

PowerPact® D-Frame Circuit Breakers and Switches

150 to 600 A

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by Schneider Electric

PowerPact® D-Frame Circuit Breakers and Switches



PowerPact® D-Frame Circuit Breakers and Switches

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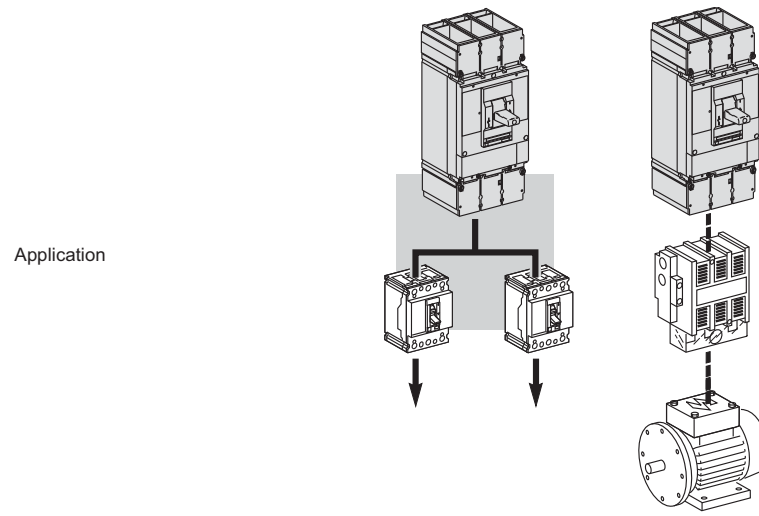
Section 1—General Information

Introduction

PowerPact® D-frame electronic trip molded case circuit breakers are designed to protect electrical systems from damage caused by overloads and short circuits. All circuit breakers are designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent. The D-frame circuit breakers use an electronic trip system to signal the circuit breaker to open automatically.

Table 1: D-Frame Circuit Breakers and Switches

	Circuit Breaker	Switches	Motor Circuit Protectors
Rated Current (A)	150–600 A	400 A, 600 A	400–600 A



For information on other PowerPact molded case circuit breakers manufactured by Square D®, see the Class 611 and 612 catalogs.

Features and Benefits

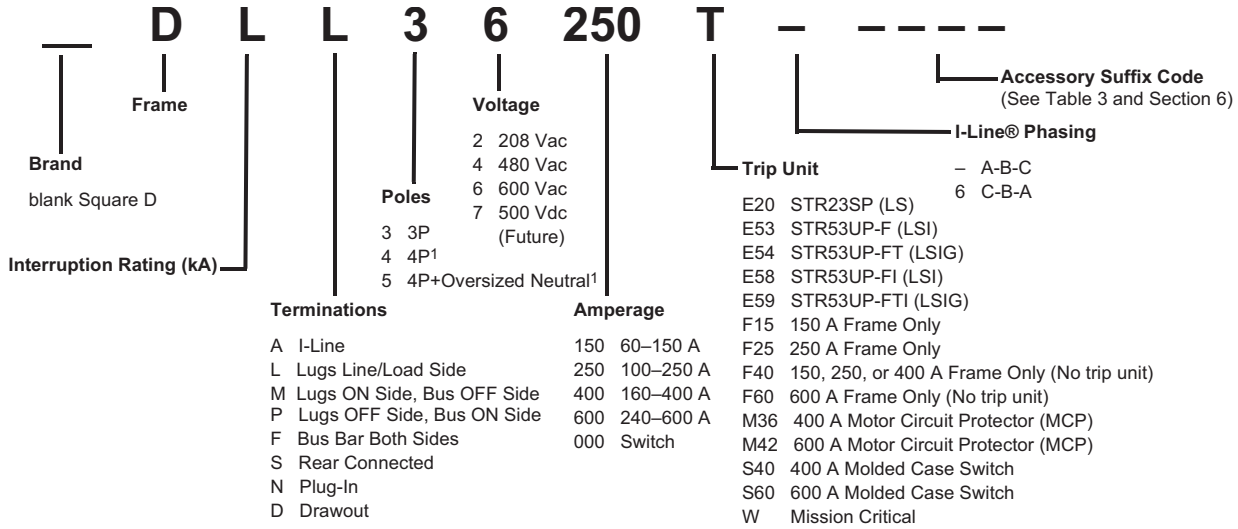
D-frame electronic trip circuit breakers:

- Provide overload and short-circuit protection
- Are true RMS sensing devices
- Provide means to manually disconnect power to the circuit
- Provide enhanced coordination by their adjustability
- Provide high interrupting ratings and withstand ratings
- Use many of the same accessories as other PowerPact circuit breakers
- Have a wide range of NEMA and IEC operating mechanisms

PowerPact® D-Frame Circuit Breakers and Switches

General Information

Table 2: Catalog Numbering



Interrupting Rating	UL/CSA/NOM	IEC 60947-2 Icu/Ics						
	240 Vac	480 Vac	600 Vac	220/240 Vac	380/440/415 Vac	500/525 Vac	250 Vdc	500 Vdc
G	65 kA	35 kA	18 kA	65/65 kA	35/35 kA	18/18 kA	20 kA	20 kA
J	100 kA	65 kA	25 kA	100/100 kA	65/65 kA	25/25 kA	20 kA	20 kA
L	125 kA	100 kA	25 kA	125/125 kA	100/100 kA	50/50 kA	20 kA	20 kA

¹ 4P circuit breaker available in plug-in, draw-out and rear-connected only. Availability of 4P bus-connected and lug configurations to be announced.

Table 3: Accessory Suffix Codes (Building Sequence as Listed)

(1) Auxiliary Switch			(3) Shunt Trip		Voltage	(4) Undervoltage Release UVR		(5) Motor Operator		
Suffix	Contacts	Kit No.	Suffix	Kit No.		Suffix	Kit No.	Suffix	Voltage	Kit No.
AA	1A/1B Standard	S29450	SK	S29384	24 Vac	UK	S29404	ML	48/60 Vac	S32839
AB	2A/2B Standard	2x S29450	SL	S29385	48 Vac	UL	S29405	MA	120 Vac	S32840
AE	1A/1B Low Level	S29482	SA	S29386	120 Vac	UA	S29406	MD	277 Vac	S32841
AF	2A/2B Low Level	2x S29482	SD	S29387	208–277 Vac	UD	S29407	MF	380/415 Vac	S32845
(2) Alarm/Overcurrent Trip Switch			SH	S29388	380–480 Vac	UH	S29408	MH	440/480 Vac	S32847
BC	Alarm Switch (SD)	S29450	SJ	S29389	525–600 Vac	UJ	S29409	MO	24/30 Vdc	S32843
BH	Alarm Switch (SD) Low-Level	S29452	SN	S29382	12 Vdc	UN	S29402	MP	48/60 Vdc	S32844
BD	SDE Standard	S29450	SO	S29390	24 Vdc	UO	S29410	MR	110/130 Vdc	S32845
BJ	SDE Low-Level	S29452	SU	S29391	30 Vdc	UU	S29411	MS	250 Vdc	S32846
BE	SD and SDE Standard	2 S29450	SP	S29392	48 Vdc	UP	S29412	(6) IEC Style Rotary Handle		
BK	SD and SDE Low-Level	2 S29452	SV	S29383	60 Vdc	UV	S29403	Suffix	Handle Type (color)	Kit No.
			SR	S29393	125 Vdc	UR	S29413	RD12	Direct Mount (black)	32597
			SS	S29394	250 Vdc	US	S29414	RE12	Extended Door Mount (black)	32598
								RT12	Telescoping (black)	32603
								RD22	Direct Mount (red)	32599
								RE22	Extended Door Mount (red)	32600
								—	MCC Conversion Accessory	32606

PowerPact® D-Frame Circuit Breakers and Switches

General Information

Features

PowerPact electronic trip circuit breakers have a molded case made of a glass-reinforced insulating material (thermal set composite resin) that provides high dielectric strength. These circuit breakers:

- Are available in either dual-rated UL/IEC or IEC-only constructions
- Dual-rated UL/IEC circuit breakers are also CSA and ANCE certified
- Are manufactured in unit-mount, I-Line®, plug-in and drawout constructions
- Share common tripping of all poles
- Can be mounted and operated in any position
- Are available in motor circuit protector and automatic molded case switch constructions
- Can be reverse connected, without restrictive LINE and LOAD markings
- Meet the requirements of NEC® Sections 240-6 by providing a means to seal the rating plug and trip unit adjustments
- Have field-interchangeable trip units

Circuit Breaker Ratings

Interrupting Rating

The interrupting rating is the highest current at rated voltage which the circuit breaker is designed to safely interrupt under standard test conditions. Circuit breakers must be selected with interrupting ratings equal to or greater than the available short-circuit current at the point where the circuit breaker is applied to the system (unless it is a branch device in a series-rated combination). Interrupting ratings are shown on the front of the circuit breaker.

Table 4: UL/IEC Circuit Breaker Interrupting Ratings (See Table 20 for switch and Table 23 for motor circuit protection ratings.)

Circuit Breaker	UL/CSA Rating (60 Hz)			IEC 60947-2 Rating (50/60 Hz)			
				240 Vac		380/415 Vac	
	240 Vac	480 Vac	600 Vac	Icu	Ics	Icu	Ics
DG	65 kA	35 kA	18 kA	85 kA	85 kA	45 kA	45 kA
DJ	100 kA	65 kA	25 kA	100 kA	100 kA	70 kA	70 kA
DL	125 kA	100 kA	25 kA	150 kA	150 kA	150 kA	150 kA

Ampere Rating (Continuous Current Rating)

The ampere rating (or continuous current rating) (I_r) is the maximum current that a circuit breaker can carry. The sensor size (I_n) is the maximum ampere rating for a specific circuit breaker and is based on the size of the sensor inside the circuit breaker (sensors are an integral part of the D-frame circuit breaker and cannot be removed or replaced). This value is printed in a window above the trip unit.

NOTE: The maximum ampere rating a circuit breaker family can carry is called the frame size. Sensor size is less than or equal to frame size.

The ampere rating of an electronic trip circuit breaker is determined by the mathematical equation:

$$\text{Ampere Rating} = \text{Sensor Size (I}_n\text{)} \times \text{Long-Time (I}_r\text{)}$$

The rating plug varies the circuit breaker ampere rating as a function of its sensor size. Rating plugs have nine dial settings; the multiplier values corresponding with each setting are printed on the rating plug. The maximum setting range is 0.4–1.0 x I_n.

PowerPact® D-Frame Circuit Breakers and Switches

General Information

Standard and 100% Ratings

Special constructions are designed for continuous operation at 100% of their current rating. All 400 A and smaller D-frame circuit breakers are 100% rated. The 600 A D-frames are standard (80%) rated only.

Trip System

The trip system causes the circuit breaker to open automatically under overload, short-circuit or equipment ground-fault conditions. Electronic trip circuit breakers give the customer more versatility to achieve coordination with features such as adjustable instantaneous pickup and high withstand ratings.

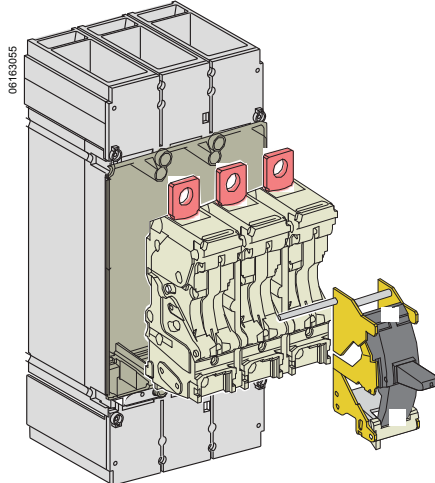
Communication between trip units allows zone-selective interlocking (ZSI) between circuit breakers at different levels in the system. ZSI reduces fault stress by allowing the upstream circuit breaker closest to the fault to ignore its preset delay time and trip without any intentional delay on a short circuit or ground fault. For more information on ZSI, see data bulletin Reducing Fault Stress with Zone-Selective Interlocking.

For more information, see “Trip Units for PowerPact® D-Frame Circuit Breakers” on page 17.

Enclosed Breaking System

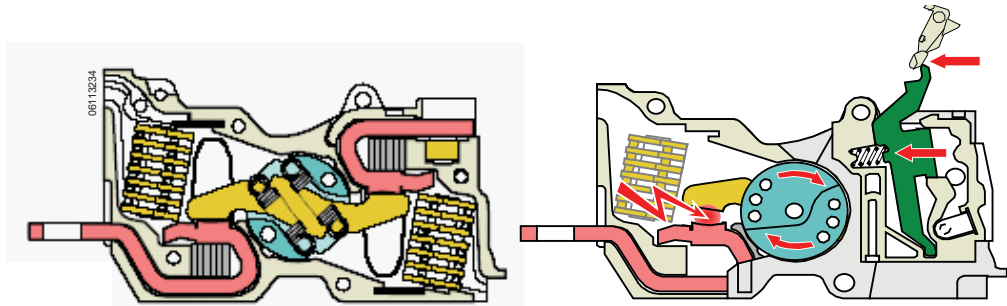
The 3 and 4-pole D-Frame circuit breakers are made up of several identical breaking units. Each is housed in a thermoset polyester enclosure. Thanks to this design the mechanism, the trip unit and internal accessories are protected from the negative effects of interruption (pressure, temperature rise, electromagnetic disturbances).

This technique, developed by Schneider Electric, makes it possible to manufacture relatively small circuit breakers offering outstanding high interrupting capacities, current limitation and durabilities.



Dual-Break Rotating Contacts

All PowerPact® D-frame circuit breakers are equipped with dual-break rotating contacts that reduce the amount of peak current during a short circuit fault. The moving contact has the shape of an elongated “S” and rotates around a floating axis. The shape of the fixed and moving contacts are such that the repelling forces appear as soon as the circuit reaches approximately 15 times I_n .



Reduced Let-Through Currents

Due to the rotating movement, repulsion is rapid and the device greatly limits short-circuit currents, whatever the interrupting level of the unit (G, J or L). The fault current is extinguished before it can fully develop. This enhances equipment protection. Lower let-through currents result in less peak energy, thus reducing the required bus bar bracing, lowering enclosure pressure, and delivering improved series or combination ratings.

Piston Assist of Tripping

As soon as the current reaches approximately 25 times the nominal current, the contacts naturally open, and an arc appears, creating a temperature rise (and pressure) in the breaking unit. The pressure is ported to a piston which is located between breaking units and is used to trip the circuit breaker within a couple of milliseconds.

Internal Operating Mechanism

D-frame circuit breakers have a single operating handle that acts directly through the operating mechanism against the contact blades. Multi-pole circuit breakers have a common trip bar for positive action of all poles on manual and automatic operation. These circuit breakers have a trip-free mechanism that allows them to trip even though the operating handle may be restricted (by a handle operating mechanism or padlock attachment) in the ON position. If not restricted, the operating handle moves to a position between ON and OFF when the circuit breaker is tripped.

The face of the circuit breakers is marked with standard ON/OFF and international I/O markings to indicate handle position. In addition, the OFF portion of the circuit breaker handle is color coded green.

Push-to-Trip Button

The push-to-trip button located on the face of each circuit breaker is a standard feature on these circuit breakers. This allows the user to manually trip the circuit breaker without risking exposure to live parts. During normal on-off operation, the handle opens and closes the circuit breaker contacts but does not exercise the tripping mechanism.

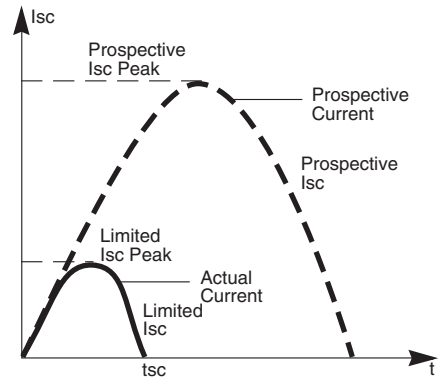
Use the push-to-trip button to:

- Exercise the circuit breaker mechanism
- Check the auxiliary and alarm switch circuits

Low Let-Through Current

The low let-through capacity of a circuit breaker is its ability to limit short-circuit currents. Advantages include:

- Longer service life as current limiting circuit breakers greatly reduce the negative effects of short circuits on installations
- Less temperature rise in conductors, therefore longer service life for cables
- Reduced electrodynamic forces, therefore less risk of electrical contacts or busbars being distorted or broken
- Less electromagnetic effects, resulting in less disturbance for measuring devices located near electrical circuits



The low let-through capacity of the PowerPact D-frame circuit breaker is due to the double break technique (rapid natural repulsion of contacts and the appearance of two arc voltages in series with a steep wavefront). Refer to Let-Through Curves on pages 63–66.

This low let-through capacity of the PowerPact circuit breaker line greatly reduces the forces created by fault currents in devices. The result is a major increase in breaking performance. In particular, the service breaking capacity I_{cs} is equal to 100% of I_{cu} (ultimate breaking capacity).

The I_{cs} value, defined by IEC 60947-2, is guaranteed by tests comprising the following operations:

- Breaking a fault current equal to 100% of I_{cu} three times consecutively
- Checking that the device continues to function normally
- Conduction of rated current without abnormal temperature rise
- Protection functions perform within the limits specified by the standard
- Suitability for isolation is not impaired.

Operating Conditions

Temperature

To meet the requirements of the UL489 Standard, molded case circuit breakers are designed, built and calibrated for use on 50/60 Hz ac systems in a 104°F (40°C) ambient environment. Unlike thermal-magnetic circuit breakers, the electronic trip units react only to the magnitude of the current flowing through the circuit breaker and are therefore inherently ambient insensitive.

However, the ambient temperature does affect the insulation of the conductors and other elements of the system. Therefore, if the STR23SP or STR53UP trip units are used at high operating temperatures, the setting must take into account the thermal limits of the circuit breaker. See table 5 below for fixed circuit breaker and switch re-rating values.

Table 5: Maximum Long-Time (LT) Protection Setting Depending on Ambient Temperature

Rating	Temperature	40°C	45°C	50°C	55°C	60°C	65°C	70°C
400 A	In: 400 A	400	400	400	390	380	370	360
	I _o /I _r Max.	1/1	1/1	1/1	1/0.98	1/0.95	1/0.93	1/0.9
600 A	In: 600 A	600	590	570	560	540	530	510
	I _o /I _r Max.	1/1	1/0.98	1/0.95	1/0.93	1/0.9	1/0.88	1/0.85

PowerPact® D-Frame Circuit Breakers and Switches General Information

Enclosures

Table 6: Minimum Enclosure Sizes Without Ventilation for D-Frame Circuit Breakers

Type		Rating	H	W	D
Fixed	DG 400	100%	40.50 in. (1030 mm)	13.75 in. (350 mm)	4.33 in. (110 mm)
	DJ 400				
	DL 400				
	DG 600	80%			
	DJ 600				
	DL 600				
Drawout	DG 400	100%	40.50 in. (1030 mm)	13.75 in. (350 mm)	6.33 in. (160 mm)
	DJ 400				
	DL 400				
	DG 600	80%			
	DJ 600				
	DL 600				

Altitude

D-frame circuit breakers are suitable for use at altitudes up to 13,100 ft. (4000 m). For altitudes higher than 6560 ft. (2000 m), circuit breakers must be rerated as shown.

Table 7: Altitude Derating Values per ANSI C37.20.1 Table 10

Altitude	≤ 6,600 ft. (≤ 2,000 m)	8,500 ft. (2,600 m)	13,000 ft. (3,900 m)
Voltage	1.00	0.95	0.80
Current	1.00	0.99	0.96

Storage Temperature

Circuit breakers with trip units may be stored in the original packaging at temperatures between -58°F (-50°C) and 185°F (85°C).

Extreme Atmospheric Conditions

PowerPact circuit breakers have successfully passed the tests defined below for extreme atmospheric conditions.

Dry cold and dry heat:

- IEC 68-2-1—Dry cold at -55°C
- IEC 68-2-2—Dry heat at +85°C

Damp heat (tropicalization)

- IEC 68-2-30—Damp heat (temperature +55°C and relative humidity of 95%)
- IEC 68-2-52 level 2—Salt mist

The materials used in the PowerPact circuit breakers will not support the growth of fungus and mold.

Vibration

PowerPact circuit breakers meet IEC 60068-2-6 Standards for vibration:

- 2 to 13.2 Hz and amplitude 0.039 in. (1 mm)
- 13.2 to 100 Hz constant acceleration

PowerPact® D-Frame Circuit Breakers and Switches

General Information

Codes and Standards

D-frame electronic trip circuit breakers and switches are manufactured and tested in accordance with the following standards:

Table 8: Standards

Circuit Breakers	Switches
UL 489 ¹ IEC Standard 60947-2 CSA 22.2 No 5-02 ² Federal Specification W-C-375B/GEN NEMA AB1 NF, VDE, BS, CEI, AS	UL 489 IEC Standard 60947-3 CSA 22.2 No 5-02 Federal Specification W-C-375B/GEN NEMA AB1 NF, VDE, BS, CEI, AS

¹ Circuit breakers, switches and their accessories, except where noted, are Listed under UL files E63335, E103740 and E103955

² Circuit breakers, switches and their accessories, except where noted, are Certified under CSA files LR69561 and LR88980

Circuit breakers should be applied according to guidelines detailed in the National Electrical Code® (NEC®) and other local wiring codes.

Specifications of Marine Classification Organizations

PowerPact D-frame circuit breaker is UL Listed per UL489 Supplement SA. Certifications for marine application by the American Bureau of Shipping, Bureau Veritas, Lloyd's Register of Shipping, Registro Italiano Navale, Germanischer Lloyd's and Det Norske Veritas are pending.

Pollution Degree

PowerPact circuit breakers are certified for operation in pollution degree III environments as defined by IEC standard 60947-1 (industrial environments).

Environmental Protection

PowerPact circuit breakers take into account concerns for environmental protection. Most components are recyclable and parts are marked as specified in applicable standards.

Suitability for Isolation (Positive Contact Indication)

All PowerPact circuit breakers and switches are suitable for isolation as defined in the IEC 60947-2 Standard:

- The isolation position corresponds to the off (O) position
- The operating handle cannot indicate the off position unless the contact are open
- Padlocks may not be installed unless the contacts are open

Installation of a rotary handle or a motor mechanism does not alter the functionality of the position indication system.

The isolation function is certified by tests guaranteeing:

- The mechanical reliability of the position indication system
- The absence of leakage currents
- Overvoltage withstand capacity between upstream and downstream connections



Testing Requirements

UL, NEMA and CSA requirements

The UL, NEMA and CSA labels on a circuit breaker indicate that the circuit breaker meets the requirements of UL Standard 489, NEMA Standard AB-1 and CSA Standard C22.2. The labels also mean that the production procedure is monitored by UL, CSA and ANCE inspectors to ensure continued compliance to these standards. These requirements include the following tests:

- *200% Overload Calibration*—each pole of the circuit breaker must trip within a specified time limit when carrying 200% of its continuous current rating.
- *135% Overload Calibration*—with all poles connected in series, the circuit breaker must trip within a specified time limit while carrying 135% of its continuous current rating.
- *Overload*—the circuit breaker must make and break 600% of its continuous current rating at rated voltage. Circuit breaker frame sizes through 1600 A must perform 50 operations at 600%. (Circuit breaker frame sizes 1600 A through 2500 A must perform 25 operations at 600%.)
- *Temperature Rise*—while carrying 100% of rated current and mounted in open air, temperature rise on a wiring terminal must be within specified limits. For 100% rating, the circuit breaker is mounted in an enclosure of specified dimensions.
- *Endurance*—the circuit breaker must complete the following number of operations:

Table 9: Endurance Operations

Frame Size	Operations With Current	Operations Without Current
600	1000	5000

- *Calibration*—both the 200% and 135% overload calibration tests are repeated after endurance testing.
- *Short Circuit*—the circuit breaker shall be subjected to test currents based on voltage rating and frame size; with the type and number of operations based on number of poles, frame rating and voltage rating. Example: a 3-pole, 600 Vac, 600 A frame circuit breaker is subjected to one 20 kA single phase closing of the circuit on the circuit breaker per pole and one 30 kA three phase closing of the circuit on the circuit breaker for a total of seven short circuit tests.
- *Trip Out*—the 200% thermal calibration test is repeated following the short-circuit tests.
- *Dielectric*—the circuit breaker must withstand, for one minute, twice its rated voltage plus 1000 V:
 - Between line and load terminals with the circuit breaker in the tripped and in the OFF positions.
 - Between terminals of opposite polarity with the circuit breaker closed.
 - Between live parts and the overall enclosure with the circuit breaker both open and closed.

