance	Minimum of 100 Megohms @ 500 VDC.
Dielectric Strength	1960 VAC, 60 Hz for one minute between all electrically isolated terminals.
Resistance, Impedance	from Line to Load Terminal (Values Based on Series Trip Circuit Breaker)

RESISTANCE, IMPEDANCE VALUES from Line to Load Terminals



CURRENT (AMPS)	TOLERANCE (%)
0.10 - 5.0	15%
5.1 - 20.0	25%
20.1 - 50.0	35%



Pulse Tolerance Curve

Leakage To Ground

Standard Must Trip Leakage Current Ratings	7, 10, 15, 30, 50 & 100 milliamps. For other ratings, consult factory.
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.

Mechanical

Endurance	10,000 ON-OFF operations @ 6 per minute; with rated current and voltage.
Trip Free	All SmartGuard equipment leakeage circuit breakers will trip on overload or leakage to ground, even when actuator is forcibly held in the ON position.
Trip Indication:	The actuator moves to the OFF position when an overload or earth leakage ground fault causes the breaker to trip. The LED is illuminated when leakage to ground causes the circuit breaker to trip.

Physical

Number of Poles	2, 3 & 4
Length (included switched or unswitched neutral)	4.2 inches (106.7 mm)
Width	2-pole: 3.0 inches (76.2 mm) 3-pole: 3.75 inches (95.3 mm) 4-pole: 4.5 inches (114.3 mm)
Depth	2.5inches (63.5mm).
Weight: 2-pole	16.0 oz. (453.6 gm) 3-pole: 21.4 oz. (606.7 gm) 4-pole: 26.9 oz. (762.6 gm)
Standard Colors	Housing - gray; Actuator - black, red, or white
Mounting	Front Panel or Standard 35mm Symmetrical DIN Rail (35 x 7.5 or 35 x 15mm per DIN EN5002).
Termination	Box Lug

Environmental

Operating Temperature	+10°C to +50°C

PD	R	–	B	–	24	–	650	–	B	–	2	A	1	–	1	–	C
1 Series	*2 Voltage/ Poles*		*3 Circuit*		*4 Frequency & Delay*		*5 Current Rating*		*6 Equipment Leakage - Trip Current*		*7 Terminal*	*8 Actuator*	*9 Actuator Color*		*10 Mounting*		*11 Agency Approval*

1 SERIES
PD

2 SYSTEM VOLTAGE/POLES[1]

	System Voltage	*Poles*
A	120VAC 1Ø	One plus unswitched neutral
B	120/240 VAC 1Ø	Two
C	120/208 VAC 1Ø, 120/240 VAC 1Ø	Two plus unswitched neutral
D	120/208 VAC 1Ø, 120/240 VAC 1Ø	Two plus switched neutral
E	208/240 VAC 3Ø	Three
F	208/240 VAC 3Ø	Three plus unswitched neutral
G	208/240 VAC 3Ø	Three plus switched neutral
P	480Y VAC 3Ø	Three
Q	480Y VAC 3Ø	Three plus unswitched neutral
R	480Y VAC 3Ø	Three plus switched neutral

3 CIRCUIT
B Series Trip (Current)

4 FREQUENCY & DELAY

20	50/60Hz Instantaneous	**24**	50/60Hz Medium
22	50/60Hz Short	**26**	50/60Hz Long

5 CURRENT RATING (AMPERES)

410	1.000	**445**	4.500	**610**	10.000	**717**	17.500
512	1.250	**450**	5.000	**710**	10.500	**618**	18.000
415	1.500	**455**	5.500	**611**	11.000	**619**	19.000
517	1.750	**460**	6.000	**711**	11.500	**620**	20.000
420	2.000	**465**	6.500	**612**	12.000	**622**	22.000
522	2.250	**470**	7.000	**712**	12.500	**624**	24.000
425	2.500	**475**	7.500	**613**	13.000	**625**	25.000
527	2.750	**480**	8.000	**614**	14.000	**630**	30.000
430	3.000	**485**	8.500	**615**	15.000	**635**	35.000
435	3.500	**490**	9.000	**616**	16.000	**640**	40.000
440	4.000	**495**	9.500	**617**	17.000	**650**	50.000

