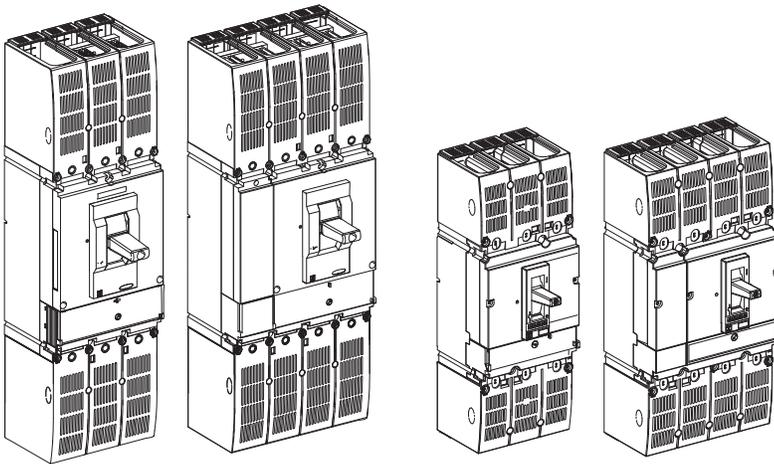


# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

Catalog  
0611CT1302 R05/15  
**2015**  
Class 0611



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# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches



# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

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## Section 1—Introduction

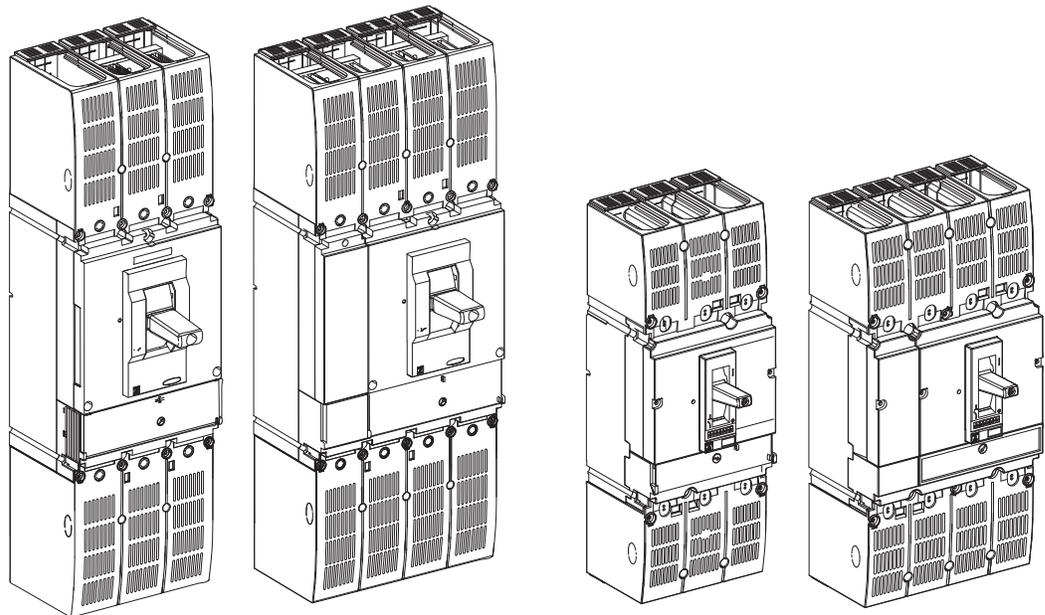
### Photovoltaic Installation

Schneider Electric™ photovoltaic packages give you dependable, clean, and affordable solar power. High quality, highly efficient, and available everywhere, our systems are reliable and simple-to-install. The PowerPact™ T- and U-frame DC PV range of molded case circuit breakers and switches with operational voltage up to 1000 Vdc include the protection components you need for the safety and operation efficiency of your photovoltaic installation in commercial buildings and power plants.

With serial connectors supplied as standard, the circuit breaker or switch rating is optimized, avoiding the need to oversize protection components and saving space in the enclosure. As part of the PowerPact range, the existing auxiliaries and accessories are compatible. The terminal covers are included with the products for isolation. The shunt trip auxiliary and motor operator are available for remote disconnection or operation.