No conditioning of the circuit breaker can take place during or between tests. There can be no failure of functional parts at the conclusion of the sequences.

After qualifying a set of circuit breakers to the standard tests, a manufacturer can have additional circuit breaker samples tested on higher than standard available fault currents. The following performance requirements apply:

- *200% Overload Calibration*—each pole of the circuit breaker must trip within a specified time limit when carrying 200% of its continuous current rating.
- *Short-Circuit Test*—with the load side terminals connected by 10-inch lengths of specified cable (or a shorting bar), the circuit breaker is exposed to a short-circuit current for a set time interval. After safe interruption, the circuit breaker is reset and closed again on the short circuit.
- *250% Overload Calibration*—each pole of the circuit breaker must trip within a specified time limit when carrying 250% of its continuous current rating.

PowerPact® D-Frame Circuit Breakers and Switches

General Information

- *Dielectric Withstand*—the circuit breaker is subjected to twice the voltage rating at which the interrupting test was conducted, but not less than 900 V.
 - Between line and load terminals with the circuit breaker in the tripped and in the OFF positions.
 - Between terminals of opposite polarity with the circuit breaker closed.
 - Between live parts and the overall enclosure with the circuit breaker both open and closed.

When the sample circuit breakers pass these tests, circuit breakers of the same construction can be marked or labeled with the current interrupting rating for the higher fault currents.

IEC Requirements

The IEC markings on a circuit breaker indicates that the circuit breaker meets the requirements of IEC Standard 60947-2 for circuit breakers and 60947-3 for automatic switches. These requirements include the following tests:

Table 10: IEC Test Sequence

Sequence	Category of Devices	Tests
General Performance Characteristics (Sequence 1)	All Circuit Breakers	<ul style="list-style-type: none"> • Tripping limits and characteristics • Dielectric properties • Mechanical and electrical endurance • Overload • Dielectric voltage withstand • Temperature rise • 145% calibration (3 poles in series or 3-phase test)
Rated Service Short-Circuit Breaking Capacity (Ics) (Sequence 2)	All Circuit Breakers	<ul style="list-style-type: none"> • Rated service short circuit breaking capacity (O-t-CO-t-CO) • Electrical endurance (5% of with current operations of Sequence 1) • Dielectric voltage withstand • Temperature rise • 145% calibration (3 poles in series or 3-phase test)
Rated Ultimate Short-Circuit Breaking Capacity (Icu) (Sequence 3)	Circuit Breakers of Utilization Category A Circuit Breakers of Utilization Category B	<ul style="list-style-type: none"> • 200% calibration (each pole separately) • Rated ultimate short circuit breaking capacity (O-t-CO) • Dielectric voltage withstand • 250% calibration (each pole separately)
Rated Short-Time Withstand Current (Icw) (Sequence 4)	Circuit Breakers of Utilization Category B	<ul style="list-style-type: none"> • 200% calibration (each pole separately) • Rated short-time withstand current • Temperature rise • Short-circuit breaking capacity at maximum short-time withstand current (O-t-CO) • Dielectric voltage withstand • 200% calibration (each pole separately)
Combined Sequence	Circuit Breakers of Utilization Category B: When Icw = Ics Replaces Sequences 2 and 4 When Icw = Ics = Icu Replaces Sequences 2, 3 and 4	<ul style="list-style-type: none"> • 200% calibration (each pole separately) • Rated short-time withstand current Icw • Rated service short-circuit breaking capacity at Ics (O-CO-CO) at maximum relay temp. • 145% calibration (3 poles in series or 3-phase test) • Dielectric voltage withstand • Temperature rise • 200% calibration (each pole separately)
Individual Pole Short-Circuit Test Sequence (Annex H)	Circuit Breakers for Use in IT Systems	<ul style="list-style-type: none"> • Individual pole short-circuit breaking capacity • Dielectric voltage withstand • 250% calibration (each pole separately)

The CCC (Chinese Compulsory Certification) marking now applies to these PowerPact D-frame circuit breakers:

- Unit-mounted circuit breakers
- Unit-mounted motor circuit protectors (MCP)

This rating allows our customers to support their international business. All products exported to China by OEMs and Panelbuilders have to be CCC marked. Using CCC certified components helps customers obtain and maintain the CCC certification on their equipment.

The CCC marking does not apply to automatic switches or any I-Line mounted products.

Section 2—Electronic Trip Units and Test Kits

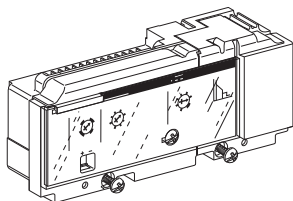
Trip Units for PowerPact® D-Frame Circuit Breakers

PowerPact D-frame circuit breakers are equipped with current sensors and an STR electronic trip unit. Current sensors are available in two different sizes:

- 400 A frame—150, 250 and 400 A versions
- 600 A frame—600 A version

STR trip units provide protection for loads, from 60 to 600 A:

- STR23SP and STR53UP for standard protection can be mounted on all circuit breakers
- Trip unit STR53UP offers a greater number of optional indication and measurement functions, protection settings and ground-fault protection
- STR23SP-OSN for oversized neutral protection (factory-installed only)
- STR53UP for generator supplied network protection and long cable runs
- STR23SP and STR53UP trip units are available on 4P circuit breakers with sealable, three-position neutral protection setting:
 - 4P 3D (no neutral protection)
 - 4P 3D + N/2 (neutral protection at $0.5 \times I_r$ where I_r is trip unit current setting)
 - 4P 4D (neutral protection at I_r where I_r is trip unit current setting).



PowerPact® D-Frame Circuit Breakers and Switches Electronic Trip Units and Test Kits

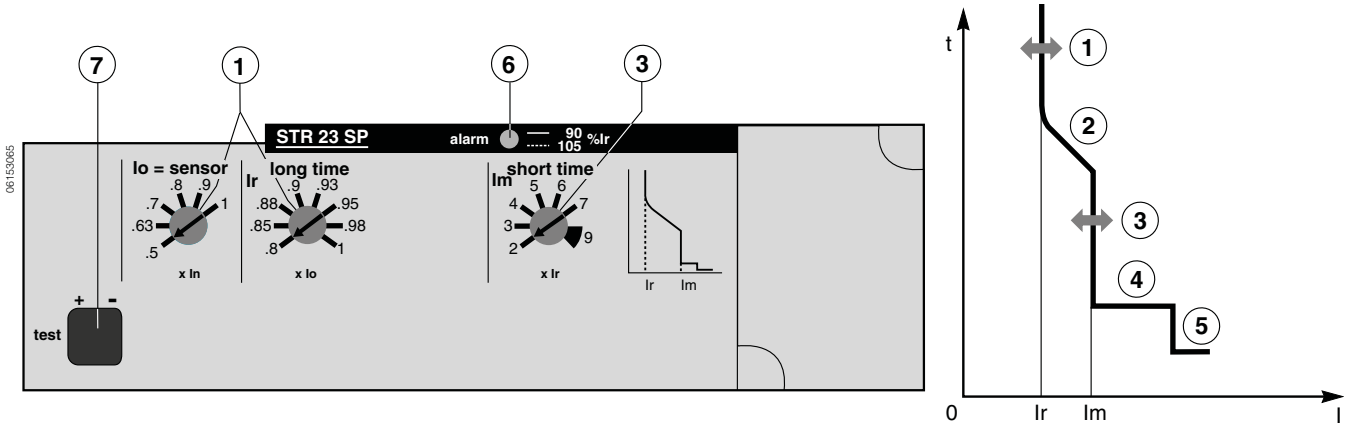
Table 11: Trip Units

		STR23SP	STR53UP					
Overload Protection (Long-Time)								
Tripping Threshold (A)	I_n	20–70°C	Adjustable (48 Settings) 0.4–1 x I_n	Adjustable (32 Settings) 0.4–1 x I_n				
Tripping Time (s) (Min–Max)		—	Fixed	Adjustable				
	At 1.5 x I_r		120–180	17–25	34–50	69–100	138–200	277–400
	At 6 x I_r		5–7.5	0.8–1	1.6–2	3.2–4	6.4–8	12.8–16
	At 7.2 x I_r		3.2–5.0	0.5–0.7	1.1–1.4	2.2–2.8	4.4–5.5	8.8–11
Short-Circuit Protection (Short Time)								
Tripping	IM/ISD		Adjustable (7 Settings) 2–9 x I_r	Adjustable (7 Settings) 1.5–7 x I_r				
	Accuracy		± 15%					
Time Delay (ms)	Max. Overcurrent Time Before Tripping		Fixed ≤ 40	Adjustable (4 Settings + Constant I^2t Function)				
				≤ 15	≤ 60	≤ 140	≤ 230	
	Total Breaking Time		≤ 60	≤ 60	≤ 140	≤ 230	≤ 350	
Short-Circuit Protection (Instantaneous)								
Tripping Threshold (A)			Fixed ≥ 9 x I_n	Adjustable (7 Settings) 1.5–7 x I_r				
Adjustable Neutral Protection (Three Position Switch) (STR23SP OSN¹ only)								
	Switch	Settings	Protection Level					
	Position 1	4P 3D	No Neutral Protection		—			
	Position 2	4P 3D + N/2	0.5 x I_r		—			
	Position 3	4P 4D	1.0 x I_r		—			
Electronic Trip Unit (Field Replaceable)								
		Trip Unit ²	Trip Function	Suffix	Cat. No.			
Long-Time, Short-Time and Fixed Instantaneous Protection		STR23SP	LS	E20	36940			
Long-Time, Short-Time, Instantaneous Protection and Options		STR53UP-F	LSI	E53	36942			
		STR53UP-FT	LSIG	E54	36943			
		STR53UP-FI	LSI	E58	36944			
		STR53UP-FTI	LSIG	E59	36945			
		Communication Wiring	—	—	32441			
	Replacement Battery	—	—	32434				

¹ Oversized Neutral

² F - Fault Indicator; T = Residual-Type Ground-Fault Protection; I = Ammeter

Electronic Trip Unit STR23SP and SR23SP-OSN (Oversized Neutral)



Protection

Definitions

- I = Current
- In = Nominal Current = Sensor Rating
- Io = Course Adjustment x In
- Ir = Long-Time (LT) Pickup x Io
- Im = Short-Time (ST) Pickup x Ir

- Long-time (LT) overload protection, adjustable threshold, based on the actual RMS current:
 - Adjustable threshold (2) using six Io base settings (0.5–1) and fine adjustment Ir with eight settings (0.8–1)
 - Non-adjustable tripping time (2)
- Short-time (ST) short-circuit protection:
 - Adjustable threshold Im (3)
 - Fixed time delay (4)
- Instantaneous (I) short-circuit protection, fixed threshold (5)
- Neutral protection available on standard 4P circuit breakers; protection level controlled using three-position switch:
 - 4P 3D: no protection of neutral
 - 3D + N/2: neutral protection at 0.5 Ir
 - 4P 4D: neutral protection at Ir
- Neutral protection for STR23SP-OSN (oversized neutral) available on four-pole circuit breakers equipped with oversized neutral protection; protection level controlled using three-position switch:
 - 4P 3D: no protection of neutral
 - 3D + N/2: neutral protection at 0.75 x Ir
 - 4P 4D: neutral protection at 1.5 x Ir

Indications

Load indication (LED) in front (6):

- Lights solid at 90% of Ir threshold
- Flashes at > 105% or greater of Ir threshold

Test

Test connector in front (7) allows connection to the test kit, to check circuit breaker operation after fitting the trip unit or other accessories.

Setting Example

Question: what is the overload protection threshold of a 400 A D-frame circuit breaker equipped with trip unit STR23SP where Io = 0.5 and Ir = 0.8?

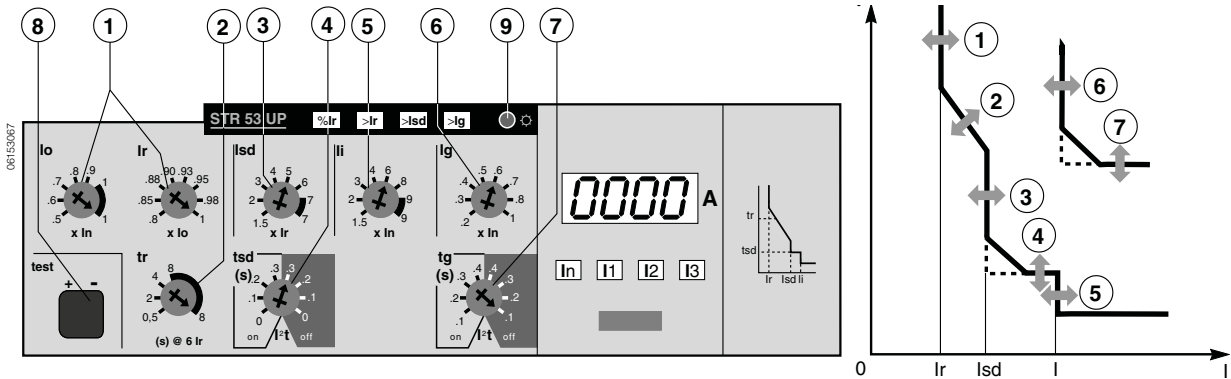
PowerPact® D-Frame Circuit Breakers and Switches

Electronic Trip Units and Test Kits

Answer: $I_n \times I_o \times I_r = 400 \times 0.5 \times 0.8 = 160 \text{ A}$

The same trip unit with the same settings, mounted on a 600 A frame circuit breaker, will have the following tripping threshold: $I_n \times I_o \times I_r = 600 \times 0.5 \times 0.8 = 240 \text{ A}$.

Electronic Trip Unit STR53UP



Definitions

- I = Current
- I_n = Nominal Current = Sensor Rating
- I_o = Course Adjustment $\times I_n$
- I_r = Long-Time (LT) Pickup $\times I_o$
- I_m = Short-Time (ST) Pickup $\times I_r$
- I_{sd} = Instantaneous Pickup
- I_g = Ground-Fault Pickup

Protection

- Long-time (LT) overload protection, adjustable threshold, based on actual rms current, as defined by IEC 60947-2, appendix F:
 - Adjustable threshold (1) using six I_o base settings (0.5–1) and fine adjustment I_r with eight settings ranging (0.8–1)
 - Adjustable tripping time (2)
- Short-time (ST) short-circuit protection:
 - Adjustable threshold I_{sd} (3)
 - Adjustable time delay (4), with or without constant I^2t function
- Instantaneous (I_i) short-circuit protection, adjustable threshold (5)
- Neutral protection available on standard 4P circuit breakers; protection level controlled using three-position switch:
 - 4P 3D: no protection of neutral
 - 3D + N/2: neutral protection at 0.5 I_r
 - 4P 4D: neutral protection at I_r

Overload Indications (% I_r)

- LED (9) lights solid when current exceeds 0.9 I_r
- LED (9) flashes when current exceeds long-time threshold I_r

Fault Indications

LEDs indicate the type of fault that caused tripping:

- Overload (LT protection) or abnormal component temperature ($> I_r$)
- Short-circuit (ST or instantaneous protection) ($> I_{sd}$)
- Ground-fault (if ground-fault protection option is present) $> I_g$
- Microprocessor malfunction—both ($> I_r$ and $> I_{sd}$) LEDs go on, plus the $> I_g$ LED, if the ground fault protection option is present

The LEDs are battery powered with spare batteries supplied in the adapter box. When a fault occurs, the LED indicating type of fault shuts off after approximately 10 minutes to conserve battery power.

PowerPact® D-Frame Circuit Breakers and Switches Electronic Trip Units and Test Kits

The fault data is stored in memory and the LED can be re-illuminated by pressing the battery/LED test button (9). The LED automatically goes off and memory is cleared when the circuit breaker is reset.

Test

- Test connector in front (8) for connection to test kit (see page 20); used to check circuit breaker operation after fitting trip unit or other accessories
- Test button (9) for LEDs (%I_r, > I_r, > I_m and > I_g) and battery

Self-Monitoring

The circuit breaker trips for both microprocessor faults and abnormal temperatures.

Options for Electronic Trip Unit STR53UP

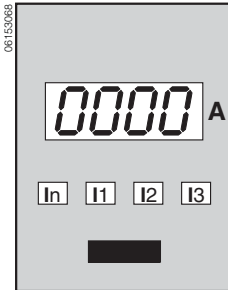
Equipment Ground-fault Protection

Table 12: Equipment Ground-Fault Protection (T)—See (6) and (7), Page 20

Type		Residual Current
Tripping Threshold	I _g	Adjustable (8 Settings) 0.2–1 x I _n
	Accuracy	± 15%
Tripping Time	Max. Overcurrent Time Before Tripping (T _g)	Adjustable (4 Settings + Constant ([² t] Function) 60, 140, 230, 350
	Total Breaking Time	-140, -230, -350, -500

Ammeter (I)

A digital display continuously indicates the current of the phase with the greatest load. By pressing a scroll button, it is also possible to display successively the readings of I₁, I₂, I₃ and I neutral. LEDs indicate the phase for which the current is displayed.



Zone-Selective Interlocking (ZSI) with STR53 Trip Unit

The STR53 trip unit provides an output for selective zone interlocking with an upstream circuit breaker or other device. In the event of a short circuit or ground fault:

- If a given STR53UP trip unit detects a fault, it informs the upstream circuit breaker, which will not trip for the preset time delay, allowing the downstream device to trip first.
- If the STR53UP trip unit does not detect the fault, the upstream circuit breaker trips after its preset time delay

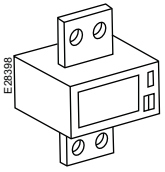
In this way, the fault is cleared rapidly by the nearest circuit breaker. In addition, thermal stresses on the circuits are minimized and time discrimination is maintained throughout the installation.

The upstream device must be an S48890 or S48895 Restraint Interface Module (RIM), a circuit breaker with a Micrologic #.0x trip unit, or an STR58 trip unit. These signals are output from terminals Z11 and Z12 of the STR53 trip unit.

Optical Outputs

The use of optical transistors ensures total isolation between the internal circuits of the trip unit and the circuits wired by the user.

PowerPact® D-Frame Circuit Breakers and Switches Electronic Trip Units and Test Kits



External Neutral Current Transformers (CT)

Current transformers are available for applications requiring ground-fault protection on three-phase, four-wire systems or for neutral protection and metering. Neutral current transformers are not required on non-ground-fault circuit breakers or on three-phase, three-wire systems. The rating of the external neutral current transformer must be compatible with the rating of the circuit breaker.

Table 13: External Neutral CT (Sensor)

Rating	Cat. No.
150 A	36950
250 A	36951
400 A	36952
600 A	36953

Electronic Trip Unit Test Kits

The test kits presented below are compatible with D-frame (and Compact NSJ) circuit breakers.

Tests performed by test kits are only functional tests designed to electrically test the operation integrity of the trip unit, the flux shifter, and the mechanical operation of the circuit breaker. Tests are not designed to calibrate the circuit breaker.

Mini Test Kit (43362) and Hand-Held Test Kit (S33594)

The Mini Test Kit and the Hand-Held Test Kit are portable units which require no external power supply. Both are powered by five 9 V alkaline batteries, not supplied. These test kits are used to check operation of the electronic trip unit and circuit breaker tripping. Connection of either test kit is made via the test port on the front of the trip unit.



Mini Test Kit



Hand-Held Test Kit

Portable Test Kit (55391)

The Portable Test Kit and the Full-Function Test Kit are calibration units. Both require a power supply of 110 or 240 Vac, 50/60 Hz (two-position selector). These test kits are used to check the operation of the trip unit by measuring actual trip times:

- At 1.5 x I_r for long-time protection
- At 15 x I_r for short-time protection
- At 0.8 x I_n for ground-fault protection

Manual test mode is also available.



PowerPact® D-Frame Circuit Breakers and Switches Electronic Trip Units and Test Kits

Full-Function Test Kit (S33595)

The full-function test kit consists of a signal-injection box which can be used alone or with a supporting personal computer (PC). The optional test kit software is compatible with Windows® 95, 98 and Windows NT® operating systems.



The test kit without a supporting PC may be used to check:

- The mechanical operation of the circuit breaker
- The electrical continuity of the connection between the tripping coil and the trip unit
- Trip unit operation — for example:
 - Display of settings
 - Operating tests on the electronic component
 - Automatic and manual tests on protection functions (trip curve verification)
 - Tests on the Zone-Selective Interlocking (ZSI) function
 - Inhibition of the ground-fault protection for equipment
 - Inhibition of the thermal imaging
- Save test data into test kit

The test kit with a supporting PC may be used to:

- Print test data
- Compare the real tripping curve with the curves available on the PC

Table 14: Full-Function Test Kit Catalog Numbers

Device	Cat. No.
Full-function Test Kit	S33595
Two-Pin Test Cable (for Connection Between Test Kit and Trip Unit) ¹	S48908
230 Vac Filtered Power Cord ¹	S48856
120 Vac Filtered Power Cord ¹	S48855

¹ Included in the test kit. Kit for replacement only.

Section 3—Circuit Breakers

Introduction

PowerPact® D-frame electronic trip molded case circuit breakers are available tested to UL 489 or IEC 60947-2, in three interruption ratings.

Ratings and Interrupting Ratings

Table 15: Ratings and Interrupting Ratings

			Circuit Breaker ^{1,2}						
Rated Current (A)	In	40° C	400 ³			600 ⁴			
Number of Poles			3, 4, 4 OSN ⁵			3, 4			
UL489 Ratings									
Rated Current	AC 50/60 Hz		600 Vac			600 Vac			
			G	J	L	G	J	L	
Interrupting Ratings (kA rms)	AC 50/60 Hz	240 V	65	100	125	65	100	125	
		480 V	35	65	100	35	65	100	
		600 Y/347 V	—	—	—	—	—	—	
		600V	18	25	25	18	25	25	
IEC 60947-2 and EN 60947-2 Ratings									
Rated Insulation Voltage	Ui		750 V			750 V			
Rated Impulse Withstand Voltage (kV)	Uimp		8 kV			8 kV			
Rated Operational Voltage	Ue	AC 50/60 Hz	690 V			690 V			
		DC	500 V			500 V			
Ultimate Breaking Capacity (kA rms)	Ic	AC 50 Hz	N	H	L	N	H	L	
			220/240 V	85	100	150	85	100	150
			330/415 V	45	70	150	45	70	150
			445 V	42	65	130	42	65	130
			500 V	30	50	70	30	50	70
			525 V	22	35	50	22	35	50
600/690 V	10	20	35	10	20	35			
Service Breaking capacity	Ics	(% Icu)	100%	100%	100%	100%	—	100%	
Utilization Category			A	A	A	A	—	A	

¹ For 4-pole device, replace the 3 in the fourth position with a 4.

² 4-pole devices are available in plug-in (N), draw-out (D) and rear-connected (S) only.

³ 100% Rated Circuit Breaker

⁴ 100% rated in rear-connected figuration only.

⁵ Oversized Neutral

Table 16: D-Frame 3P 600 A Circuit Breakers, Frame Only

Basic Frame Only (600 Vac) ¹			
Ampere Rating	G Interrupting	J Interrupting	L Interrupting
	Cat. No.	Cat. No.	Cat. No.
150 A	DGL36150F40	DJL36150F40	DLL36150F40
250 A	DGL36250F40	DJL36250F40	DLL36250F60
400 A	DGL36400F40	DJL36400F40	DLL36400F40
600 A	DGL36600F60	DJL36600F60	DLL36600F60

¹ Available with lugs (L) or bus (F) connections only.