6 EQUIPMENT LEAKAGE - TRIP CURRENT (milliamps)[2]

B	7	**D**	15	**F**	50
C	10	**E**	30	**G**	100

7 TERMINAL
2 Front Connected Box Lug

8 ACTUATOR
A Handle
B Handle. with handleguard

9 ACTUATOR COLOR & LEGEND[4]

Actuator Color	*Marking:*			*Marking Color:*
Color:	I-O	ON-OFF	Dual	
White	**A**	**B**	**1**	Black
Black	**C**	**D**	**2**	White
Red	**E**	**F**	**3**	White

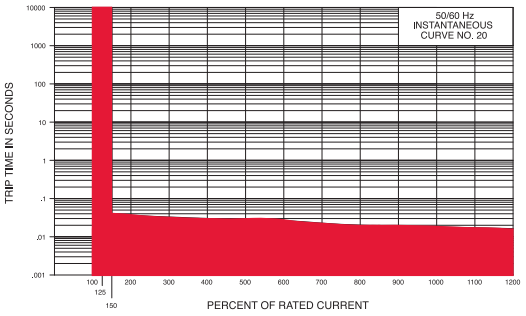
10 MOUNTING[3]
1 Threaded Insert 6-32 x 0.195 inches
2 Threaded Insert ISO M3 x 6.5 mm

11 AGENCY APPROVAL
C UL Recognized & CSA Certified
U TUV Certified

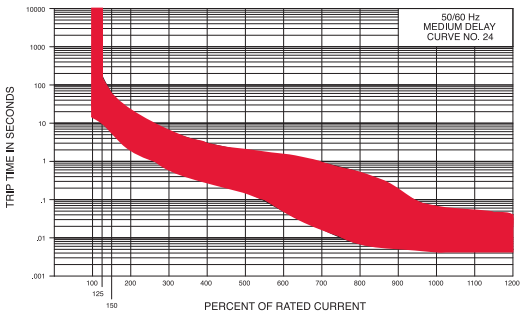
Notes:
1 Units with a switched or unswitched neutral connection are the same size as a unit with an additional breaker pole (e.g. a 2-pole unit with a switched or unswitched neutral is the same physical size as a 3-pole unit.)
Switched neutral poles contain the same overcurrent protection as the other poles.
2 The leakage currents shown will cause the breaker to trip (must-trip current). The must-hold current is 67% of the must-trip current.
3 All breakers are front panel mountable using screw size shown. Breakers may also be mounted on either 35mm x 7.5mm or 35mm x 15mm symmetrical DIN rail.
4 TUV certifed units must have I-O or Dual legends.