PowerPact® D-Frame Circuit Breakers and Switches Circuit Breakers

Table 17: D-Frame 3P 50/60 Hz Unit-Mount Circuit Breaker with Lugs and Electronic Trip Units Catalog Numbers¹

Electronic Trip Unit Type	Trip Function	Trip Unit ²	Continuous Current ³	Catalog Number			(Wires per Terminal) Wire Range (AWG/kcmil)
				G Interrupting	J Interrupting	L Interrupting	
Standard	LS	STR23SP	150 A	DGL36150E20	DJL36150E20	DLL36150E20	(1) 2–600 Cu or (1) 2–500 Al
			250 A	DGL36250E20	DJL36250E20	DLL36250E20	
			400 A	DGL36400E20	DJL36400E20	DLL36400E20	
			600 A	DGL36600E20	DJL36600E20	DLL36600E20	
	LSI	STR53UP-F	150 A	DGL36150E53	DJL36150E53	DLL36150E53	(1) 2–600 Cu or (1) 2–500 Al
			250 A	DGL36250E53	DJL36250E53	DLL36250E53	
			400 A	DGL36400E53	DJL36400E53	DLL36400E53	
			600 A	DGL36600E53	DJL36600E53	DLL36600E53	
	LSIG	STR53UP-FT	150 A	DGL36150E54	DJL36150E54	DLL36150E54	(1) 2–600 Cu or (1) 2–500 Al
			250 A	DGL36250E54	DJL36250E54	DLL36250E54	
			400 A	DGL36400E54	DJL36400E54	DLL36400E54	
			600 A	DGL36600E54	DJL36600E54	DLL36600E54	
Ammeter	LSI	STR53UP-FI	150 A	DGL36150E58	DJL36150E58	DLL36150E58	(1) 2–600 Cu or (1) 2–500 Al
			250 A	DGL36250E58	DJL36250E58	DLL36250E58	
			400 A	DGL36400E58	DJL36400E58	DLL36400E58	
			600 A	DGL36600E58	DJL36600E58	DLL36600E58	
	LSIG	STR53UP-FTI	150 A	DGL36150E59	DJL36150E59	DLL36150E59	(1) 2–600 Cu or (1) 2–500 Al
			250 A	DGL36250E59	DJL36250E59	DLL36250E59	
			400 A	DGL36400E59	DJL36400E59	DLL36400E59	
			600 A	DGL36600E59	DJL36600E59	DLL36600E59	

¹ Refer to Table 2 for catalog numbering for 4-pole circuit breakers and termination options.

² F = Fault indicator; T = Residual-type ground-fault protection; I = Ammeter

³ D-frame circuit breaker 400 A and below are 100% rated, 600 A are standard (80%) rated.



Table 18: D-Frame 3P 50/60 Hz I-Line® Circuit Breaker with Lugs and Electronic Trip Units Catalog Numbers

Electronic Trip Unit Type	Trip Function	Trip Unit ¹	Continuous Current ²	Catalog Number			(Wires per Terminal) Wire Range (AWG/kcmil)
				G Interrupting	J Interrupting	L Interrupting	
Standard	LS	STR23SP	150 A	DGA34150E20	DJA34150E20	DLA34150E20	(1) 2–600 Cu or (1) 2–500 Al
			250 A	DGA34250E20	DJA34250E20	DLA34250E20	
			400 A	DGA34400E20	DJA34400E20	DLA34400E20	
			600 A	DGA34600E20	DJA34600E20	DLA34600E20	
	LSI	STR53UP-F	150 A	DGA34150E53	DJA34150E53	DLA34150E53	(1) 2–600 Cu or (1) 2–500 Al
			250 A	DGA34250E53	DJA34250E53	DLA34250E53	
			400 A	DGA34400E53	DJA34400E53	DLA34400E53	
			600 A	DGA34600E53	DJA34600E53	DLA34600E53	
Ammeter	LSI	STR53UP-FI	150 A	DGA34150E58	DJA34150E58	DLA34150E58	(1) 2–600 Cu or (1) 2–500 Al
			250 A	DGA34250E58	DJA34250E58	DLA34250E58	
			400 A	DGA34400E58	DJA34400E58	DLA34400E58	
			600 A	DGA34600E58	DJA34600E58	DLA34600E58	

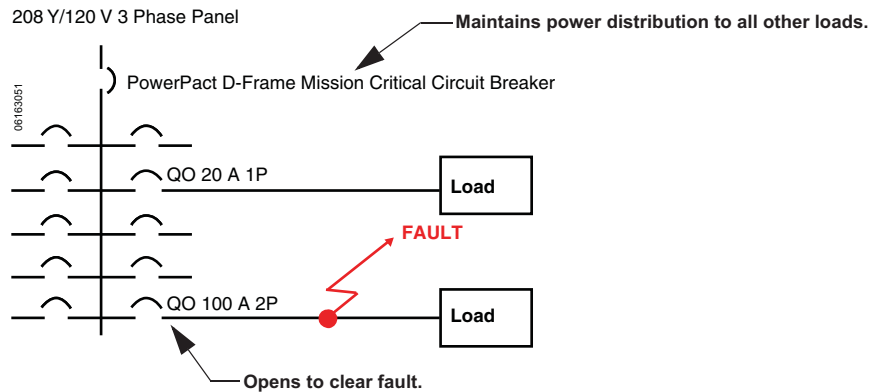
¹ F = Fault indicator; T = Residual-type ground-fault protection; I = Ammeter

² D-frame circuit breaker 400 A and below are 100% rated, 600 A are standard (80%) rated.

Section 4—Mission Critical Circuit Breakers

The PowerPact® D-Frame Mission Critical circuit breakers deliver high levels of selective coordination in a flexible design that can be easily configured for a variety of applications. Tested to be selectively coordinated with the QO® family of miniature circuit breakers through 30 kA fault current, this solution provides peace of mind when power availability is critical.

An electronic trip unit provides adjustable long-time settings in four sensor sizes, allowing coverage from 60 A through 600 A on a 208Y/120 V system. In conjunction with the QO family of branch circuit breakers, the PowerPact D Mission Critical circuit breaker delivers full selective coordination downstream of Square D brand transformers ranging from 15 kVA to 300 kVA.



Ratings	Available Configurations
UL 489 Listed CSA Certified Voltage: 208Y/120 V Handle Ratings: 60–600 A AIR: 65 kA	<ul style="list-style-type: none"> • Four Sensor Sizes: 150, 250, 400 and 600 A • Main circuit breaker in NQ panelboards • Unit mount for OEM users • Plug-in base for OEM users • Drawout base for OEM users

In addition to unique design attributes, the D-frame Mission Critical circuit breakers have also undergone rigorous testing procedures to certify the coordination with downstream circuit breakers—combining innovative engineering with validated test results.

Apply Schneider Electric Mission Critical circuit breakers in emergency power distribution systems, data centers, hospitals, or anywhere continuity of service is desired.

Part numbers are derived as shown in Table 19 by selecting two variable components: termination type and sensor rating.

Table 19: Mission Critical Circuit Breaker Part Number

D	J	L	3	2	150	W	+ Accessories
D-Frame	Interrupting Rating 65 kA at 208Y/120 Vac	Termination Options A = I-Line ON end L = Lugs On/Off End M = Lugs On End P = Lugs off End F = Bus Bar S = Rear Connected N = Plug-in D = Drawout	Poles 3-Pole Only	Voltage 208Y/120 Vac only	Sensor Rating Amperage 150 = 60–150 A 250 = 100–250 A 400 = 160–400 A 600 = 240–600 A	Mission Critical	

PowerPact® D-Frame Circuit Breakers and Switches

Mission Critical Circuit Breakers

Theory of Operation

There are several dynamic forces between the D-frame Mission Critical and downstream circuit breakers during a fault occurring below the downstream circuit breaker. Many of these high short-circuit regions cannot be shown on the trip curve.

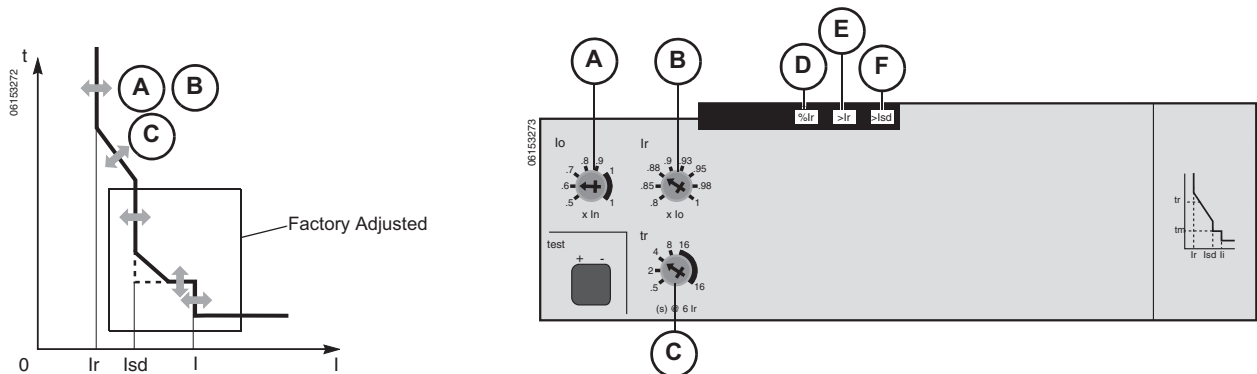
The D-frame Mission Critical circuit breakers use an energy-based tripping system to protect the circuit breakers while allowing the maximum selectivity with downstream circuit breakers. The trip units have a special selectivity delay to allow downstream circuit breakers to clear. However, on very high faults or if the downstream circuit breaker does not trip, the circuit breakers employ a piston-based tripping system that uses the energy (I^2t) pressure to open the mechanism.

1. At a very high level (about 25X the frame rating of the circuit breaker), the contacts begin to open due to magnetic fields pushing the contacts apart.
2. As the contacts part, arcing begins. As the energy increases, the pressure inside the arcing chamber increases.
3. At a preset pressure (depending on circuit breaker capability), a piston opens the mechanism to trip the circuit breaker.

This piston system is referred to as “reflex tripping” and is shown on page 63 of this catalog.

The combination of the D-frame Mission Critical and downstream circuit breakers shown in the selectivity charts in the instruction bulletin are selective due to the fact that the series impedance and the let-through from the downstream circuit breaker does not produce enough I^2t energy to trip the D-frame Mission Critical circuit breaker.

This system maximizes the interaction of the circuit breakers in series to allow selectivity. See the trip unit drawing shown below.



LSI Protection

- A. Sensor (I_o) switch sets sensor value for circuit breaker.
- B. Long-time pickup (I_r) switch sets maximum current level (based on sensor setting I_o) which circuit breaker will carry continuously without tripping.
- C. Long-time delay (t_r) switch sets time circuit breaker will carry an overcurrent above long-time pickup current level before tripping.

Indicator light

- D. Load indication alarm
 - Lights at % of I_r pickup.
 - Flashes at 105% or more of I_r pickup.

Indicator LEDs

- E. Overload indicator LED lights when circuit breaker trips due to overload (I_r) or abnormal component temperature. When lit at same time as short-circuit indicator light, indicates microprocessor malfunction.
- F. Short-circuit indicator LED lights when circuit breaker trips due to short circuit (I_{sd}) or instantaneous (I) faults. When lit at same time as overload indicator light, indicates microprocessor malfunction.

Fixed (Factory Adjusted) Settings

The following parameters are factory set to maximize selectivity, and cannot be adjusted by the user:

- Short time (I_{sd})
- Short-time delay
- Instantaneous (I)

Section 5—Automatic Switches

D-frame circuit breakers are also available in an automatic molded case switch construction. Automatic switches are similar in construction to electronic trip circuit breakers, except that the switches open instantaneously at a factory-set, non-adjustable trip point calibrated to protect only the molded case switch itself. Because of their molded case construction, they are more compact than conventional disconnect switches and accept electrical accessories for added flexibility. (See Section 8—Accessories.)

Molded case switches are identical to molded case circuit breakers, except they are not equipped with thermal (overload) trip units. Molded case switches open when the handle is switched to the off position or in response to an auxiliary tripping device such as a shunt trip or an undervoltage release.

Molded case switches are intended for use as disconnect devices only. UL489 requires molded case switches to be protected by a circuit breaker or fuse of equivalent rating. Molded case switches are labeled with their appropriate withstand ratings. The withstand rating of a switch is defined as the maximum current at rated voltage that the molded case switch will withstand without damage when protected by a circuit breaker with an equal continuous current rating.

Table 20: Ratings and Interrupting Ratings

		400 A	600 A	
Number of Poles		3, 4, 4P OSN ¹	3, 4	
Rated Current (A)		400	600	
UL 489 Ratings				
Rated Voltage (V)		600	600	
IEC 60947-3 ratings				
Rated Insulation Voltage (V)		750	750	
Rated Impulse Withstand Voltage (kV)		8	8	
Rated Operational Voltage	U _e	AC 50/60 Hz	690	690
		DC	500	500
Rated Operational Current	I _e	AC 23A 690 V	400	630
		DC 23A 250 V	400	630
		DC 23A 500 V (2 poles in series)	400	630
Making Capacity (kA peak)		7.1	8.5	
Short-Time Withstand Current (kA rms)	I _{cw}	I _{cw} (kA ms)	5	6
		Duration (s)	1	1

¹ Oversized Neutral Protection

These switches are suitable for use on a circuit capable of delivering not more than:

Table 21: Short-Circuit Withstand Current

Voltage	Short-Circuit Availability
240 Vac	150 kA
480 Vac	100 kA
600 Vac	25 kA

PowerPact® D-Frame Circuit Breakers and Switches Automatic Switches

Switches are Listed under UL file E103740 and Certified under CSA file LR88980.

Table 22: Switch Catalog Numbers

Ampere Rating	Poles ¹	J Interrupting		Terminal Kit (One Side)	Wire Range
		Cat. No.	Trip Point		
Unit-Mount Circuit Breakers					
400 A	3P	DJL3600S40	6000 A	32508	2 AWG–500 kcmil Al or 2 AWG–600 kcmil Cu
600 A		DJL3600S60	6000 A	32510	(2) 2/0 AWG–500 kcmil Al or (2) 2/0 AWG–350 kcmil Cu
400 A	4P	DJL4600S40	6000 A	M32509	2 AWG–500 kcmil Al or 2 AWG–600 kcmil Cu
600 A		DJL4600S60	6000 A	M32511	(2) 2/0 AWG–500 kcmil Al or (2) 2/0 AWG–350 kcmil Cu
400 A	4P OSN	DJL5600S40	6000 A	M32509	2 AWG–500 kcmil Al or 2 AWG–600 kcmil Cu
600 A		DJL5600S60	6000 A	M32511	(2) 2/0 AWG–500 kcmil Al or (2) 2/0 AWG–350 kcmil Cu
I-Line Circuit Breakers					
400 A	3P	DJA3400S40	6000 A	32508	2 AWG–500 kcmil Al or 2 AWG–600 kcmil Cu
600 A		DJA3400S60	6000 A	32510	(2) 3/0 AWG–500 kcmil Al/Cu

New!

¹ 4P circuit breaker available in plug-in, draw-out and rear-connected only. Availability of 4P bus-connected and lug configurations to be announced.

Section 6—Motor Circuit Protectors

Motor Circuit Protectors

An instantaneous trip version of the PowerPact D-frame circuit breaker is also available for motor circuit protection. These motor circuit protectors comply with NEC requirements for providing short-circuit protection when installed as part of a Listed combination controller having motor overload protection.

Electronic trip motor circuit protectors are designed as disconnect devices for use in combination with motor starters. These motor circuit protectors provide short-circuit protection only and have an adjustable amperage pickup so they can be set to open instantaneously at current values slightly above the motor starting inrush current. This setting coordinates the pickup time-current response of the motor circuit protector with the overload relay of the motor starter to give the best possible protection.

Current interrupting ratings for these UL Recognized components are established in combination with motor starters and properly-sized overload relays and contactors.

Table 23: Motor Circuit Protector Ratings and Interrupting Ratings

Catalog Number		DJL36400M36	DJL36600M42		
Rated Current	In	400 A	600 A		
Number of Poles		3	3		
UL 489 Ratings					
Rated Voltage (V)		600 A	600 A		
Magnetic Trip Setting (5–10 Times Handle Rating)		2000–4000 A	3000–6500 A		
IEC 60947-3 ratings					
Rated Insulation Voltage (V)	Ui	750	750		
Rated Impulse Withstand Voltage (kV)	Uimp	8	8		
Rated Operational Voltage	Ue	AC 50/60 Hz	690		
		DC	500		
Ultimate Breaking Capacity (kAIR)	Icu	AC 50/60 Hz	220/240 V	100	100 kAIR
			380/415 V	70	70
			440 V	65	65
			500 V	30	30
			525 V	35	35
			660/690 V	20	20
		DC	250 V (1P)	85	85
			500 V (2 poles in series)	85	85
Service Breaking Capacity	Ics	(% Icu)	100%	100%	
Utilization Category		A	A		

Table 24: Motor Circuit Protector Catalog Numbers¹

Ampere Rating	Adjustable Trip Range	Catalog Number	Wire Range
400 A	2000–4000 A	DGL36400M36	2 AWG–500 kcmil Al or 2 AWG–600 kcmil Cu
600 A	3000–6000 A	DGL36600M42	(2) 3/0 AWG–500 kcmil Al/Cu
400 A	2000–4000 A	DJL36400M36	2 AWG–500 kcmil Al or 2 AWG–600 kcmil Cu
600 A	3000–6000 A	DJL36600M42	(2) 3/0 AWG–500 kcmil Al/Cu
400 A	2000–4000 A	DLL36400M36	2 AWG–500 kcmil Al or 2 AWG–600 kcmil Cu
600 A	3000–6000 A	DLL36600M42	(2) 3/0 AWG–500 kcmil Al/Cu

¹ Also available in I-Line®, plug-in, and drawout versions.

Section 7—Circuit Breaker Mounting and Connections

Mounting Configurations

The PowerPact D-frame circuit breakers are available in a variety of configurations.

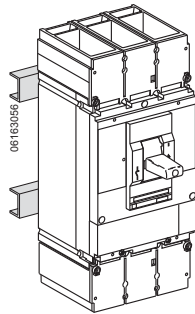
Table 25: Mounting Options

Termination Letter	Poles		Options Code Suffix
A = I-Line®	3 Pole Only	For factory-installed terminations, place termination letter in the third block of the circuit breaker catalog number. D₁G₁D₁3,6,4,0,0,1E₁2,0,H₁J₁0,0 Termination No. Options Code	(A, N, and D Terminations Only)
F = Bus Bar	3 Pole Only		H = Plug-In or Drawout
L = Lugs on Both Ends	3 Pole Only		J = No Stationary part
M = Lugs ON End	3 Pole Only		0 = No Switches
P = Lugs OFF End	3 Pole Only		0 = No Shutters
N = Plug-In	3 or 4 Pole		
D = Drawout	3 or 4 Pole		
S = Rear Connection	3 or 4 Pole		

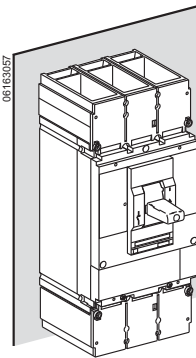
Refer to circuit breaker installation bulletin before installing circuit breaker, accessories, or wiring.

Fixed Mounting

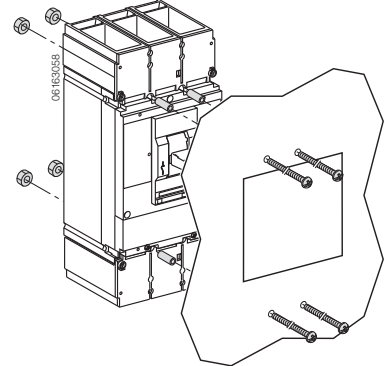
Mounting on Rails



Mounting on Backplate



Flush Mounting



I-Line® Circuit breakers

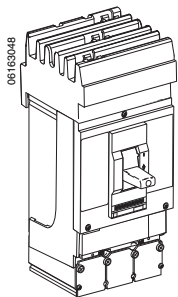
PowerPact D-frame circuit breakers are now available in I-Line construction for easy installation and removal in I-Line panelboards and switchboards.

I-Line circuit breakers use “blow-on” type line side connectors. In case of a short circuit, increased magnetic flux causes the plug-on connectors of the circuit breaker to tighten their grasp on the panelboard or switchboard bus bars. The I-Line connectors and circuit breaker mounting bracket are integral parts of I-Line circuit breakers and cannot be removed or replaced. I-Line circuit breakers come with mechanical load side lugs, or optional terminal nut to connect to bus bars or to compression (crimp) lugs.

Table 26: Phase Options—Example: DGA34150()

Phase Option Number	Phase Connection	Example
Standard	ABC	DGA34150

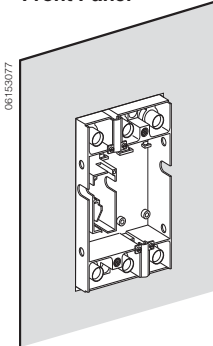
New!



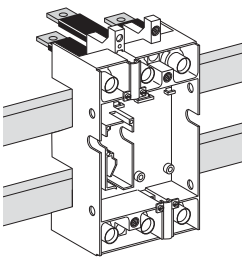
PowerPact® D-Frame Circuit Breakers and Switches

Circuit Breaker Mounting and Connections

Mounting through
Front Panel



Mounting on Rails



Plug-In Mounting

The plug-in configuration makes it possible to:

- Extract and/or rapidly replace the circuit breaker without having to touch connections
- Allows for addition of future circuits at a later date

When the circuit breaker is in the connected position, the primary voltage is fed through the circuit breaker by means of multiple finger disconnects. Control voltage of internal accessories is provided through secondary disconnects.

To create a plug-in configuration on a fixed-mounted circuit breaker requires:

- A set of power and secondary disconnects that are added to the circuit breaker
- A plug-in kit
 - A plug-in base for mounting through a front panel or on rails
 - A safety trip installed on the circuit breaker, which causes automatic tripping if the circuit breaker is ON before engaging it or withdrawing it; the safety trip does not prevent circuit breaker operation, even when the circuit breaker is disconnected
 - Mandatory short terminal shields

The plug-in mounting is Listed under UL file E113555 and Certified under CSA file LR 69561.

Drawout Mounting

The chassis is made up of two side plates installed on the plug-in base and two other plates mounted on the circuit breaker.

The drawout mounting provides all of the functions of the plug-in base, plus:

- Disconnected position—the power circuit is disconnected, the circuit breaker is simply withdrawn and may still be operated (on, off, push-to-trip)
- Circuit breaker may be locked using 1 to 3 padlocks—diameter 0.19 to 0.31 inch (5–8 mm)—to prevent connection
- Auxiliaries can be tested using manual auxiliary connector

Drawout mounting is on a backplate:

- Through a front panel or on rails
- Horizontally or vertically

Accessories for drawout circuit breakers:

- *Auxiliary switches* for installation on the fixed part of the chassis, indicating the “connected” and “disconnected” position
- *Toggle collar* for circuit breakers with toggle through front panel, intended to maintain the degree of protection whatever the position of the circuit breakers (supplied with a toggle extension)
- *Keylock* which, depending on the bolt fitted, can be used to
 - Prevent insertion for connection
 - Lock the circuit breaker in the connected or disconnected position
- *Telescopic shaft* for extended rotary handles
- *Control voltage*, which is provided through automatic secondary disconnect in the connected position only. See Section 7 for more details. Electrical accessories can be tested in the disconnected position with an external wiring harness.

The drawout-mounted chassis is listed under UL file E113555 and certified under CSA file LR69561.

PowerPact® D-Frame Circuit Breakers and Switches Circuit Breaker Mounting and Connections

Plug-In Mounting and Drawout Mounting

Used for connection of bus bars or cables with compression lugs. The rear connections are installed flat. The plug-in base or the chassis is mounted through a front panel.

Accessory circuits exit the circuit breaker via one to three secondary disconnecting blocks (nine wires each). Circuit breaker connection wires for the options installed with trip unit STR53UP exit via the automatic secondary disconnecting blocks. These are made up of:

- A moving part connected to the circuit breaker via a support (one support per circuit breaker)
- A fixed part mounted on the plug-in base, equipped with connectors for wire up to 14 AWG (2.5 mm²)

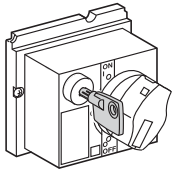
For test purposes, circuit breakers may be equipped with one to three manual auxiliary connectors, which allow the auxiliaries to remain connected when in the “disconnected” position.



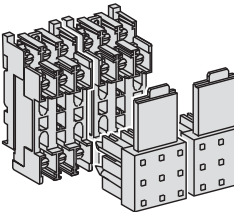
Plug-In Mounting



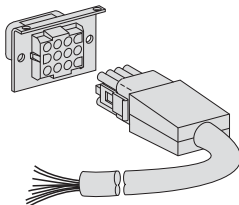
Drawout Mounting



Locking Device



Disconnecting Blocks



Manual Auxiliary Connector

Table 27: Plug-In and Drawout Mountings for D-Frame Circuit Breakers

Description			Factory-Installed Suffix	Field-Installed Kit No.	
			3P and 4P	3P	4P
Plug-In Mounting = Bus Bar Connection + Plug-In Kit					
Kit (Stationary and Moving Part)			N (Termination)	32546	M32547
Consisting Of:	Stationary Part	Plug-In Base	—	32514	M32515
	Moving Part	Moving Part of Chassis	HJ00 (With N termination, to order moving parts only)	—	—
		Short Terminal Covers		32562	32563
		Safety Trip Interlock		32500	32520
		Power Connections		3X 32518	4X 32518
Drawout Mounting = Bus Bar Connection + Drawout Kit					
Kit (Stationary and Moving Part)			D (Termination)	32548	M32549
Consisting Of:	Stationary Part	Plug-In Base	—	32514	M32515
	Moving Parts	Fixed Part of Chassis	—	32532	32532
		Moving Part of Chassis	HJ00 (With D termination, to order moving parts only)	32533	32533
		Short Terminal Covers		32562	32563
		Safety Trip Interlock		32520	32520
Power Connections	3X 32518	4X 32518			
Plug-In and Drawout Accessories					
Secondary Disconnecting Blocks ¹	Fixed Part	9-Wire Connector	—	29273	
	Moving Part	9-Wire Connector	—	32523	
		Support for 3 Moving Connectors	—	32525	
Manual Auxiliary Connector	9-Wire Connector for Disconnected Operation		—	29272	
Shutter	Two Shutters for Plug-In Base		—	32521	
Classic Accessories	Extended Escutcheon for Toggle		—	32534	
	Locking Device (Key Lock is Not Included)		—	29286	
	Two Position Indicating Switches (Connected/Disconnected)		—	29287	

¹ Included when electrical accessories are factory installed.

PowerPact® D-Frame Circuit Breakers and Switches

Circuit Breaker Mounting and Connections

Connection

All D-frame circuit breakers are suitable for reverse feeding.

Front Connection

Cable connectors bolt onto the circuit breaker terminals or the terminals of the plug-in base.

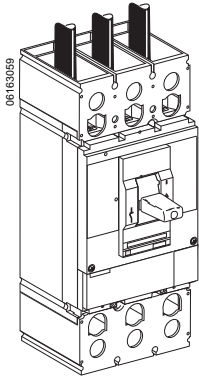

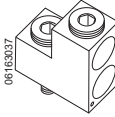
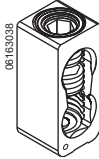
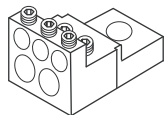


Table 28: D-frame Lug Information

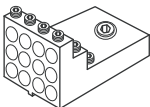
Lug 1	Circuit Breaker	Rating	Conductor			Catalog No.	
			Type	Qty.	Size Stranded Only	3P Kit	4P Kit ²
 Unit Mount (ON and OFF ends) I-Line (OFF end)		≤400 A	Al	1	2 AWG–500 kcmil (35–240 mm ²)	AL400L61K3	AL400L61K4
			Cu	1	2 AWG–600 kcmil (35–300 mm ²)		
			Cu	1	2 AWG–600 kcmil (35–300 mm ²)	CU400L61K3	CU400L61K4
			Al	1	2 AWG–500 kcmil (35–240 mm ²)	32508	—
			Cu	1	2 AWG–600 kcmil (35–300 mm ²)		
 Unit Mount (ON and OFF ends)		600 A	Al	2	2/0 AWG–500 kcmil (70–240 mm ²)	AL600LS52K3	AL600LS52K4
			Cu	2	2/0 AWG–350 kcmil (70–185 mm ²)		
			Cu	2	2/0 AWG–350 kcmil (70–185 mm ²)	CU600LS32K3	CU600LS32K4
			Al	2	2/0 AWG–500 kcmil (70–240 mm ²)	32510	—
			Cu	2	2/0 AWG–350 kcmil (70–185 mm ²)		
 I-Line (OFF end)		600 A	Al	2	3/0 AWG–500 kcmil (95–240 mm ²)	AL600LF52K3	AL600LF52K4
			Cu	2	3/0 AWG–500 kcmil (95–240 mm ²)		
			Cu	2	3/0 AWG–500 kcmil (95–240 mm ²)	CU600LF52K3	CU600LF52K4
Control Tap Takeoff (Kit of 2)						29348	29348
Compression Lug						future	future

¹ For control wire installation, use an 8-32 x 1/4 in. screw (not provided) into tapped control wire hole in lower left hand corner of lug.

² Use 4-pole kit and terminal shield for UL508 applications only (do not use for UL489 applications).



PDC5DG20 (3)



PDC12DG4 (3)

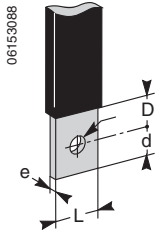
Table 29: Power Distribution Connectors

Description	Circuit Breaker Ampere Rating	(Wires per Terminal) Wire Range Cu or Al	Catalog Number	
			Qty. per Kit	Kit Number
Power Distribution Connector	150–600 A	(3) 14–2 AWG + (2) 14–2/0 AWG (5 total)	3	PDC5DG2 ¹
	150–600 A	(12) 14 AWG	3	PDC12DG4 ¹
Terminal Shield	Use with Power Distribution Connectors		1	36965

¹ Kit includes terminal shield.

Compression (Crimp) lugs - future

PowerPact® D-Frame Circuit Breakers and Switches Circuit Breaker Mounting and Connections



Bus Bar Connection

D-frame circuit breakers are equipped as standard with captive nuts and screws for direct connection to bus bars.

Table 30: Bus Bar Connection

Screw Size	Pole Pitch	L	d	D	e	e
M10	1.8 in. (45 mm)	1.3 in. (32 mm)	0.64 in. (16 mm)	< 0.51 in. (13 mm)	0.11–0.39 in. (3–10 mm)	< 0.4 in. (10 mm)

Table 31: Bus Bar Connections Hardware

Description	Term. No.	Poles	Cat. No.
Set of 3 terminal screws and washers for one side.	F	3	36966
Set of 4 terminal screws and washers for one side.		4 ¹	36967

¹ Use 4-pole terminal shield for UL508 applications only (do not use for UL489 applications).

Rear Connection

For connection of bus bars or cables with compression lugs. Rear connections are easily installed on the circuit breaker terminals. The same connection may be installed flat, edgewise or at a 45° angle. All combinations are possible. The circuit breaker is mounted on a backplate.

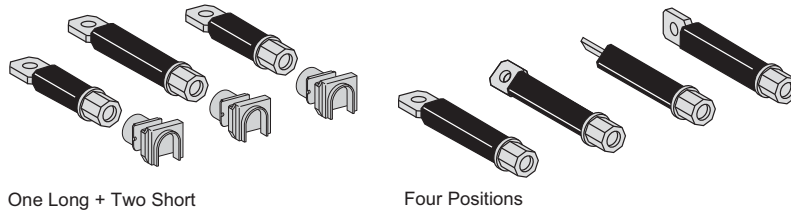
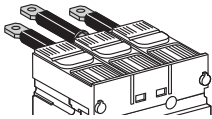


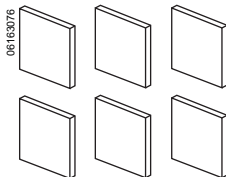
Table 32: Rear Connections (Bus Bar Connection + Rear Connection Kit)

Description	Catalog No.		
	3P	4P	
Consisting of:	Short Rear Connections (Two Sets of Two)	32475	32475
	Long Rear Connections (Two Sets of Two)	32476	32476
	Short Terminal Covers	32562	32563

Interphase Barriers

Table 33: Phase Barriers

Used With	Description	Cat. No.	Qty Per Kit
Phase Barriers		29329	6

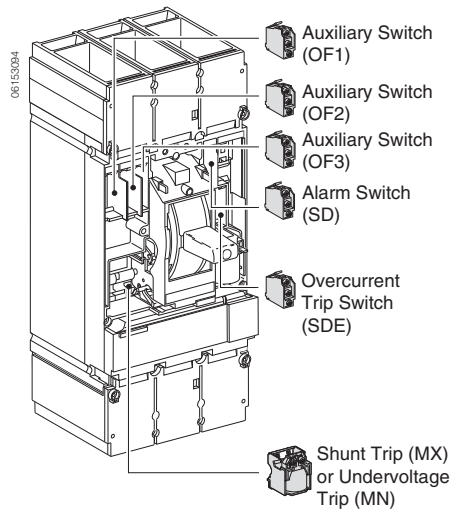


Section 8—Accessories

Electrical Accessories General Information

Location

Internal accessories comply with requirements of Underwriters Laboratories Inc. UL 489 and Canadian Standard Association C22.2 No. 5.1. All internal accessories are Listed for Fixed installation per UL file E103955 and Certified under CSA file LR 69561.



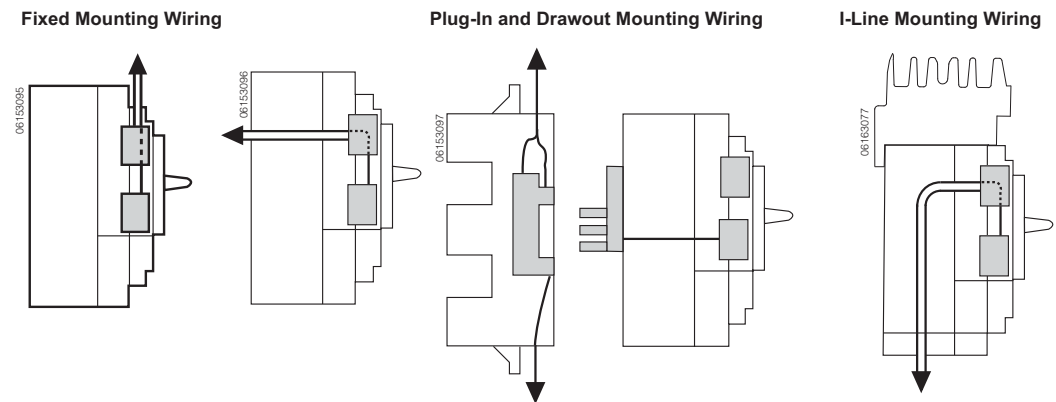
Connections

Each electrical accessory is fitted with numbered terminal blocks for wires with the following maximum size:

- 16 AWG (1.5 mm²) for auxiliary switches, undervoltage and shunt trip or undervoltage trip
- 14 AWG (2.5 mm²) for the motor operator

Auxiliary Wiring

Wiring for auxiliary circuits exit the device through a knock-out in the front cover.



Auxiliary and Alarm Switches

Auxiliary switches provide remote information of the circuit breaker status and can thus be used for indications, electrical locking, relays, etc.



Table 34: Auxiliary and Alarm Switches

Applications	<p>Open/Closed (OF) Auxiliary Switch</p> <ul style="list-style-type: none"> Indicates the position of the circuit breaker contacts <p>Trip Indication (SD) Switch</p> <ul style="list-style-type: none"> Bell alarm indicates that the circuit breaker has tripped due to an overload, short circuit or ground fault, the operation of a shunt trip or undervoltage trip or the “push-to-trip” button Resets when the circuit breaker is reset <p>Overcurrent Trip Switch (SDE)</p> <ul style="list-style-type: none"> Indicates that the circuit breaker has tripped due to an overload, short circuit or ground fault Resets when the circuit breaker is reset <p>The above auxiliary switches are also available in low-level versions (with gold flash plating) capable of switching very low loads (e.g., for controlling PLCs or electronic circuits)</p> <p>Rotary Handle Indicator: CAO (early-break) and CAF (early-make)</p> <ul style="list-style-type: none"> Fitted in the rotary handle module (see page 40)
Installation & Connection	<ul style="list-style-type: none"> The OF, SD and SDE switches snap into cavities behind the front accessory cover of the circuit breaker One model serves for all indication functions depending on where it is fitted in the circuit breaker. The SDE function of a circuit breaker equipped with a thermal-magnetic trip unit requires the SDE actuator.
Standards	<ul style="list-style-type: none"> The internal accessories comply with requirements of Underwriters Laboratories® Inc. (UL®). UL 489 and Canadian Standard Association C22.2 No. 5-02 Standards. All internal accessories are Listed for field installation per UL file E103955 and Certified under CSA file LR 69561. Auxiliary switches comply with UL 489, CSA C22.2 No. 5-02 and IEC 60947-5 Standards. “Low-level” switches are not UL Recognized.

Table 35: Electrical Characteristics

Characteristic	Voltage	Standard	Low-Level	
Supplied as Standard (Form C)		4	4	
Maximum Number of Contacts		4	4	
Breaking Capacity at a Power Factor (p.f.) of 0.3	Standard (100 mA/24 V minimum load)			
	Vac	240/380 Vac	6 A	5 A
		480 Vac	6 A	5 A
		600/690 Vac	6 A	—
	Vdc	24/48 Vdc	2.5 A	2.5 A
		240 Vdc	0.5 A	0.8 A
		380 Vdc	0.3 A	0.3 A
	Low-level (1 mA/4 V minimum load with a maximum current and voltage of 100 mA 10 V.			
	NOTE: If the maximum voltage and current is exceeded, the low-level function of the switch will be lost but the switch will continue to function as a standard switch with the following specifications.			
	Vac	24/48 Vac	5 A	—
		240 Vac	5 A	—
		380 Vac	5 A	—
	Vdc	24/48 Vdc	5/2.5 A	—
125 Vdc		0.5 A	—	
250 Vdc		0.3 A	—	

Table 36: Auxiliary Switch Catalog Numbers

Contacts	Factory-Installed Suffix	Field-Installable Kit No.
1A/1B Standard	AA	S29450
2A/2B Standard	AB	(2) S29450
1A/1B Low-Level (Gold)	AE	S29482
2A/2B Low-Level (Gold)	AF	(2) S29482

PowerPact® D-Frame Circuit Breakers and Switches Accessories

Table 37: Alarm/Overcurrent Trip Switch Catalog Numbers

Switch	Factory-Installed Suffix	Field-Installable Kit No.
Alarm Switch (SD)	BC	S29450
Alarm Switch (SD) Low-Level	BH	S29452
SDE Standard	BD	S29450 + S29451
SDE Low-Level	BJ	S29452 + S29451
SD and SDE Standard	BE	S29450 (2) + S29451
SD and SDE Low-level	BK	S29452 (2) + S29451

Shunt Trip (MX) and Undervoltage Trip (MN) Switches

A voltage release can be used to trip the circuit breaker via a control signal.



Table 38: Shunt Trip and Undervoltage Trip Switches

Applications	Shunt Trip (MX)
	<ul style="list-style-type: none"> Trips the circuit breaker when the control voltage rises above 70% of its rated voltage Impulse type ≥ 20 ms or maintained control signals AC shunt trips are suitable for ground-fault protection when combined with a Class I ground-fault sensing element
Installation and Connection	Undervoltage Trip (MN)
	<ul style="list-style-type: none"> Trips the circuit breaker when the control voltage drops below a tripping threshold Drops out between 35% and 70% of the rated voltage Circuit breaker closing is possible only if the voltage exceeds 85% of the rated voltage Permanent type If an undervoltage condition exists, operation of the closing mechanism of the circuit breaker will not permit the main contacts to touch, even momentarily. This is commonly called "Kiss Free"
Operation	<ul style="list-style-type: none"> Accessories are common to D-frame circuit breakers and snap into cavities under the front accessory cover of the circuit breaker Each terminal may be connected by one 18–14 AWG (1.0–2.5 mm²) stranded copper wire The circuit breaker must be reset locally after being tripped by shunt trip or undervoltage trip (MN or MX) MN or MX tripping has priority over manual (or motor operator) closing; in the presence of a standing trip order such an action does not result in any closing, even temporarily, of the main contacts Endurance: 50% of the rated mechanical endurance of the circuit breaker

Table 39: Electrical Characteristics

	AC	DC
Rated Voltage (V)	24, 48, 110–130, 208–277, 380–480, 525, 600	12, 24, 30, 48, 60, 125, 250
Consumption	Pickup (MX)	< 10 VA
	Seal-in (MN)	< 5 VA
Clearing Time (ms)	< 50	< 50

Table 40: Shunt Trip and Undervoltage Trip Suffix Codes and Kit Numbers

Voltage	Shunt Trip (MX)		Undervoltage Release UVR (MN)	
	Factory-Installed Suffix	Field-Installable Kit No.	Factory-Installed Suffix	Field-Installable Kit No.
24 Vac	SK	S29384	UK	S29404
48 Vac	SL	S29385	UL	S29405
120 Vac	SA	S29386	UA	S29406
208-277 Vac	SD	S29387	UD	S29407
380-480 Vac	SH	S29388	UH	S29408
525-600 Vac	SJ	S29389	UJ	S29409
12 Vdc	SN	S29382	UN	S29402
24 Vdc	SO	S29390	UO	S29410
30 Vdc	SU	S29391	UU	S29411
48 Vdc	SP	S29392	UP	S29412
60 Vdc	SV	S29383	UV	S29403
125 Vdc	SR	S29393	UR	S29413
250 Vdc	SS	S29394	US	S29414

Motor Operator

The motor operator remotely operates the circuit breaker featuring easy and sure operation:

- All circuit breaker indications and information remain visible and accessible, including trip unit settings and circuit breaker connection
- Suitability for isolation is maintained and padlocking remains possible
- Double insulation front face
- All terminations except I-Line®

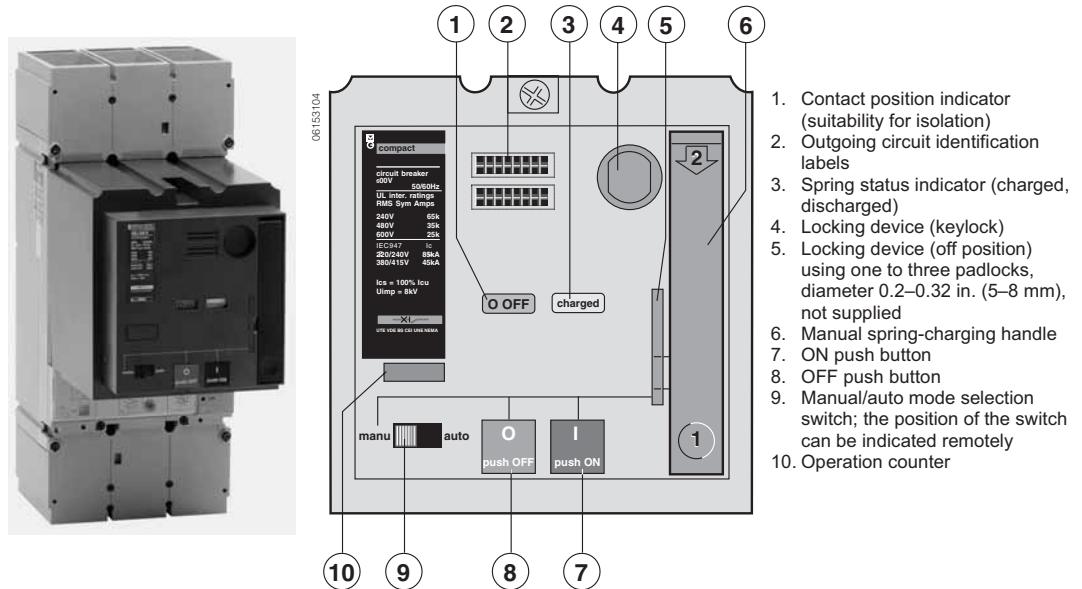
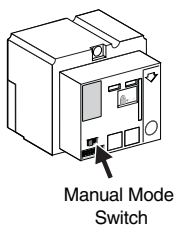


Table 41: Motor Operator

Applications	<ul style="list-style-type: none"> • Local motor-driven operation, centralized operation, automatic distribution control • Normal/standby source changeover or switching to a replacement source to optimize energy costs • Load shedding and reconnection to optimize energy costs • Synchro-coupling—less than five cycle closing time
Installation and Connection	<ul style="list-style-type: none"> • All installation (fixed, plug-in/drawout mounting) and connection capabilities are maintained except I-Line • Connections of the motor operator module are to a built-in terminal block behind its front cover • Stranded copper wire 14 AWG (2.5 mm²)
Automatic Operation	<p>The motor operator is connected in series with the overcurrent (SDE) trip switch. See wiring diagrams on page 47.</p> <ul style="list-style-type: none"> • ON and OFF by two impulse type or continuous control signals • Depending on the wiring, resetting can be done locally, remotely or automatically • Mandatory manual reset following tripping due to an electrical fault (with SDE)
Manual Operation	<ul style="list-style-type: none"> • Transfer to manual mode with possibility of remote mode indication • ON and OFF by two push buttons • Recharging of stored-energy system by pumping the lever nine times • Padlocking in off position



Manual Mode Switch

Table 42: Motor Operator Characteristics

Response Time (ms)	Opening	< 500	
	Closing	< 80	
Maximum Cycles Per Minute		4	
Consumption	AC (VA)	Opening/Closing	500
	DC (W)	Opening/Closing	500
Minimum Operating Order (ms)		700	
Operating Voltage		85–110% rated	

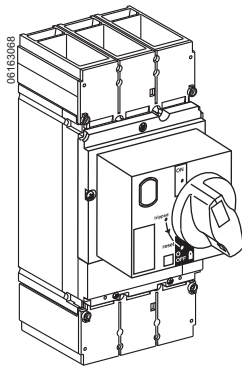
PowerPact® D-Frame Circuit Breakers and Switches Accessories

Table 43: Motor Operator and Accessory Suffix Codes and Catalog Numbers

Device	Control Voltage	Factory-Installed Suffix	Field-Installable Kit No.	
			400 A	600 A
Motor Operator	48/60 Vac	ML	32639	32839
	110/130 Vac	MA	32640	32840
	20/277 Vac	MD	32641	32841
	380/415 Vac	MF	32642	32842
	440/480 Vac	MH	32647	32847
	24/30 Vdc	MO	32643	32843
	48/60 Vdc	MP	32644	32844
	110/130 Vdc	MR	32645	32845
	250 Vdc	MS	32646	32846
Mounting Hardware	—	—	32649	32649
Ronis Lock	—	—	41940	41940
Profalux Lock	—	—	42888	42888
Operations Counter	—	—	32648	32648

Rotary Operating Handles

Directly Mounted Rotary Operating Handles



Directly Mounted Rotary Operating Handle

Installation	The directly mounted rotary operating handle replaces the circuit breaker front accessory cover (secured by screws).	
Operation	<ul style="list-style-type: none"> The direct rotary handle maintains: <ul style="list-style-type: none"> Suitability for isolation Indication of three positions: I (ON), Tripped and O (OFF) Access to the "push-to-trip" button Visibility of, and access to, trip unit settings The circuit breaker may be locked in the OFF position by using one to three padlocks (not supplied), padlock shackle diameter 0.19–0.31 in. (5–8 mm) 	
Models	<ul style="list-style-type: none"> Standard with black handle VDE type with red handle and yellow bezel for machine tool control 	
Variations	<p>Accessories transform the standard direct rotary handle for the following situations:</p> <ul style="list-style-type: none"> Motor control centers (MCCs): <ul style="list-style-type: none"> Opening of door prevented when circuit breaker is on Closing of circuit breaker inhibited when door is open Machine tool control; complies with CNOMO E03.81.501N; degree of protection IP54 Early make or early break contacts may be installed into direct mount rotary handle 	
Standards	The directly-mounted rotary operating handle is UL Listed under file E103955 and CSA Certified under file LR 69561	