Time Delay Curves

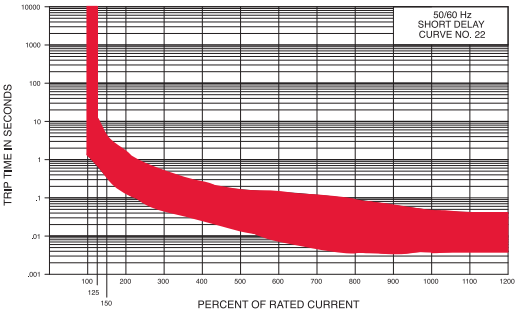
Instantaneous



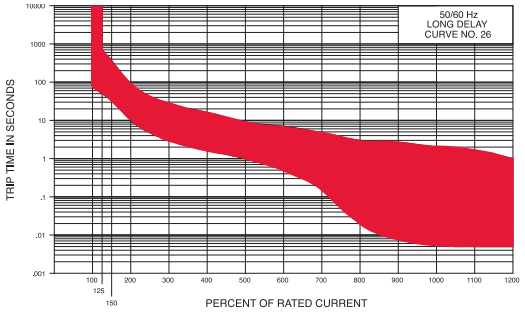
Medium



Short

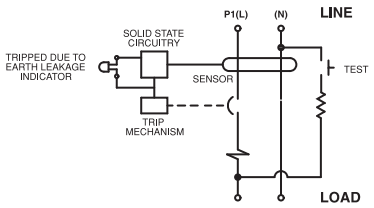


Long

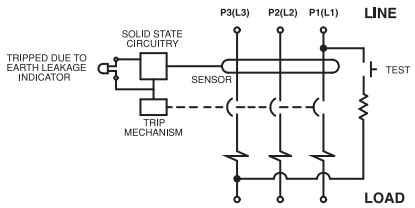


CIRCUIT SCHEMATICS

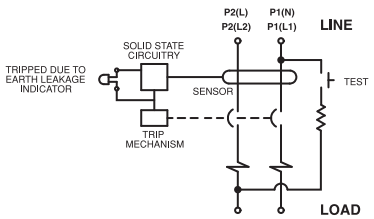
1-POLE CIRCUIT
PDA



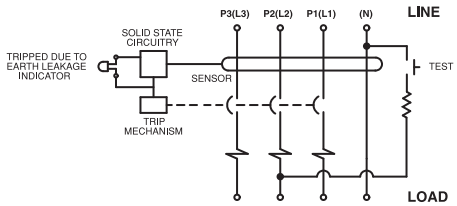
3-POLE CIRCUITS
PDE & PDP



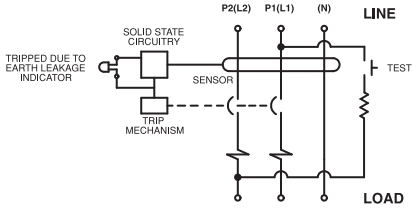
2-POLE CIRCUITS
PDB



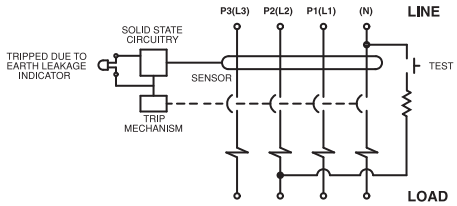
PDF & PDQ (WITH UNSWITCHED NEUTRAL)



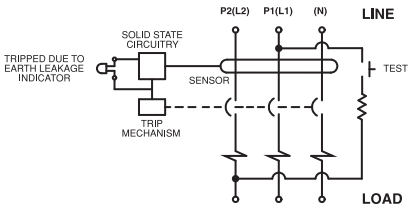
PDC (WITH UNSWITCHED NEUTRAL)

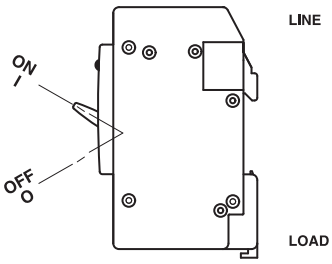


PDG & PDR (WITH SWITCHED NEUTRAL)

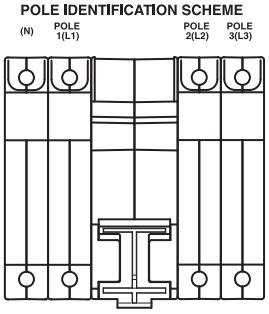


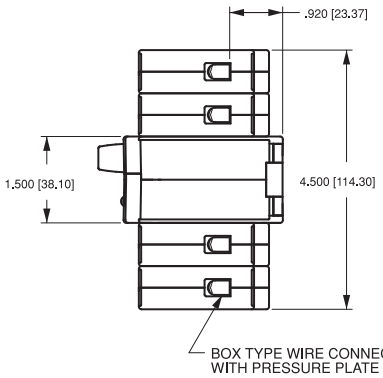
PDD (WITH SWITCHED NEUTRAL)





POLE IDENTIFICATION SCHEME



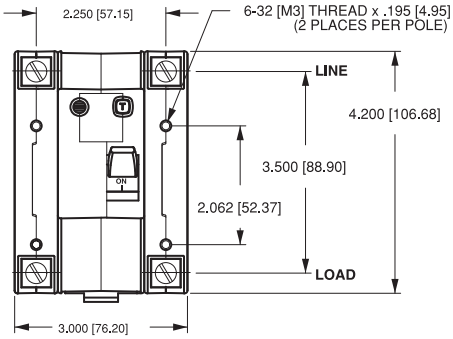


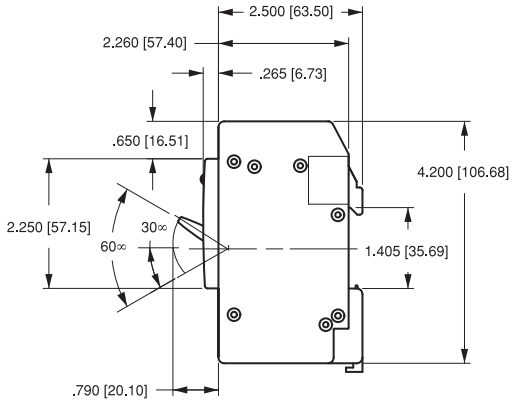
Notes:
1 All dimensions are in inches [millimeters].
2 Tolerance ±.020 [.51] unless otherwise specified.