Table 44: Directly-Mounted Rotary Operated Handles

Device	Factory-Installed Suffix	Field-Installable Kit Number
Direct Mounted	Standard Handle Black	RD12 32597
	Red handle on yellow bezel	RD22 32599
	MCC Conversion Accessory	— 32606

PowerPact® D-Frame Circuit Breakers and Switches Accessories

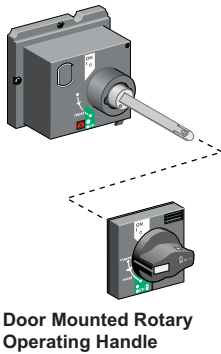


Table 45: IEC Door-Mounted Rotary Operating Handle

Installation	<p>The extended rotary operating handle is made up of:</p> <ul style="list-style-type: none"> • A unit that replaces the front accessory cover of the circuit breaker (secured by screws) • An assembly (handle and front plate) on the door that is always secured in the same position, whether the circuit breaker is installed vertically or horizontally • An adjustable extension shaft • The handle mechanism can be used in NEMA 3R and 12 enclosure applications
Operation	<p>The door mounted operating handle makes it possible to operate circuit breakers installed in enclosure from the front. The door mounted operating handle maintains:</p> <ul style="list-style-type: none"> • Suitability for isolation • Indication of the three positions I/ON, Tripped, O/OFF • Visibility of and access to trip unit settings when the door is open • Degree of protection: IP40 as per IEC 529 <p>Defeatable interlock prevents opening of door when circuit breaker is on</p> <p>The circuit breaker may be locked in the O/OFF position by using one to three padlocks, padlock shackle diameter 0.19–0.31 in. (5–8 mm); padlocks are not supplied; locking prevents opening of the switchboard door</p>
Shaft Length	<p>The shaft length is the distance between the back of the circuit breaker and the door:</p> <ul style="list-style-type: none"> • Minimum shaft length is 7.4 (185 mm) • Maximum shaft length is 24 in. (600 mm) • Extended shaft length must be adjusted
Models	<ul style="list-style-type: none"> • Standard with black handle • VDE type with red handle and yellow bezel for machine tool control
Variations	<p>For withdrawable configurations, the extended rotary handle is also available with a telescopic shaft containing two stable positions.</p>
Standards	<p>The extended rotary operating handle is UL Listed under file E103955 and CSA Certified under file LR 69561</p>

Table 46: Extended Door-Mounted Rotary Operating Handles

Device	Description	Factory-Installed Suffix	Field-Installable Kit Number
Door Mounted Handle	Standard black handle	RE12	32598
	Red handle on yellow bezel	RE22	32600
Rotary Handle Replacement Kit		—	S33875
Telescoping		RT12	32603
Accessories	Key lock adapter	—	32604
	Key locks	Ronis 1351.500	41940
		Profalux KS5 B24 D4Z	42888
	Indication Auxiliary Switch	One early-break switch	32605
Two early-make switches		RE13	29346

NEMA Door Mounted Rotary Operating Handles (Not Shown)

Table 47: NEMA Door-Mounted Rotary Operating Handles

Installation	<p>The extended rotary operating handle is made up of:</p> <ul style="list-style-type: none"> • A mounting plate that provides a rotary actuator for a standard toggle circuit breaker • Handle assemblies available for NEMA 3, 3R, 4, and 4X • Available in standard or short (3 in.) handle assemblies
Operation	<p>The door mounted operating handle makes it possible to operate circuit breakers installed in enclosure from the front.</p> <p>Provides ON and OFF indication</p> <p>The circuit breaker may be locked in the off position</p>
Mounting Depth	<p>The mounting depth is the distance between the back of the circuit breaker and the door:</p> <ul style="list-style-type: none"> • Minimum mounting depth is 5.5 in. (138 mm) • Maximum mounting depth is 10.75 in. (273 mm) with standard shaft • Maximum mounting depth is 21.3 in. (543 mm) with long shaft

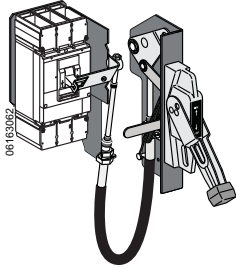
PowerPact® D-Frame Circuit Breakers and Switches Accessories

Table 48: NEMA Door-Mounted Rotary Operated Handles

Handle Type	Poles	Operating Mechanism Included in Kit	Mounting Depth Min–Max	Kit Number
Painted 6 in.	3	9421LS8 and 9421LC46	7-1/4 to 12-1/16 in. (184 to 306 mm)	9421LD1
		9421LS13 and 9421LH46	7-1/4 to 22-5/8 in. (184 to 575 mm)	9421LD4

Class 9422 Cable Operating Handle

Flange-mounted Handle Cable Operating Mechanism



Applications	<ul style="list-style-type: none"> The cable operator maintains: <ul style="list-style-type: none"> Suitability for isolation Indication of three positions: I/ON, Tripped, O/OFF Access to push-to-test The circuit breaker may be locked in the O/OFF position by one to three padlocks Door can be locked closed due to interlocking features of the handle operator
Installation	<ul style="list-style-type: none"> Handle is mounted on flange of enclosure using specified mounting dimensions while circuit breaker and operating mechanism are mounted to inside of enclosure using two screws Cable lengths available in 3-, 5- or 10-foot lengths to accommodate a variety of mounting locations. Handles are available in painted NEMA 1, 3, 3R, 4 (sheet steel) and 12 ratings or chrome (NEMA 4, 4x)

Table 49: Cable Operating Mechanism and A1 Handles

Description	Kit Number	
Cable Length (in./mm)	36/914	9422CSJ30
	60/1524	9422CSJ50
	120/3048	9422CSJ10
A1 painted flange handle	9422A1	
Operating Mechanism Only	9422RSI	

Class 9422 Flange-Mounted Variable-Depth Operating Mechanism

Designed for installation in custom-built control enclosures where main or branch circuit protective devices are required. All circuit breaker operating mechanisms are suitable for either right- or left-hand flange mounting, convertible in the field.

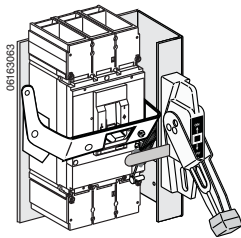


Table 50: Cable Operating Mechanism and A1 Handles

Description	Depth	Kit Number
Variable Depth Mechanism	9.00–17.75 in. (229–451 mm)	9422RSI

Handle Extension

Designed to extend the circuit breaker handle for easier manual circuit breaker operation.

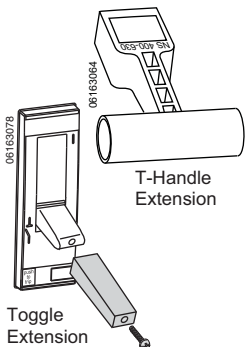
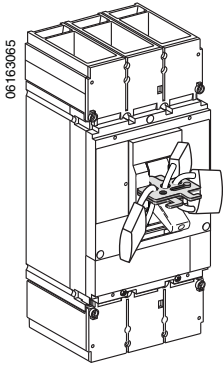


Table 51: Handle Extensions

Description	Kit Number
T-Handle Extension (Temporary)	32595
Toggle Extension (Fixed)	32553

Locking Systems

Padlocking systems can receive up to three padlocks with diameters ranging from 0.19–0.31 inch (5–8 mm); padlocks not supplied.



Removable Attachment*

Table 52: Device Locking Options

Control Device	Function	Type	Accessories Required	Kit Number
Toggle	Lock in OFF Position	Padlock	Removable Device	S29370
	Lock in ON or OFF Position	Padlock	Stationary Device ¹	S32631
	Lock in OFF Position	Padlock	Stationary Device	NJPAF
Direct Rotary Handle	Lock in OFF Position	Padlock	None	—
Extended Rotary Operating Handle	Lock in OFF Position, Door Opening Prevented	Padlock	None	—
Motor Operator	Lock in OFF Position, Motor	Padlock	None	—

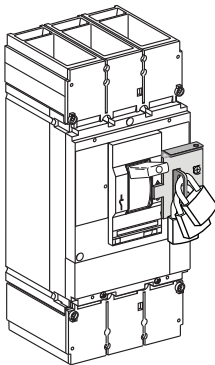
¹ Not available for 2-pole HD and HG devices

Interlocking Accessories

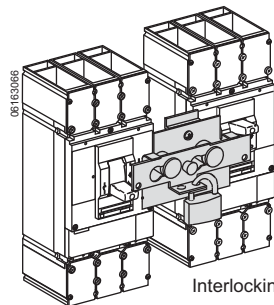
Interlocking prevents simultaneous closing of two circuit breakers.

Table 53: Interlocking Accessories

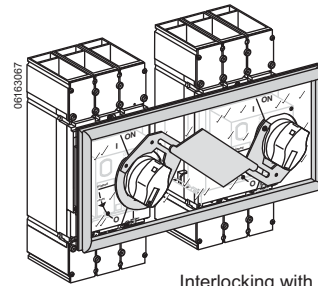
Accessory	Means	Kit Number
Toggle	Sliding Bar Interlocking Mechanical Device	32614
Rotary Handle (Directly or Door Mounted)	Mechanical Interlocking with 2 Keylocks and 1 Key	32621



Fixed Padlock Attachment



Interlocking with Toggle Control



Interlocking with Rotary Handles

Interlocking Circuit Breakers with Padlocks

Available for three-pole or four-pole circuit breakers.

Padlocking systems can receive one or two padlocks, shank diameter of 0.19–0.31 in. (5–8 mm). Both interlocked circuit breakers should be fixed version or plug-in version.

Two sliding interlocking bars can be used to interlock three circuit breakers installed side-by-side, in which case one circuit breaker is in the on position and the two others are in the off position.

Device	Description	Catalog No.
Handle Padlocking	Removable (Lock OFF Only)	S29370
	Fixed (Lock OFF or ON)	S32631
	Fixed (Lock OFF Only)	NJPAF
Interlocking (Not UL Listed)	Mechanical for circuit breakers with rotary handles	32621
	Mechanical for circuit breakers with toggle handles	32614

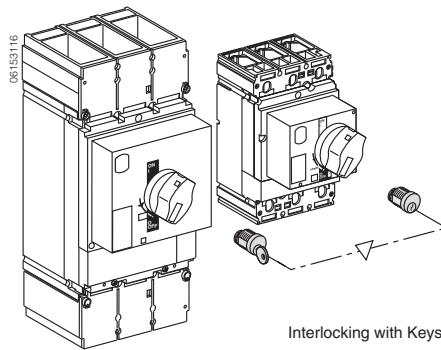
PowerPact® D-Frame Circuit Breakers and Switches Accessories

Interlocking with Keys

For circuit breakers equipped with rotary handles or a motor operator. Interlocking with keys may be easily implemented by equipping each of the circuit breakers, either fixed or drawout mounted, with a directly mounted rotary operating handle and a standard keylock, with only one key for the two keylocks. This solution enables interlocking between two circuit breakers that are geographically distant or that have significantly different characteristics.

Use:

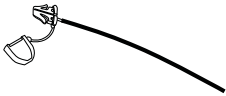
- A keylock adapter (one required for each circuit breaker)
- Two identical keylocks with a single key



Key Lock Adapter ¹	32604
Ronis® 1351.500	41940
Key Locks	
Profalux® KS5 B24 D4Z 2 lock	42878
Profalux® KS5 B24 D4Z 1 lock	42888

¹ The key lock adapter is required for either Ronis or Profalux key lock installation.

Sealing Accessory



Sealing accessory kit includes the elements required to fit seals to prevent:

- Front accessory cover removal
- Rotary handle removal
- Opening of the motor operator
- Access to accessories
- Access to trip unit settings
- Access to ground-fault protection settings
- Trip unit removal
- Terminal cover removal
- Access to power connections

Order kit number **MICROTUSEAL** .

Front-Panel Escutcheons

For Fixed or Plug-In Mounting

Door escutcheon provides better appearances of the door contact:

- Front-panel escutcheons for toggle handles secures to the panel from the front
- Front-panel escutcheons for motor-operated or rotary-operating handle secures to the panel by four screws from the front

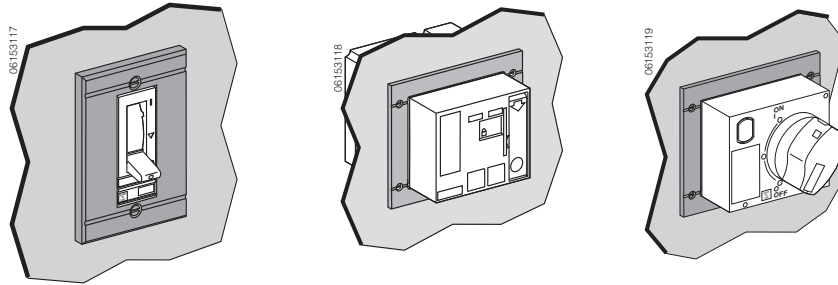
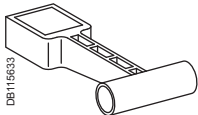


Table 54: Front-Panel Escutcheons

Description	Kit Number
Front Panel Escutcheon for Toggle Circuit Breakers	32556
Front Panel Escutcheon for Rotary Handle, Motor Operator or Extended Escutcheon	32558

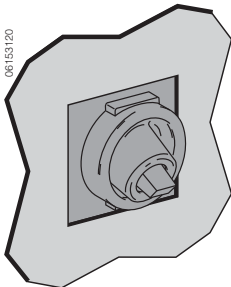
Handle Extensions

Table 55: Cable Operating Mechanism and A1 Handles



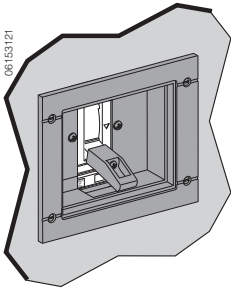
Description		Kit Number
T-Handle Extension		32595
Toggle Extension	1 per kit	32553

Toggle Boot



- Protection up to NEMA 3R
- Fits on front of circuit breaker
- Catalog number **32560**

PowerPact® D-Frame Circuit Breakers and Switches Accessories



Toggle Collars (For Drawout Mounting)

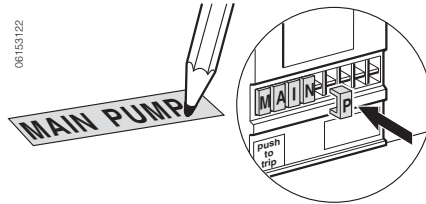
Toggle collars make it possible to maintain degrees of protection regardless of the circuit breaker position (connected, disconnected):

- Front panel escutcheons are required (identical to those for rotary handle and ammeter module)
- Toggle collars are secured by two screws on the circuit breaker
- Front panel escutcheons are secured on the switchboard
- Toggle extension is supplied with the toggle collar
- Catalog number 32534

Front panel escutcheons for motor operator, rotary operating handles are the same as for the fixed-mounted circuit breaker with the same equipment.

Outgoing Circuit Identification

Circuit breakers come with labels designed for handwritten indications.

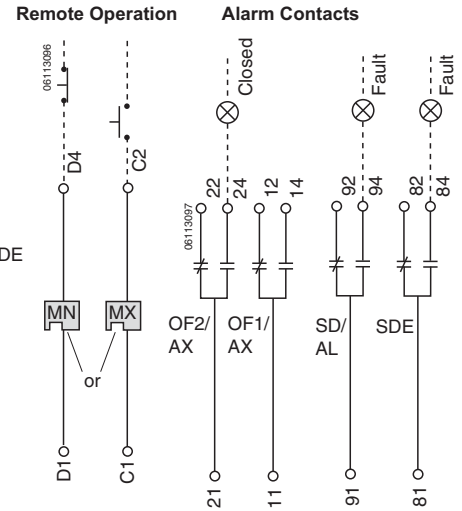
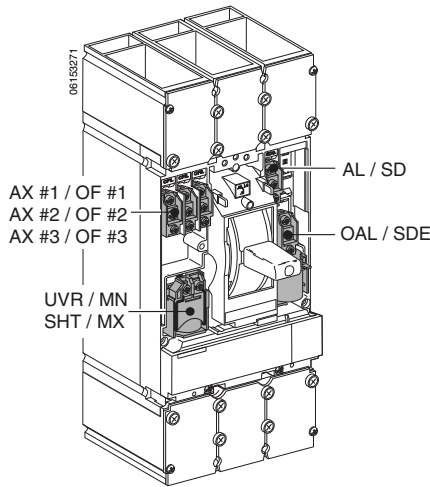


It is also possible to use preprinted, sixteen character Telemecanique® labels, order kit number AB1 .

Section 9—Wiring Diagrams

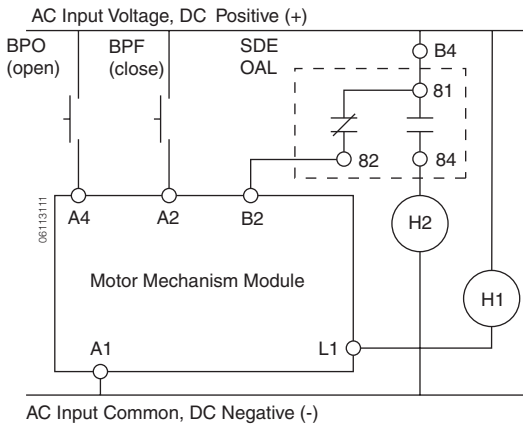
Circuit Breaker Wiring Diagrams

Auxiliary Devices		
AX / OF	Auxiliary Contact	18–14 AWG (1–2 mm ²)
AL / SD	Alarm Switch	
UVR / MN	Undervoltage Trip	
SHT / MX	Shunt Trip	
OAL / SDE	Overcurrent Trip Switch	



Standard Motor Operator Wiring (Factory Wiring Configuration)

A circuit breaker may be configured for remote operations. Remotely operated circuit breakers are factory wired for the power supply to the motor being switched by the overcurrent trip switch. This prevents the circuit breaker from being remotely reset after an overload fault as a precaution against closing on a fault.

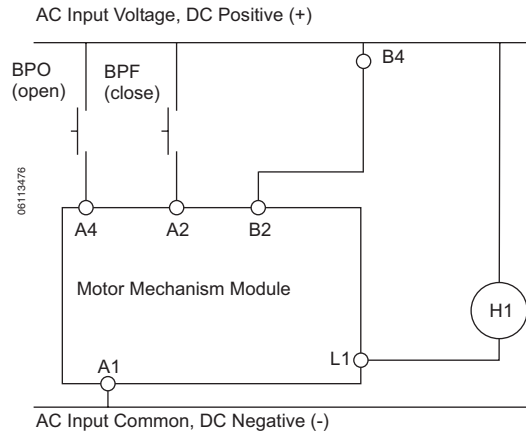


Terminal	Description
A4	Electrical opening (positive DC)
A2	Electrical closing (positive DC)
B4	Power supply connection (positive DC)
A1	Power supply connection (negative DC)
L1	Automatic position indicator
84	Overcurrent trip indicator
H1	Lamp signal indicating MCH in automatic position
H2	Lamp signal indicating overcurrent trip condition

PowerPact® D-Frame Circuit Breakers and Switches Wiring Diagrams

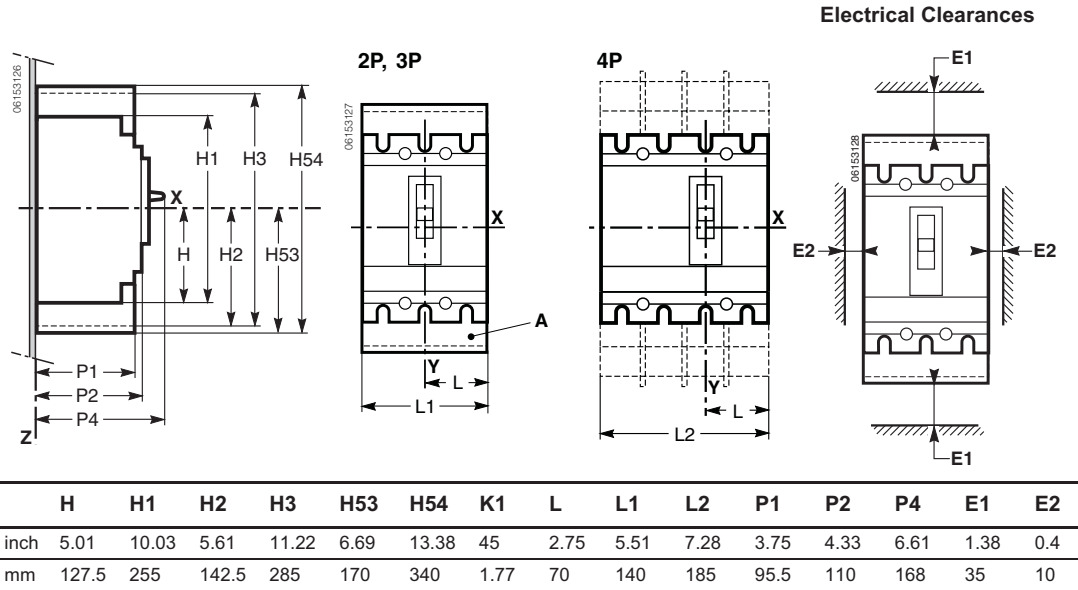
Remote Reset Wiring Without Overcurrent Trip Switch Protection

To configure circuit breaker for remote operation without overcurrent switch protection, follow the wiring diagram below.

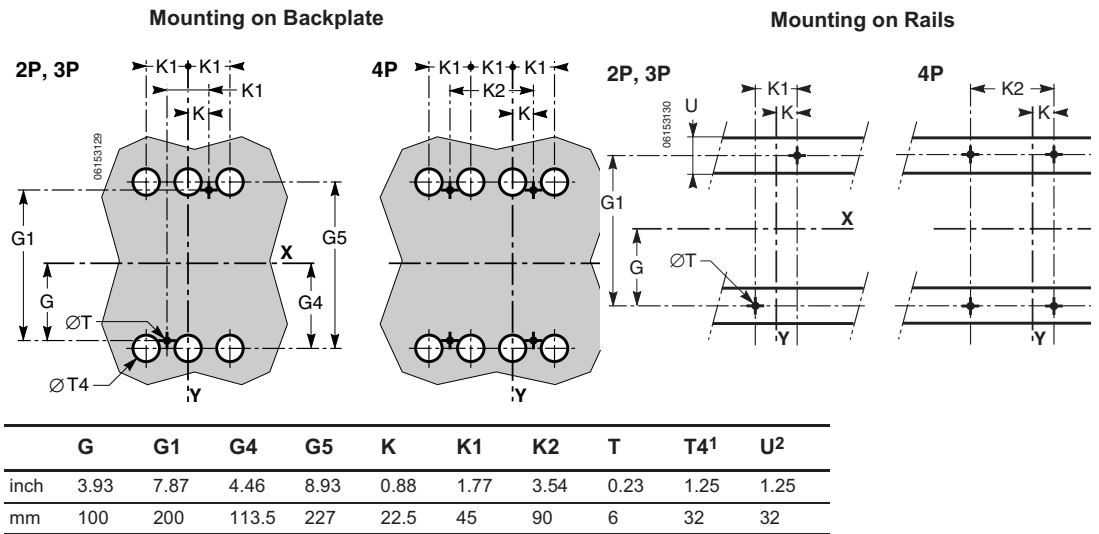


Section 10—Dimensions

Fixed Mounted Circuit Breakers



Mounting

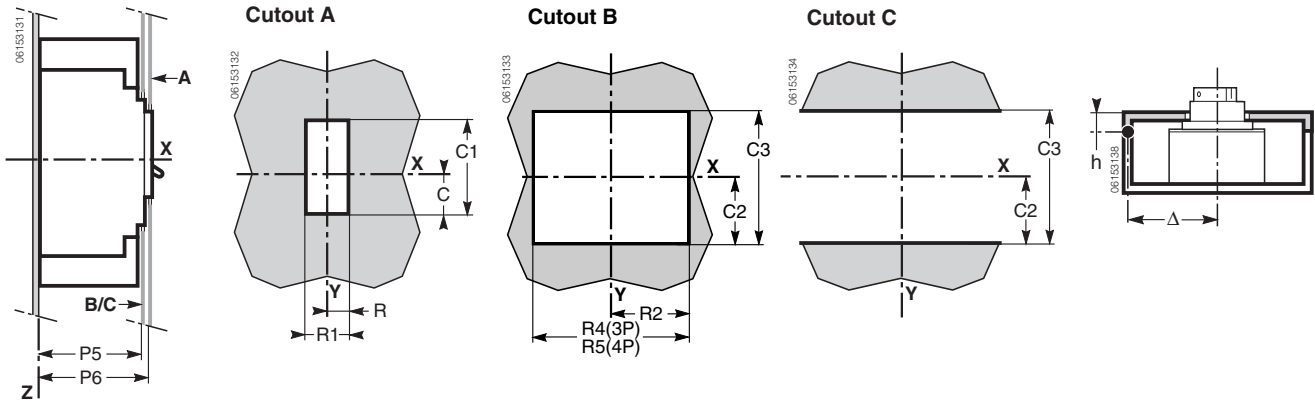


¹ For rear connected circuit breakers only.

² U is ≤ 78 in. (20 mm) on C-frame circuit breakers with secondary disconnecting blocks.

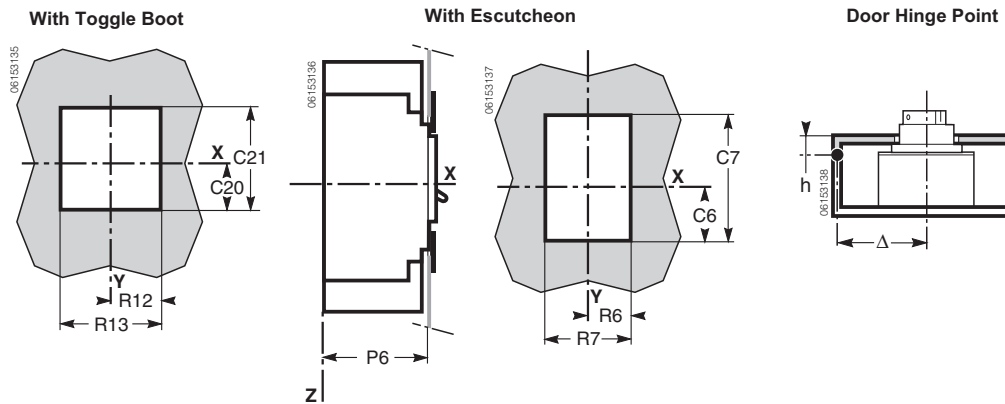
PowerPact® D-Frame Circuit Breakers and Switches Dimensions

Front Panel Cutouts for Fixed or Plug-In Circuit Breakers



	C	C1	C2	C3	P5	P6	R	R1	R2	R4	R5	Δ
inch	1.63	4.56	3.64	7.24	4.21	4.40	1.24	2.48	2.81	5.62	7.40	3.93 + (5 x h)
mm	41.5	116	92.5	184	107	112	31.5	63	71.5	143	188	100 + (5 x h)

Front Panel Cutouts for Toggle Boot and Escutcheon

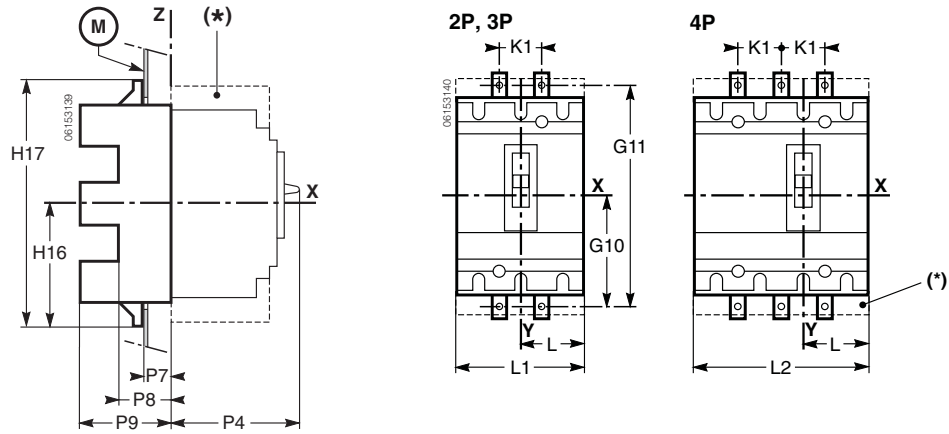


	C6	C7	C20	C21	P6	R6	R7	R12	R13	Δ
inch	2.08	5.74	1.83	1.83	4.40	1.83	3.66	2.48	4.96	3.93 + (5 x h)
mm	53	146	46.5	46.5	12	46.5	93	63	126	100 + (5 x h)

PowerPact® D-Frame Circuit Breakers and Switches Dimensions

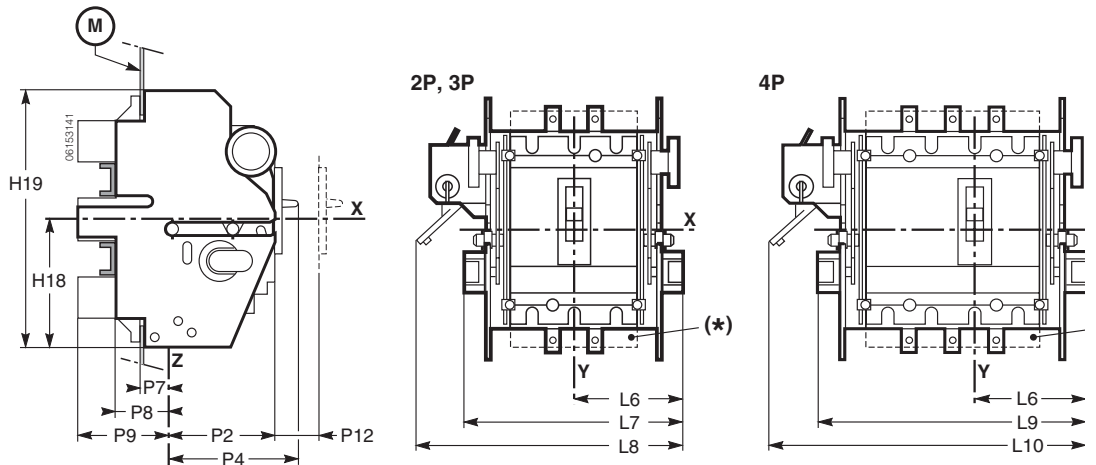
Plug-In and Drawout Mounting

Plug-In (On Base)



	G10	G11	H16	H17	K1	L	L1	L2	P4	P7	P8	P9
inch	5.90	11.8	6.20	12.40	1.77	2.75	5.51	7.28	6.61	1.06	1.77	3.93
mm	150	300	157.5	315	45	70	140	185	168	27	45	100

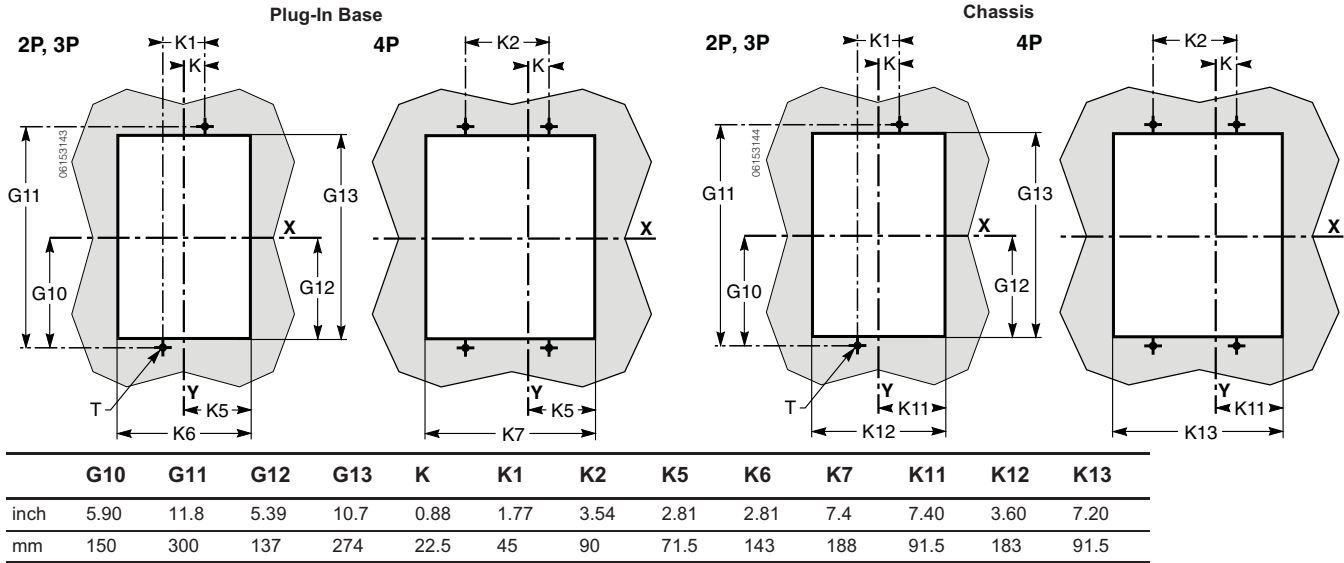
Drawout (On Chassis)



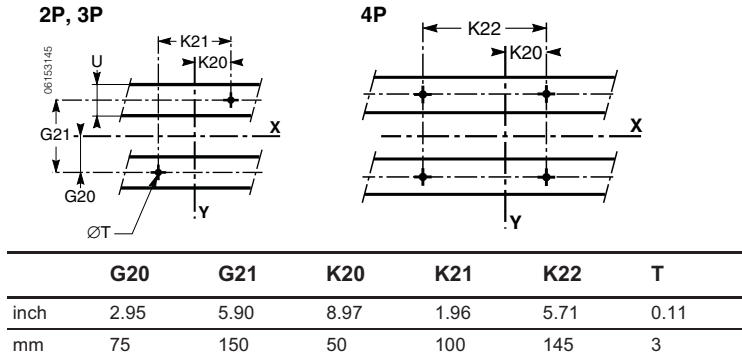
	H18	H19	L6	L7	L8	L10	P2	P4	P7	P8	P9	P12
inch	5.51	11.02	4.33	8.66	98.46	11.61	4.33	6.61	1.06	1.77	3.93	1.25
mm	140	280	110	220	250	295	110	1.68	27	45	100	32

PowerPact® D-Frame Circuit Breakers and Switches Dimensions

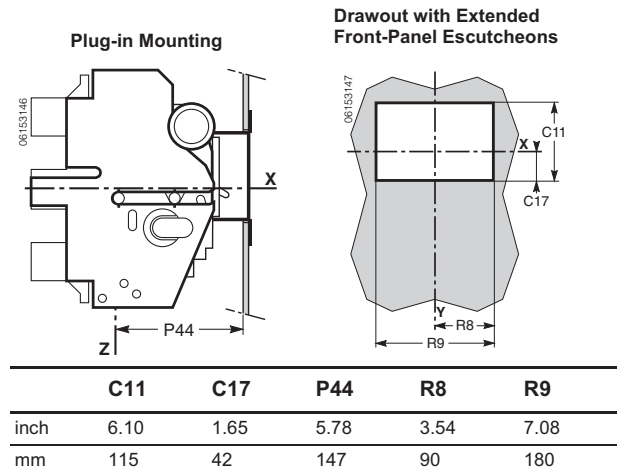
Mounting Through a Backplate



Mounting on Rails (Plug-In Base or Chassis)

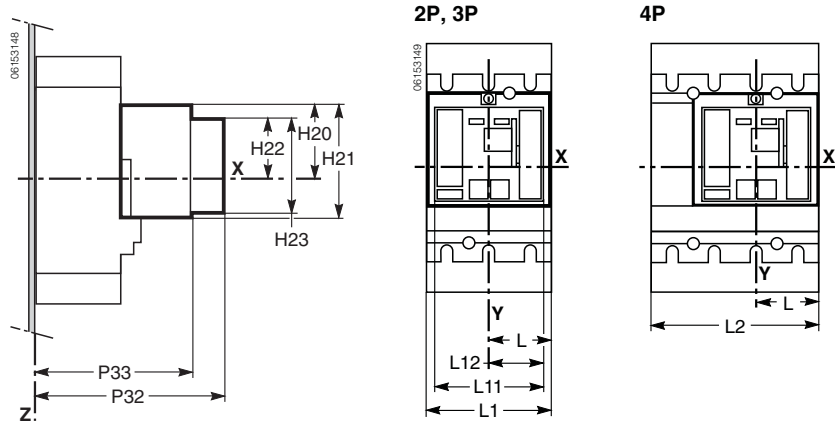


Front-Panel Cutouts



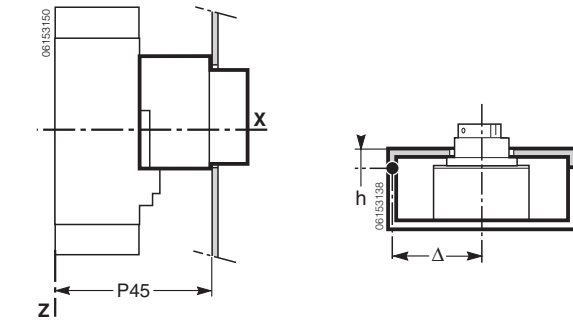
PowerPact® D-Frame Circuit Breakers and Switches Dimensions

Motor Operators



	H20	H21	H22	H23	L	L1	L2	L11	L12	P32	P33
inch	3.93	5.98	3.26	4.84	2.75	5.51	7.28	4.84	2.42	9.84	8.46
mm	100	152	83	123	70	140	185	123	61.5	250	215

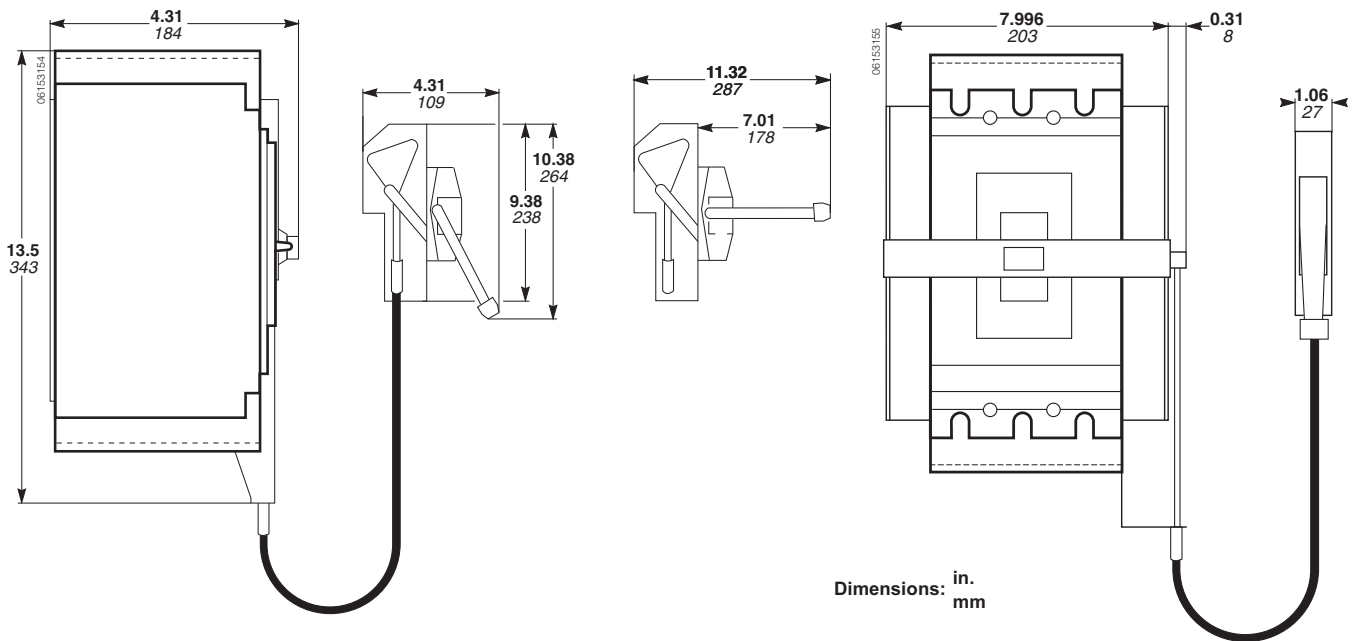
Front-Panel Cutouts



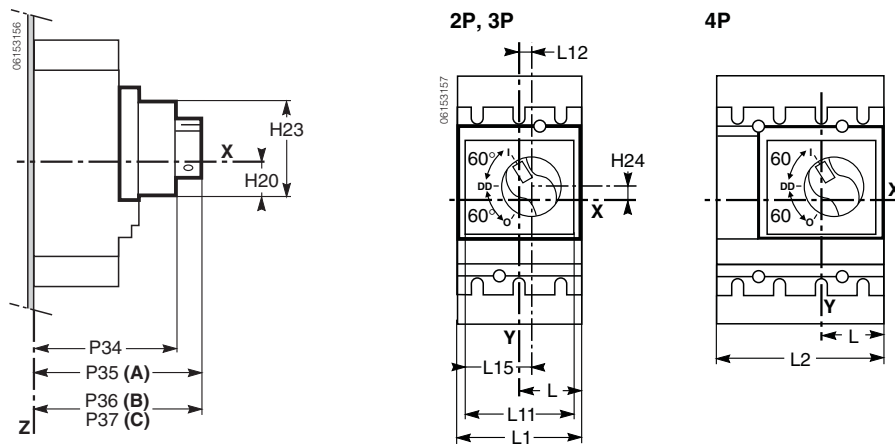
	C22	C23	P45	R14	R15	Δ
inch	1.63	4.96	8.54	2.53	5.08	3.93 + (5 x h)
mm	41.5	126	217	64.5	129	100 + (5 x h)

PowerPact® D-Frame Circuit Breakers and Switches Dimensions

Cable-Operating Handles



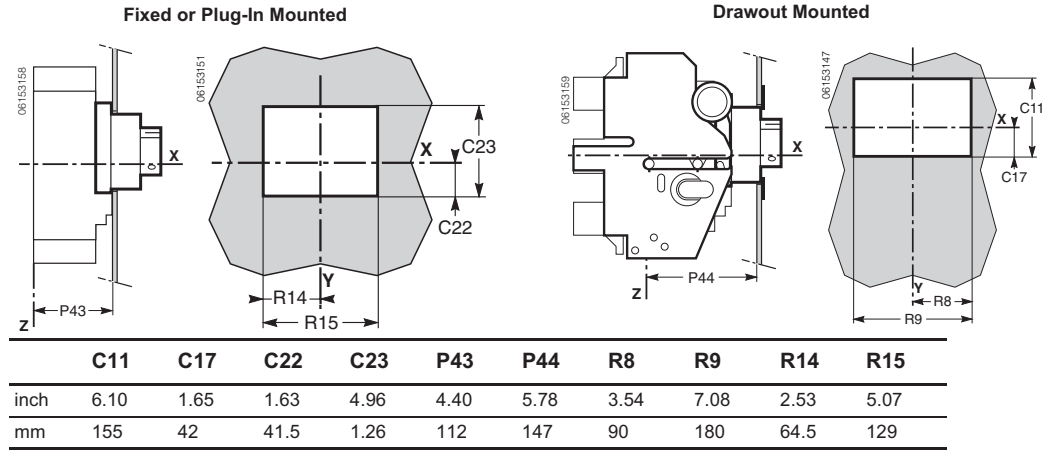
Rotary-Operating Handles



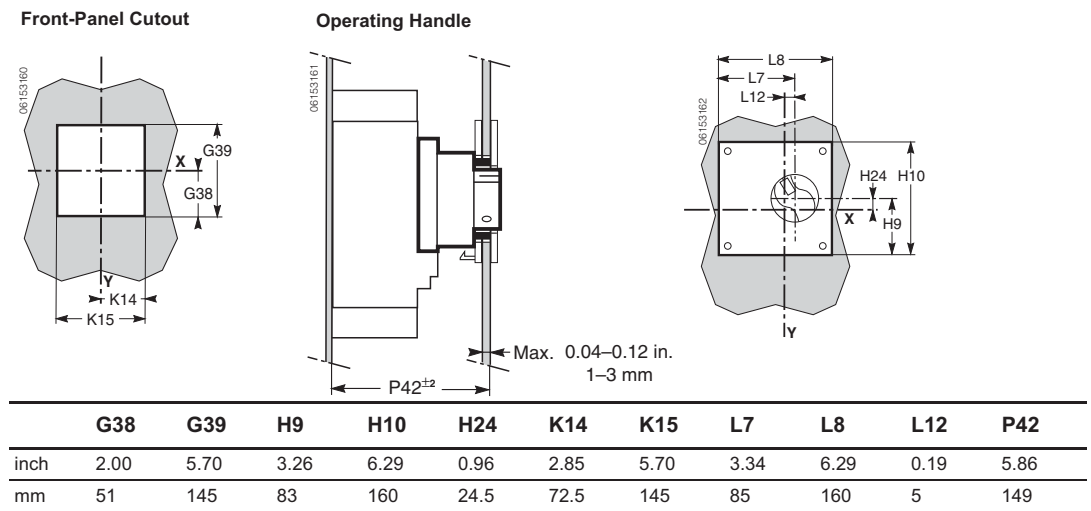
	H20	H23	H24	L	L1	L2	L11	L12	L15	P34	P35	P36	P37
inch	1.47	4.84	0.96	2.75	5.51	7.28	4.84	0.19	2.61	5.70	7.80	7.08	7.40
mm	40	123	24.5	70	140	185	123	5	66.5	145	180	180	188

PowerPact® D-Frame Circuit Breakers and Switches Dimensions

Front-Panel Cutouts



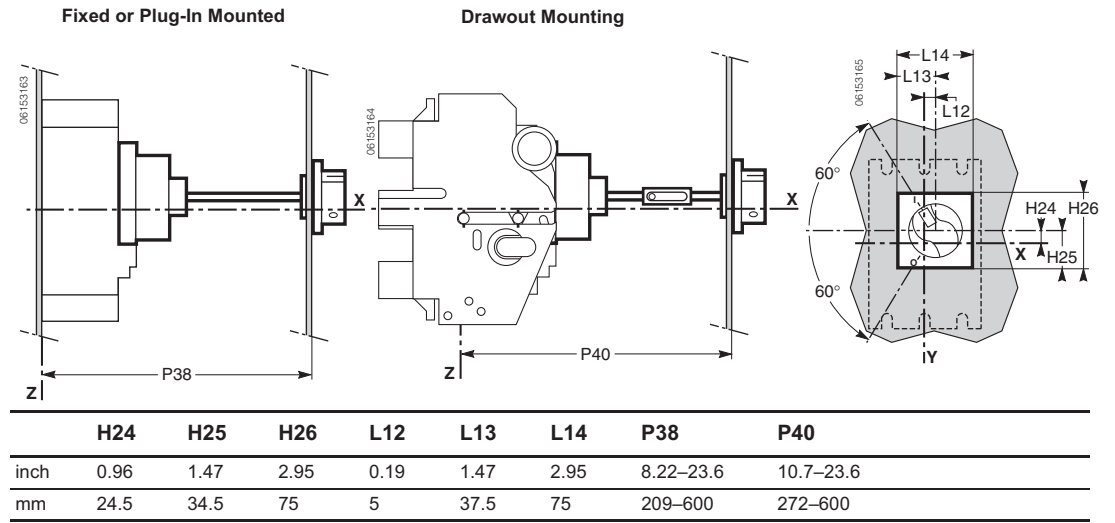
Motor-Control Center-Type Direct Rotary-Operating Handle