TIME DELAY VALUES										
	PERCENT OF RATED CURRENT									
TRIP TIME (SECONDS)	DELAY	100%	125%	150%	200%	400%	600%	800%	1000%	1200
	20	No Trip	May Trip	.040 MAX	.035 MAX	.030 MAX	.025 MAX	.020 MAX	.017 MAX	.015 MAX
	22	No Trip	.700 - 12.0	.350 - 4.00	.130 - 1.30	.027 - .220	.008 - .130	.004 - .090	.004 - .045	.004 - .040
	24	No Trip	10.0 - 160	6.00 - 60.0	2.20 - 20.0	.300 - 3.00	.050 - 1.30	.007 - .500	.005 - .060	.005 - .040
	26	No Trip	50.0 - 700	32.0 - 350	10.0 - 90.0	1.50 - 15.0	.500 - 7.00	.020 - 3.00	.006 - 2.00	.005 - 1.00

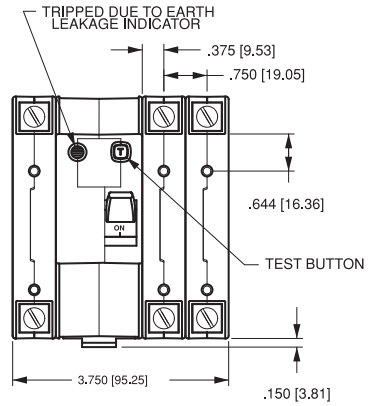
NOTES:
Other time delay values available, consult factory.
Delay Curves 21,22,24,26: Breakers to hold 100% and must trip at 125% of rated current and greater within the time limit shown in this curve.
Delay Curve 20: Breakers to hold 100% and must trip at 150% of rated current and greater within the time limit shown in this curve.
All Curves: Curve data shown represents breaker response at ambient temperature of 77°F (25°C) with no preloading. Breakers are mounted in standard wall-mount position.
The minimum inrush pulse tolerance handling capability is 12 times the rated current. These values are based on a 60 Hz 1/2 cycle, 8.33 ms pulse.

PDA & PDB

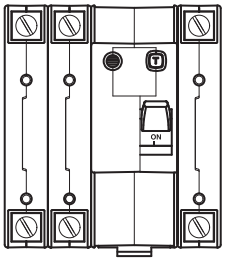




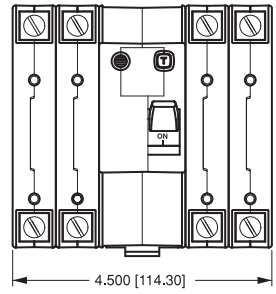
PDC & PDD

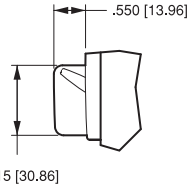


PDE &PDP

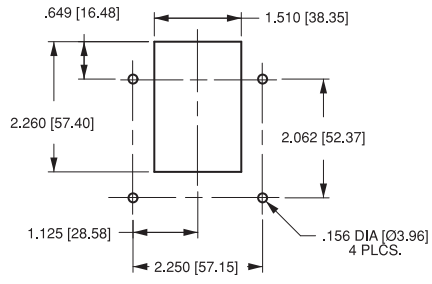


PDF, PDG
PDQ & PDR

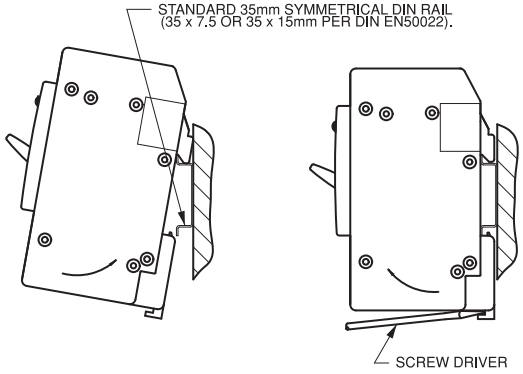




OPTIONAL HANDLE GUARD



PANEL CUT-OUT DETAIL



ASSEMBLY REMOVAL

Notes:
1 All dimensions are in inches [millimeters].
2 Tolerance ±.020 [.51] unless otherwise specified.

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