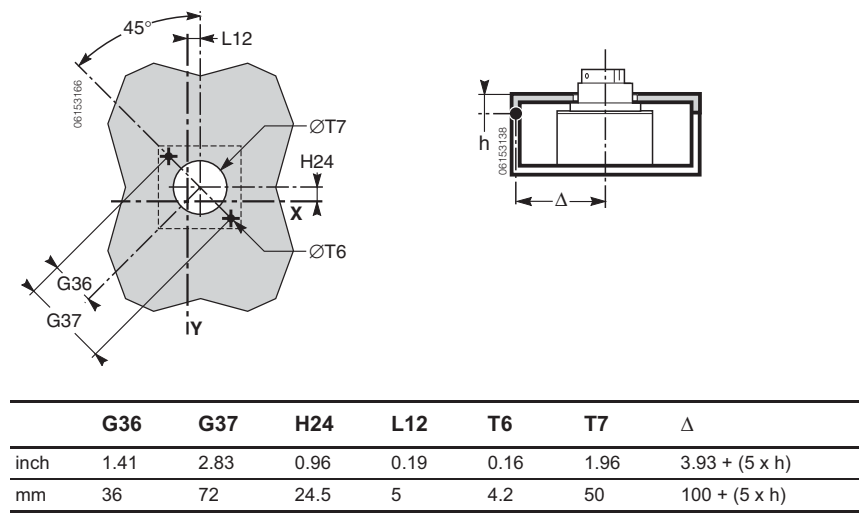
PowerPact® D-Frame Circuit Breakers and Switches

Dimensions

Mounting

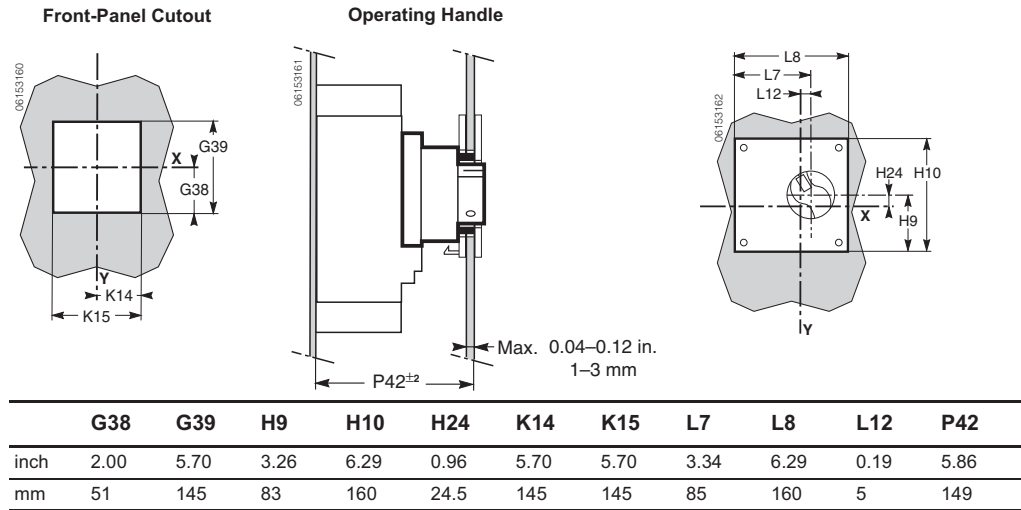


Front-Panel Cutout



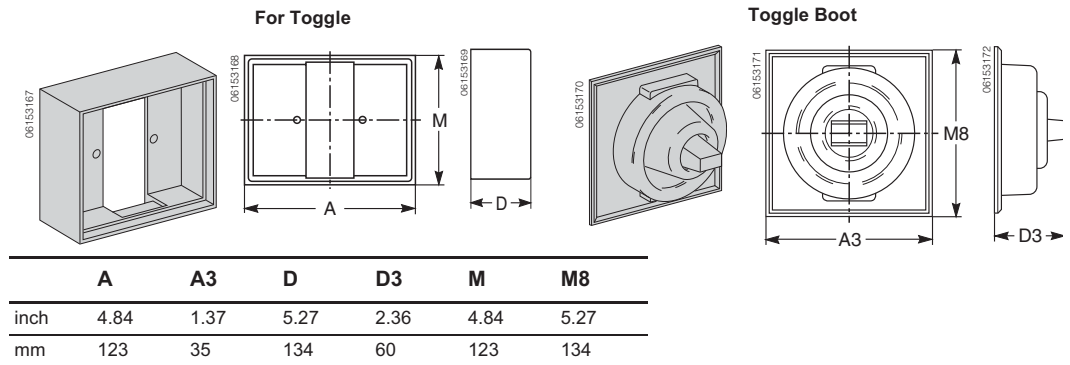
PowerPact® D-Frame Circuit Breakers and Switches Dimensions

Motor-Control Center-Type Direct Rotary-Operating Handle

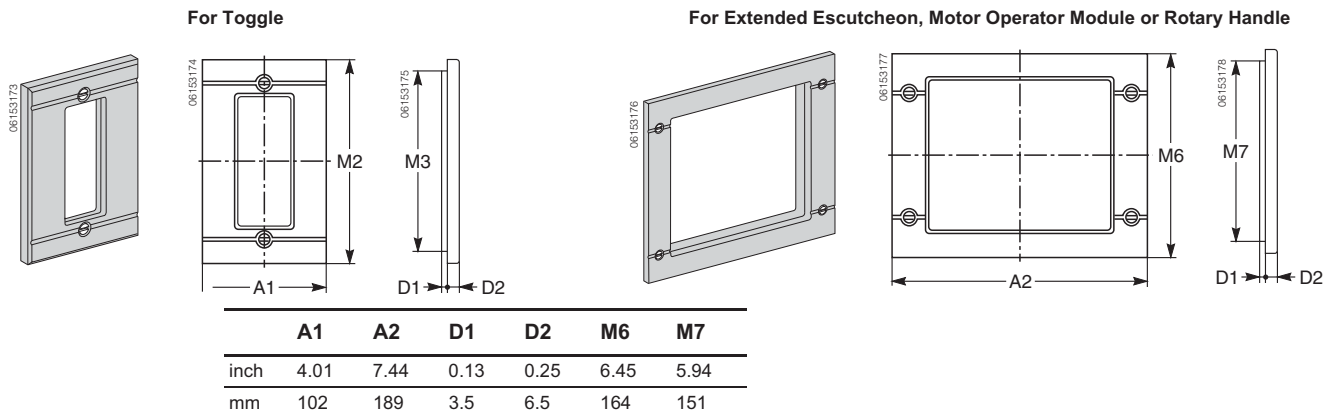


Front Accessories

Extended Escutcheons



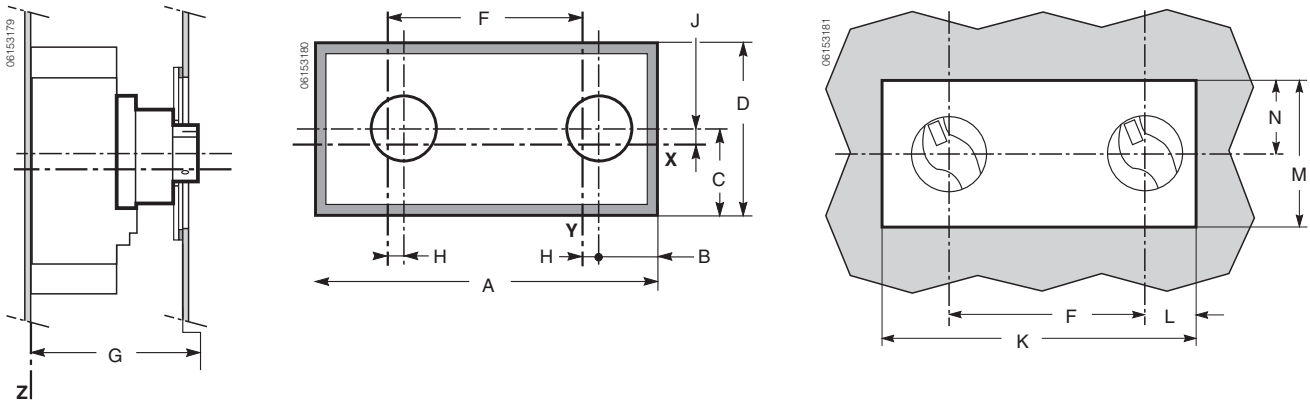
Front-Panel Escutcheons



PowerPact® D-Frame Circuit Breakers and Switches Dimensions

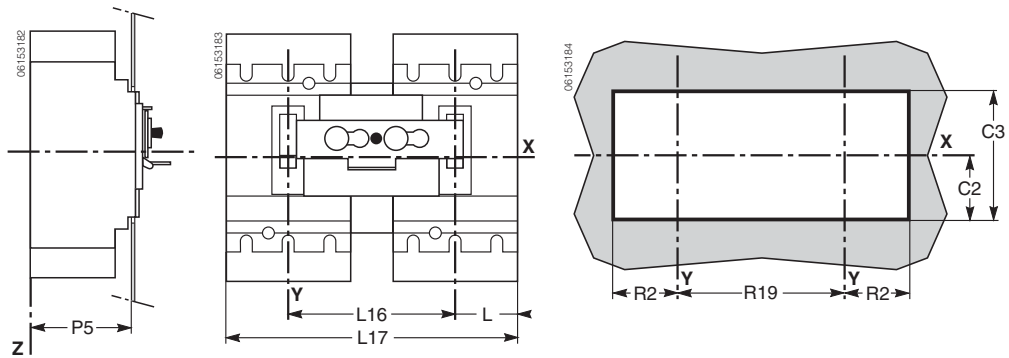
Interlocking Systems

Interlocking Systems with Rotary-Operating Handles



	A	B	C	D	F	G	H	J	K	L	M	N
inch	16.38	4.53	3.94	7.87	8.27	6.18	0.20	0.97	15.20	3.94	6.89	2.93
mm	416	115	100	200	210	157	5	24.6	386	100	175	74.5

Interlocking Systems with Toggle Handles

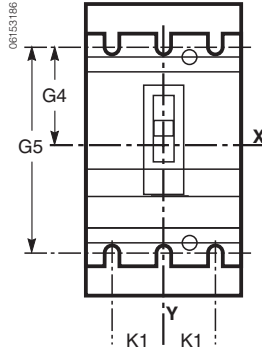
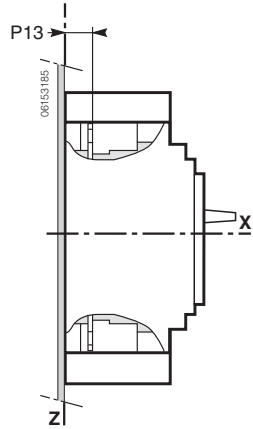


	C2	C3	L	L16	L17	R2	R19	P5
inch	3.64	7.24	2.75	7.28	12.79	2.81	7.28	4.21
mm	92.5	184	70	185	325	71.5	185	107

PowerPact® D-Frame Circuit Breakers and Switches Dimensions

Connector Dimensions

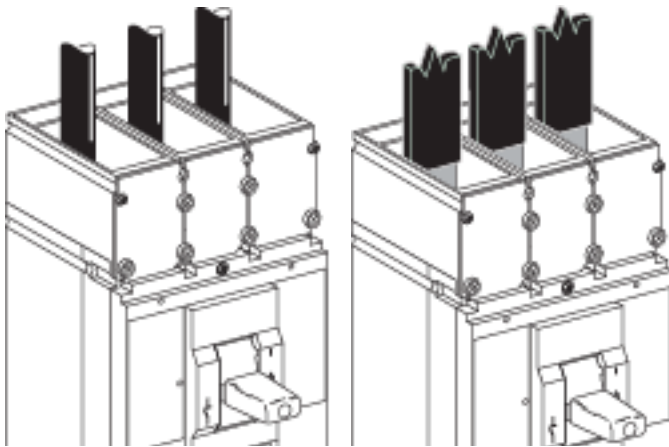
Fixed-Mounted Connections



	G4	G5	K1	P13
inch	4.46	8.93	1.77	1.02
mm	113.5	227	45	526

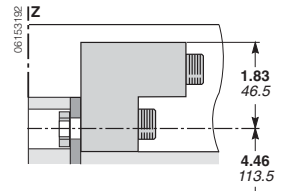
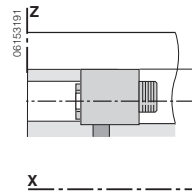
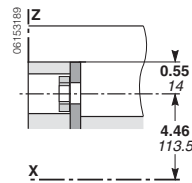
Front Connections

Front Connections



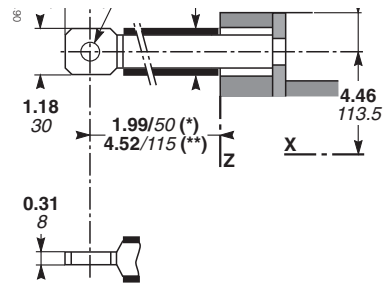
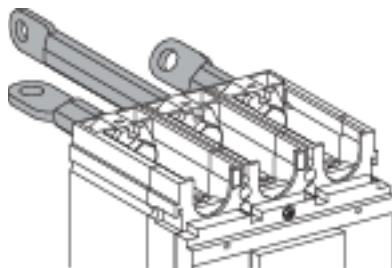
Bus Bar Connection

M10 Screws



Dimensions: in. mm

Rear Connections

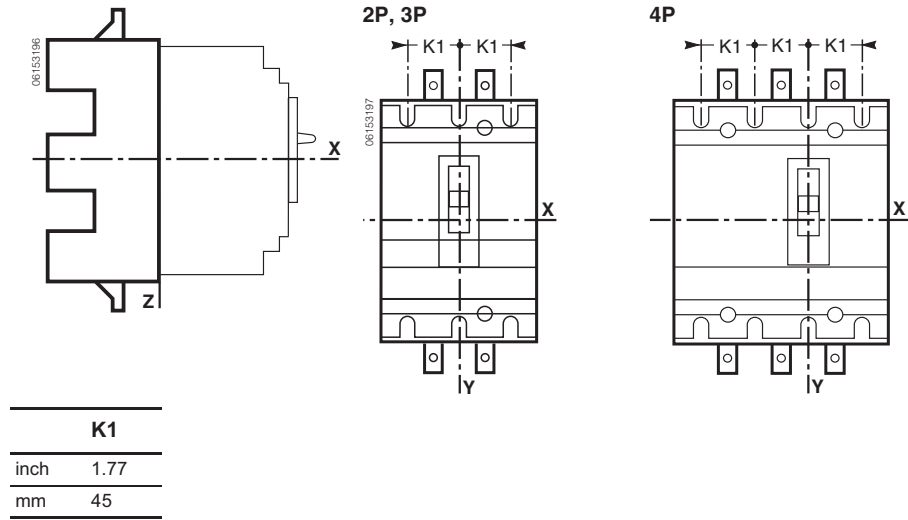


(*) Short RC : 1.96/50
(**) Long RC : 4.52/115

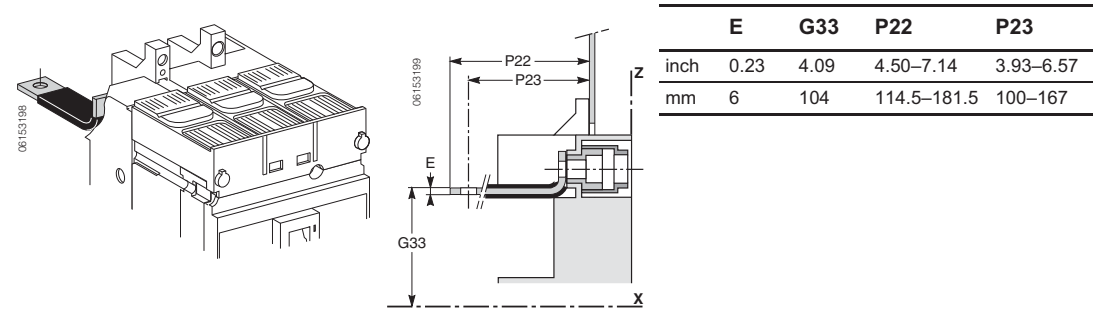
Dimensions: in. mm

PowerPact® D-Frame Circuit Breakers and Switches Dimensions

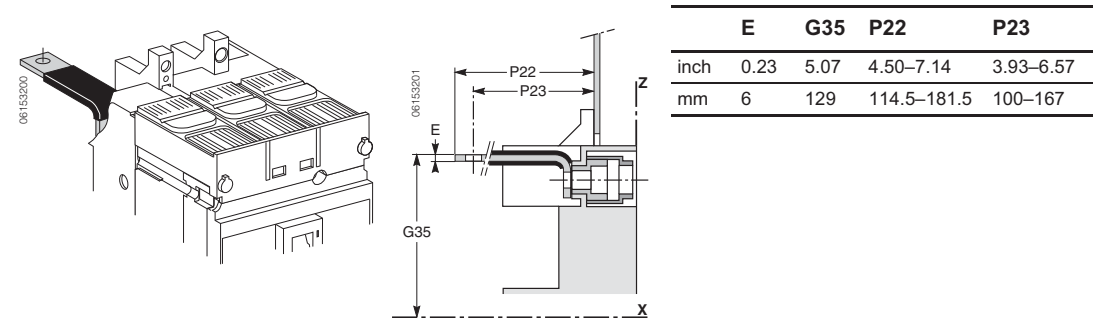
Plug-In or Drawout Mounting Connections



Rear Connections Fitted at Lower Limit

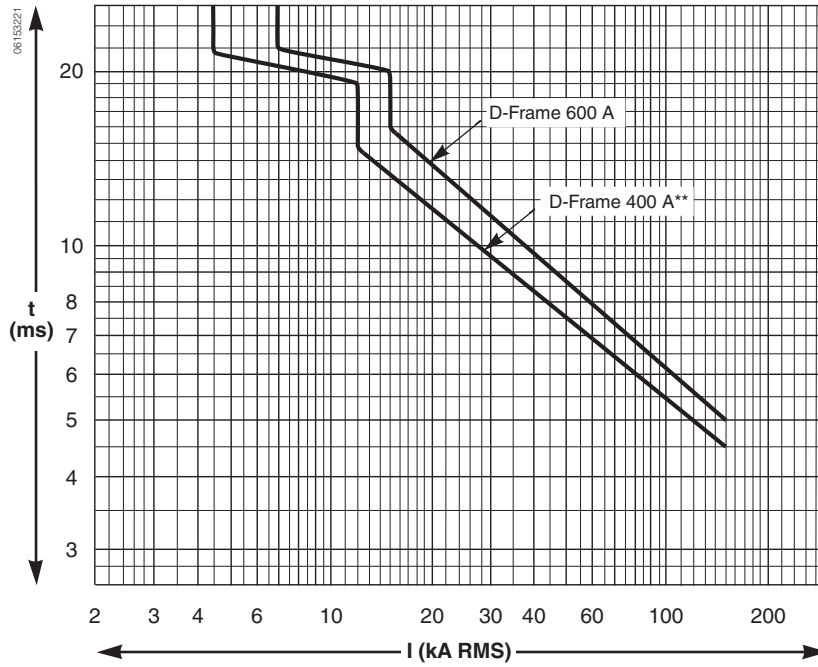


Rear Connections Fitted at Upper Limit

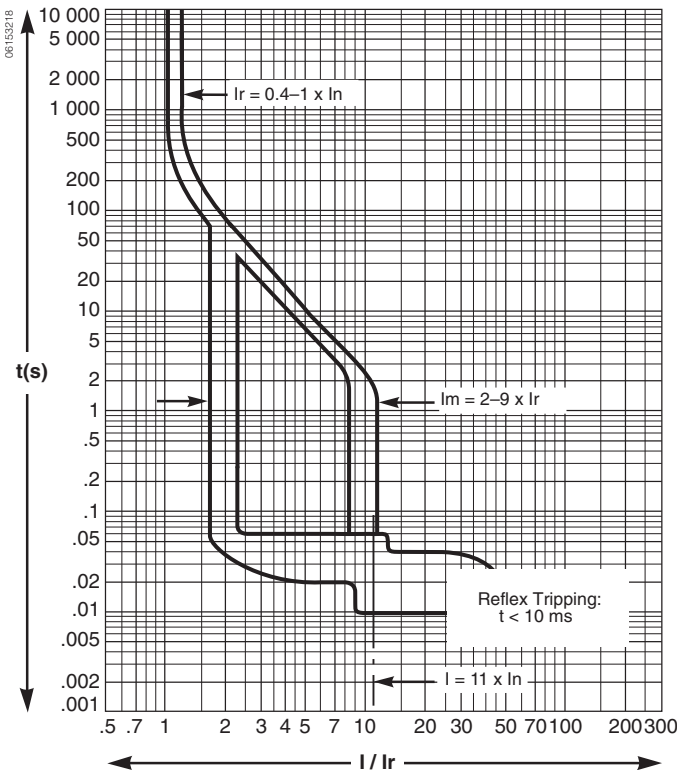


Section 11—Trip Curves

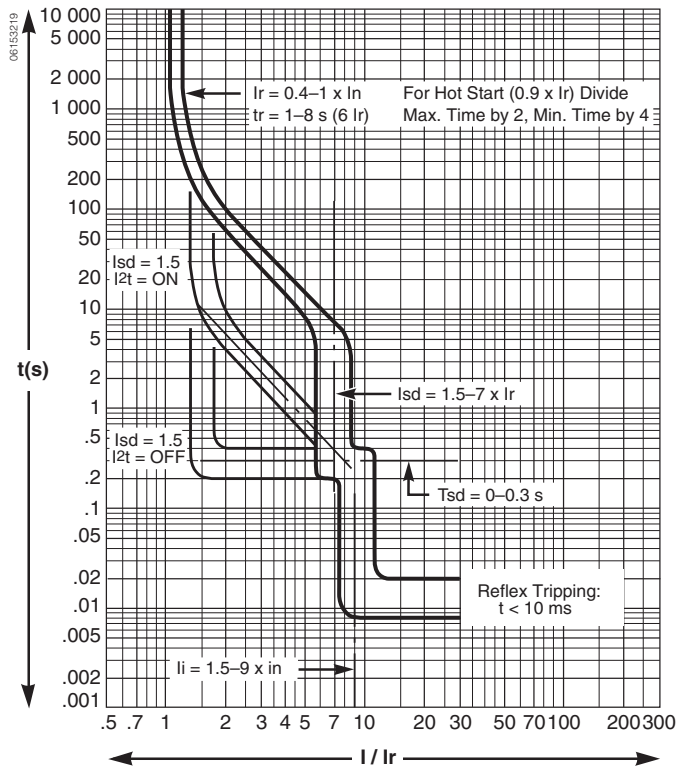
Reflex Tripping



STR23SP Trip Curve

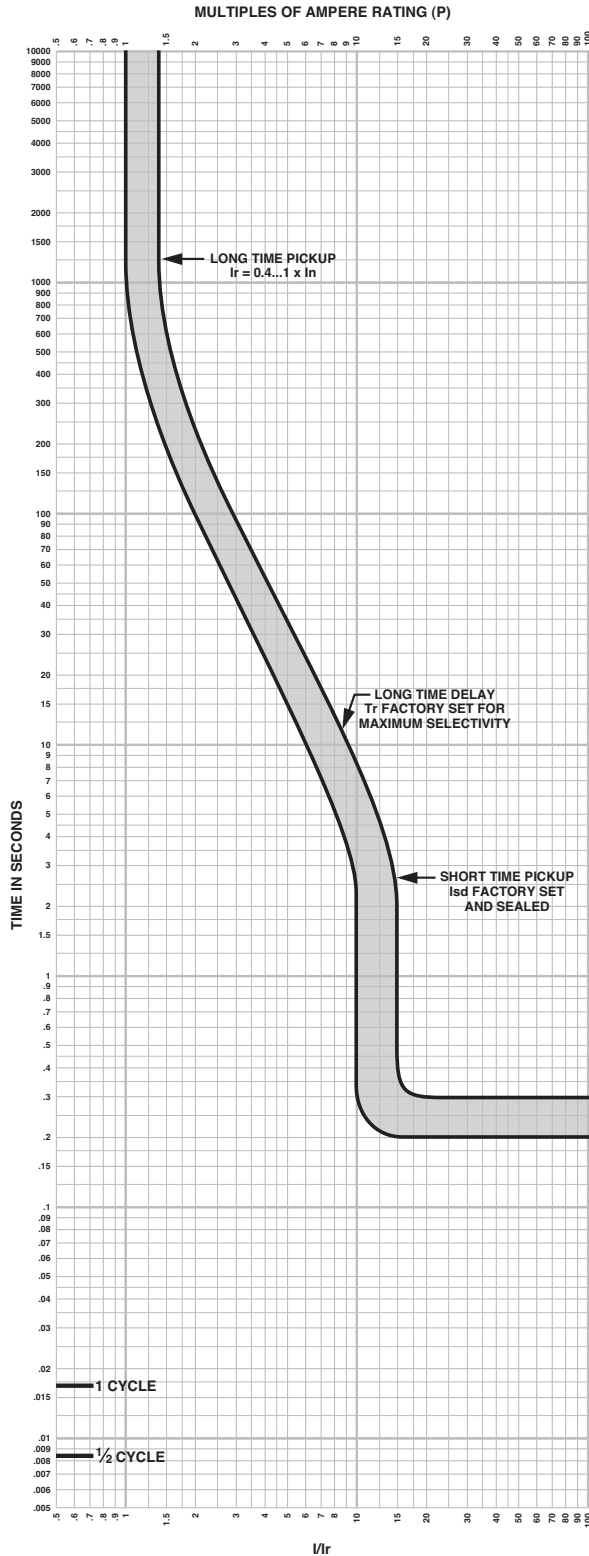


STR53UP Trip Curve



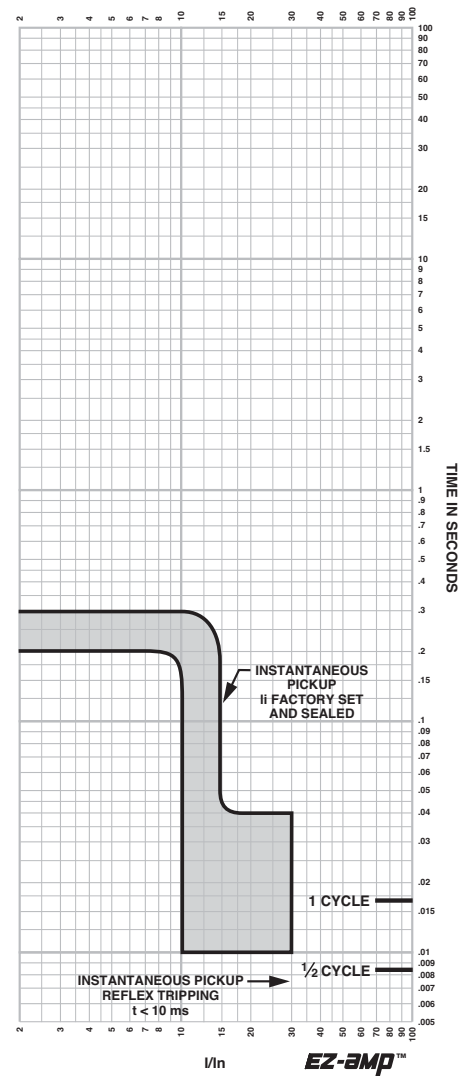
PowerPact® D-Frame Circuit Breakers and Switches Trip Curves

D-Frame Mission Critical



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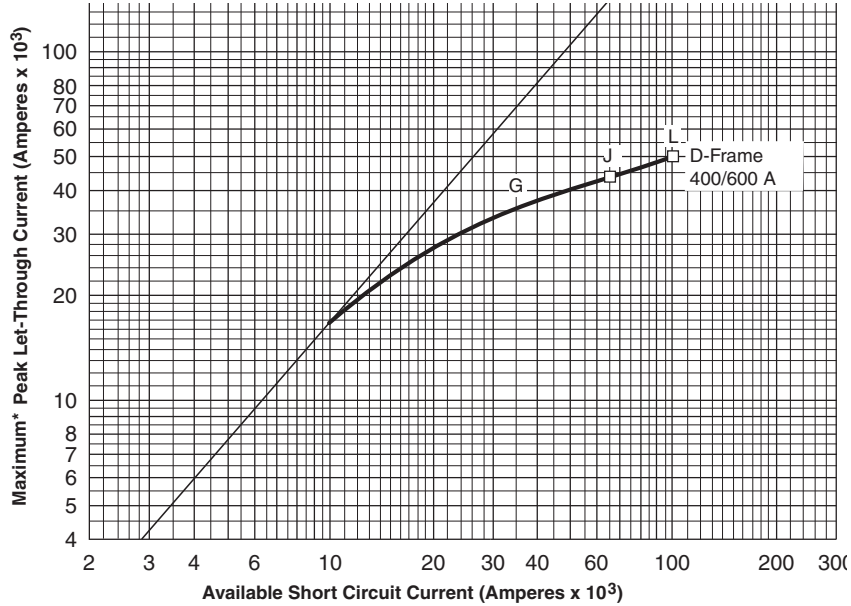
D-Frame Mission Critical Circuit Breaker



Curve No. S1A3030600
February 2010

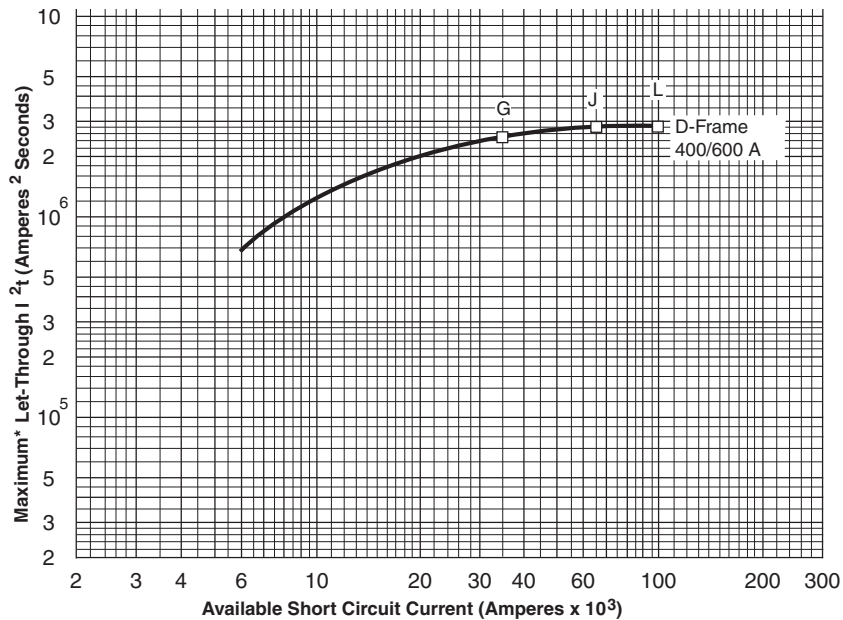
Let-Through Curves at 480 V

Maximum Peak Let-Through Current (A)



*Based on maximum values obtained throughout the circuit breaker development and UL test programs
**4P OSN Compact® NSF 125/250N and NSF 150/250N ratings are same as NSF250

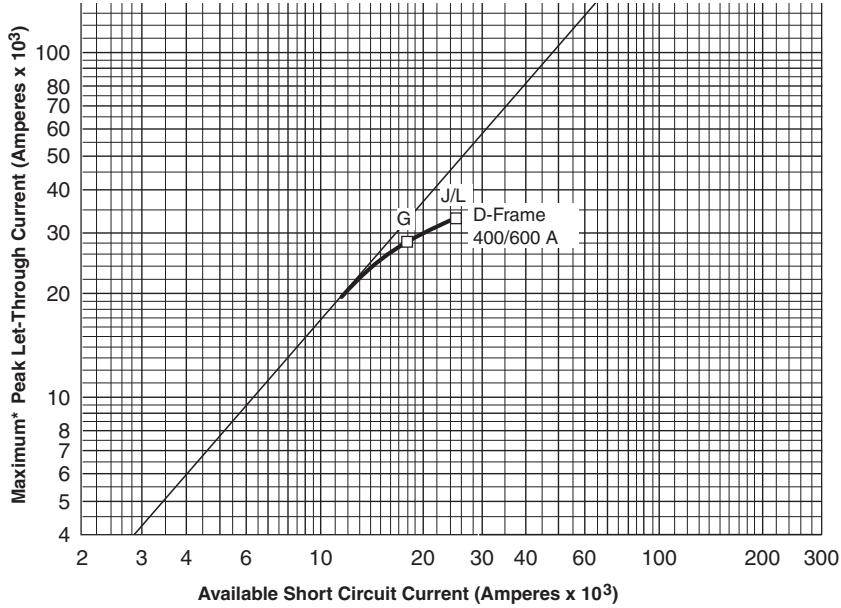
Maximum Let-Through I²t (A²s)



*Based on maximum values obtained throughout the circuit breaker development and UL test programs
**4P OSN Compact® NSF 125/250N and NSF 150/250N ratings are same as NSF250

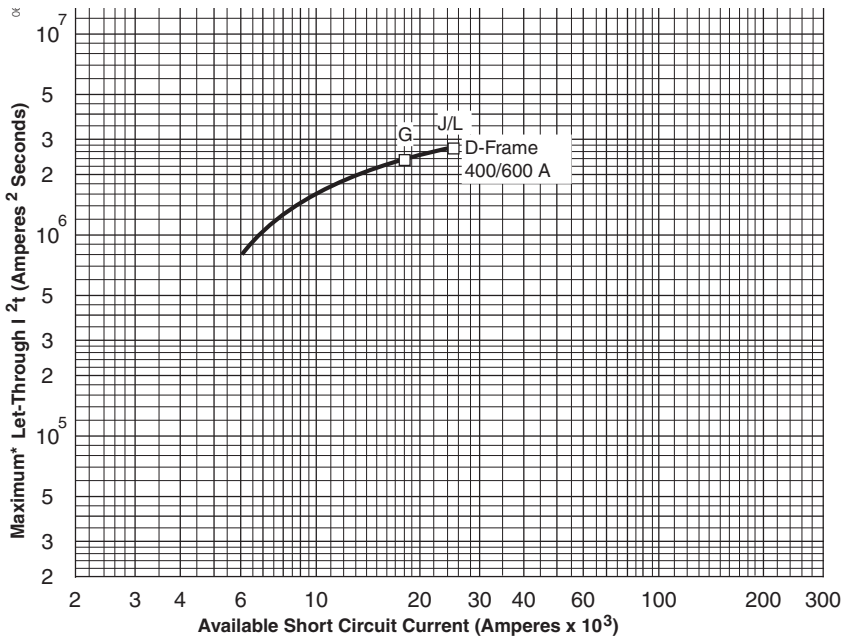
Let-Through Curves at 600 V

Maximum Peak Let-Through Current (A)



*Based on maximum values obtained throughout the circuit breaker development and UL test programs
 **4P OSN Compact® NSF 125/250N and NSF 150/250N ratings are same as NSF250

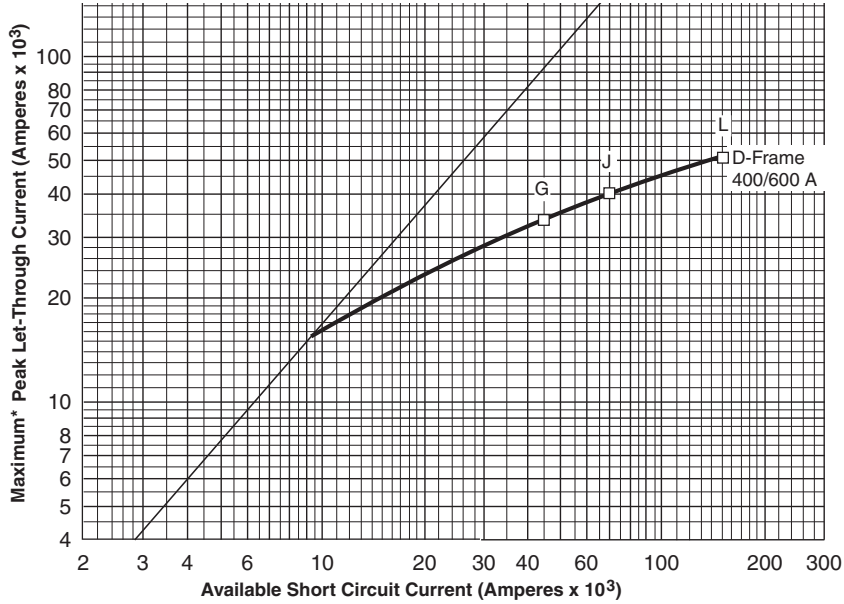
Maximum Let-Through I²t (A²s)



*Based on maximum values obtained throughout the circuit breaker development and UL test programs
 **4P OSN Compact® NSF 125/250N and NSF 150/250N ratings are same as NSF250

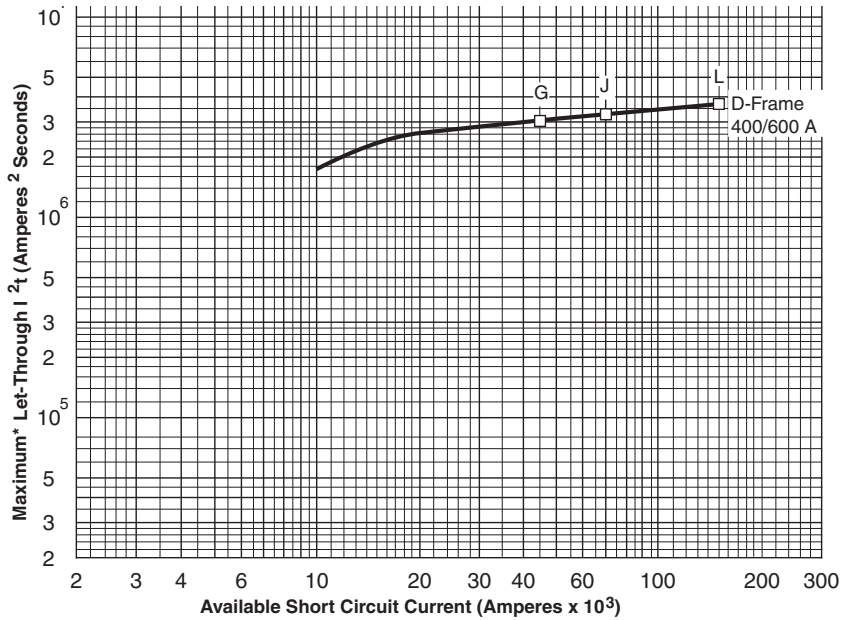
Current-Limiting Curves at 380/415 V

Maximum Peak Let-Through Current (A)



*Based on maximum values obtained throughout the circuit breaker development and UL test programs
**4P OSN Compact® NSF 125/250N and NSF 150/250N ratings are same as NSF250

Maximum Let-Through I²t (A²s)

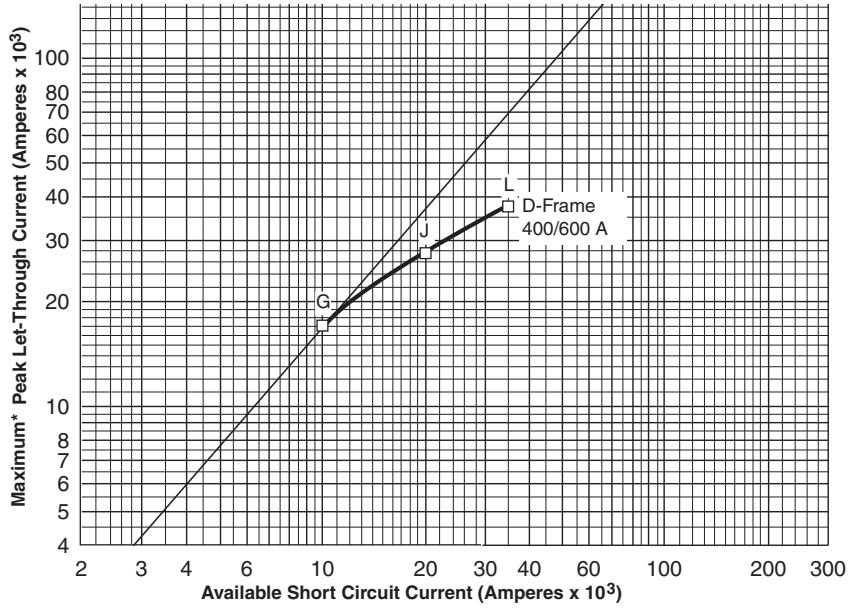


*Based on maximum values obtained throughout the circuit breaker development and UL test programs
**4P OSN Compact® NSF 125/250N and NSF 150/250N ratings are same as NSF250

PowerPact® D-Frame Circuit Breakers and Switches Trip Curves

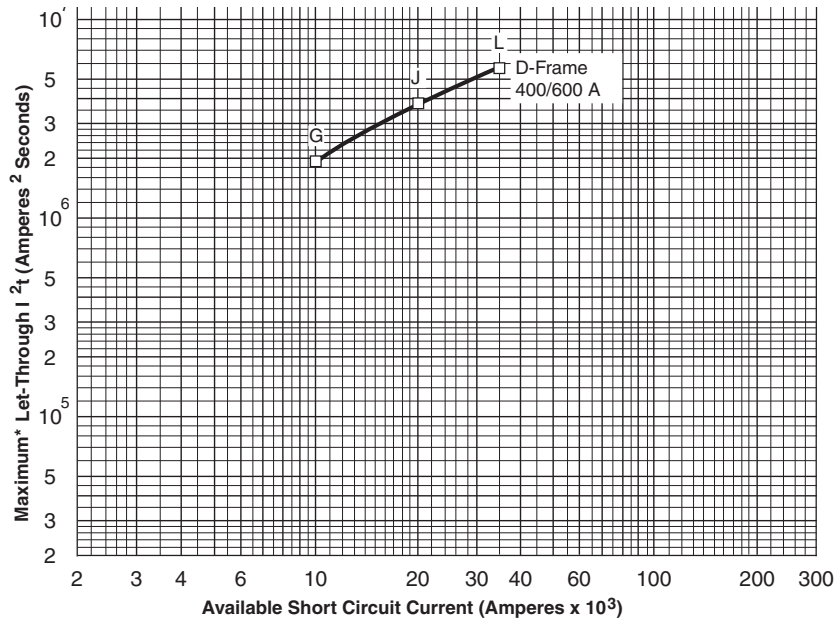
Current-Limiting Curves at 690 V

Maximum Let-Through Current (A)



* Based on maximum values obtained throughout the circuit breaker development and UL test programs
 **4P OSN Compact® NSF 125/250N and NSF 150/250N ratings are same as NSF250

Maximum Let-Through I²t (A²s)



*Based on maximum values obtained throughout the circuit breaker development and UL test programs
 **4P OSN Compact® NSF 125/250N and NSF 150/250N ratings are same as NSF250

Catalog Numbers

29272	33	32648	40	DGL36250E58	25	DLA34600E58	25	S29409	38
29273	33	32649	40	DGL36250E59	25	DLL36150E20	25	S29409	8
29286	33	32649	40	DGL36250F40	24	DLL36150E53	25	S29410	38
29287	33	32839	40	DGL36400E20	25	DLL36150E54	25	S29410	8
29346	41	32840	40	DGL36400E53	25	DLL36150E58	25	S29411	38
29348	34	32841	40	DGL36400E54	25	DLL36150E59	25	S29411	8
29348	34	32842	40	DGL36400E58	25	DLL36150F40	24	S29412	38
32434	18	32843	40	DGL36400E59	25	DLL36250E20	25	S29412	8
32441	18	32844	40	DGL36400F40	24	DLL36250E53	25	S29413	38
32475	35	32845	40	DGL36400M36	30	DLL36250E54	25	S29413	8
32475	35	32846	40	DGL36600E20	25	DLL36250E58	25	S29414	38
32476	35	32847	40	DGL36600E53	25	DLL36250E59	25	S29414	8
32476	35	36940	18	DGL36600E54	25	DLL36250F60	24	S29450	37
32500	33	36942	18	DGL36600E58	25	DLL36400E20	25	S29450	37
32508	34	36943	18	DGL36600E59	25	DLL36400E53	25	S29450	38
32510	34	36944	18	DGL36600F60	24	DLL36400E54	25	S29450	8
32514	33	36945	18	DGL36600M42	30	DLL36400E58	25	S29450	8
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32518	33	36951	22	DJA34000S60	29	DLL36400F40	24	S29450	8
32518	33	36952	22	DJA34150E20	25	DLL36400M36	30	S29450	8
32518	33	36953	22	DJA34150E53	25	DLL36600E20	25	S29452	38
32518	33	36965	34	DJA34150E58	25	DLL36600E53	25	S29452	8
32520	33	36966	35	DJA34250E20	25	DLL36600E54	25	S29452	8
32520	33	36967	35	DJA34250E53	25	DLL36600E58	25	S29452	8
32520	33	41940	40	DJA34250E58	25	DLL36600E59	25	S29482	37
32521	33	41940	40	DJA34400E20	25	DLL36600F60	24	S29482	37
32523	33	41940	41	DJA34400E53	25	DLL36600M42	30	S29482	8
32525	33	41940	44	DJA34400E58	25	M32515	33	S29482	8
32532	33	42878	44	DJA34600E20	25	M32515	33	S32631	43
32532	33	42888	40	DJA34600E53	25	M32547	33	S32839	8
32533	33	42888	40	DJA34600E58	25	M32549	33	S32840	8
32533	33	42888	41	DJL36000S40	29	MICROTUSEAL	44	S32841	8
32534	33	42888	44	DJL36000S60	29	NJPAF	43	S32843	8
32534	46	9421LD1	42	DJL36150E20	25	PDC12DG4	34	S32844	8
32546	33	9421LD4	42	DJL36150E53	25	PDC5DG2	34	S32845	8
32548	33	9422A1	42	DJL36150E54	25	S29370	43	S32845	8
32553	42	9422CSJ10	42	DJL36150E58	25	S29382	38	S32846	8
32553	45	9422CSJ30	42	DJL36150E59	25	S29382	8	S32847	8
32556	45	9422CSJ50	42	DJL36150F40	24	S29383	38	S33595	23
32558	45	9422RSI	42	DJL36250E20	25	S29383	8	S33875	41
32560	45	9422RSI	42	DJL36250E53	25	S29384	38	S48855	23
32562	33	AB1	46	DJL36250E54	25	S29384	8	S48856	23
32562	33	AL400L61K3	34	DJL36250E58	25	S29385	38	S48908	23
32562	35	AL400L61K4	34	DJL36250E59	25	S29385	8		
32563	33	AL600LF52K3	34	DJL36250F40	24	S29386	38		
32563	33	AL600LF52K4	34	DJL36400E20	25	S29386	8		
32563	35	AL600LS52K3	34	DJL36400E53	25	S29387	38		
32595	42	AL600LS52K4	34	DJL36400E54	25	S29387	8		
32595	45	CU400L61K3	34	DJL36400E58	25	S29388	38		
32597	40	CU400L61K4	34	DJL36400E59	25	S29388	8		
32597	8	CU600LF52K3	34	DJL36400F40	24	S29389	38		
32598	41	CU600LF52K4	34	DJL36400M36	30	S29389	8		
32598	8	CU600LS32K3	34	DJL36400M36	30	S29390	38		
32599	40	CU600LS32K4	34	DJL36600E20	25	S29390	8		
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32600	41	DGA34150E20	25	DJL36600E54	25	S29391	8		
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32603	41	DGA34150E58	25	DJL36600E59	25	S29392	8		
32603	8	DGA34250E20	25	DJL36600F60	24	S29393	38		
32604	41	DGA34250E53	25	DJL36600M42	30	S29393	8		
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32605	41	DGA34400E20	25	DJL46000S40	29	S29394	8		
32606	40	DGA34400E53	25	DJL46000S60	29	S29402	38		
32606	8	DGA34400E58	25	DJL56000S40	29	S29402	8		
32614	43	DGA34600E20	25	DJL56000S60	29	S29403	38		
32621	43	DGA34600E53	25	DLA34150E20	25	S29403	8		
32639	40	DGA34600E58	25	DLA34150E53	25	S29404	38		
32640	40	DGL36150E20	25	DLA34150E58	25	S29404	8		
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