### PowerPact™ DC Photovoltaic (PV) Circuit Breakers

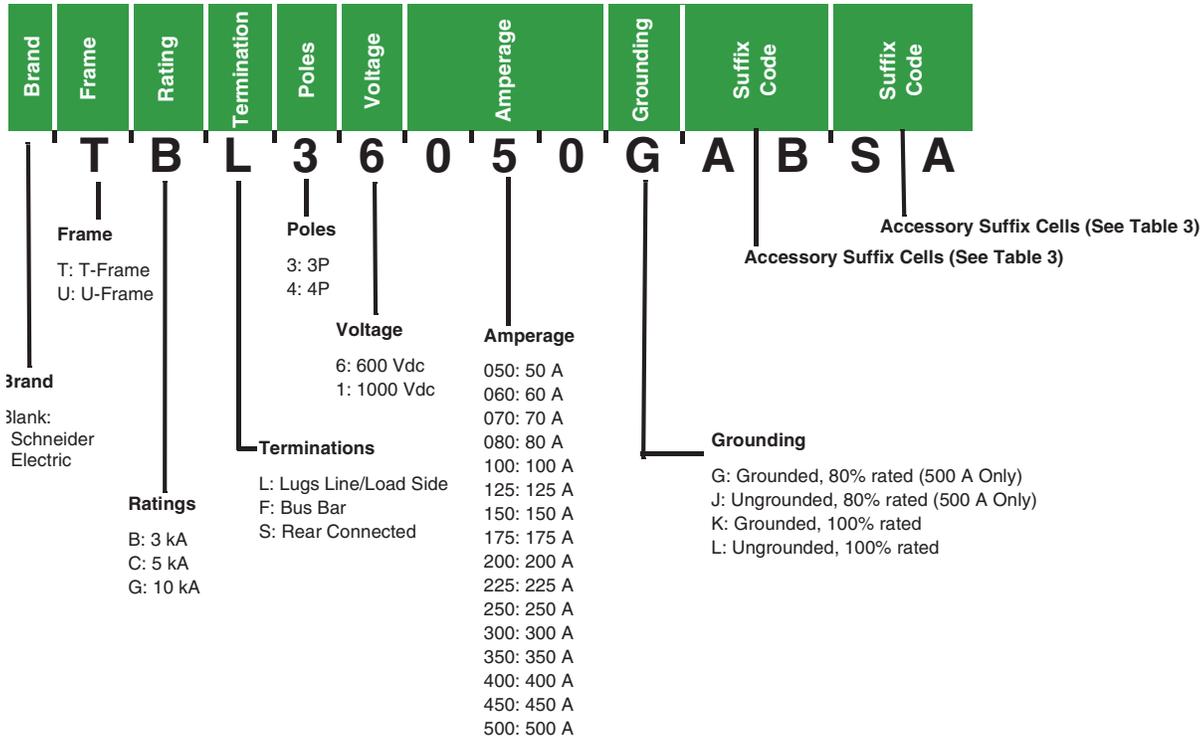
The PowerPact T- and U-frame circuit breakers are designed to protect dc photovoltaic electrical systems from damage caused by overloads and short circuits. T- and U-frame circuit breakers are available with thermal-magnetic trip units.



# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Introduction

## Catalog Numbering

### Circuit Breaker Numbering



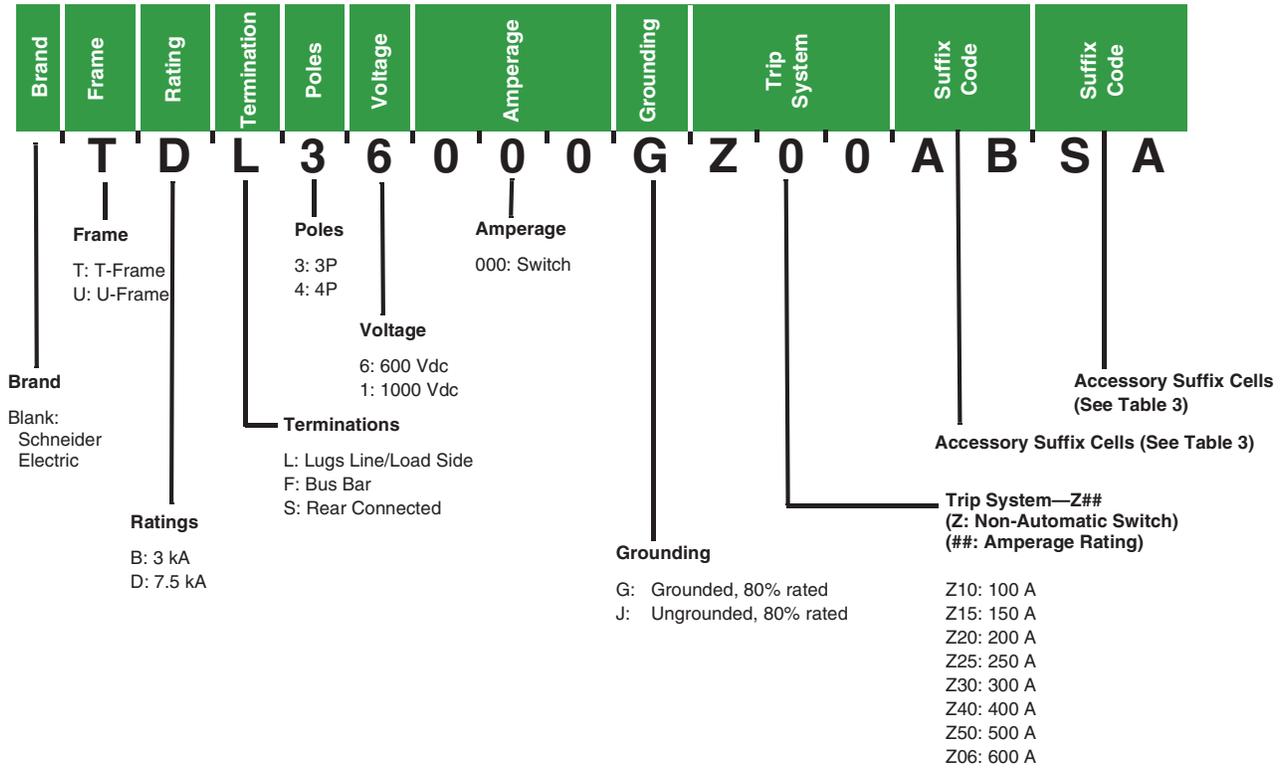
OTE: See part numbers in page 16, for possible selections.

**Table 1: Circuit Breaker Interrupting Ratings**

T-Frame		U-Frame	
600 Vdc	1000 Vdc	600 Vdc	1000 Vdc
10 kA	3 kA	10 kA	5 kA

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Introduction

## Switch Numbering



NOTE: See part numbers in page 17, for possible selections.

**Table 2: Switch Withstand Ratings**

T-Frame		U-Frame	
600 Vdc	1000 Vdc	600 Vdc	1000 Vdc
3 kA	3 kA	7.5 kA	7.5 kA

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## Introduction

**Table 3: Factory Installed Accessory Suffix Codes (Building Sequence as Listed) and Field-Installable Kit Number**

<b>(1) Auxiliary Switch</b>			
Suffix	Contacts	Kit No.	Kit Qty.
AA	1A/1B Standard	S29450	1
AB	2A/2B Standard	S29450	2
AC	3A/3B Standard (U-frame only)	S29450	3
AE	1A/1B Low-Level	S29452	1
AF	2A/2B Low-Level	S29452	2
AG	3A/3B Low-Level (U-frame only)	S29452	3
<b>(2) Alarm/Overcurrent Trip Switch</b>			
Suffix	Switch	Kit No.	Kit Qty.
PowerPact U-Frame			
BC	Alarm Switch	S29450	1
BH	Alarm Switch Low-Level	S29452	1
BD	Overcurrent Trip Switch, Standard	S29450	1
BJ	Overcurrent Trip Switch, Low-Level	S29452	1
BE	Alarm Switch and	S29450	2
BK	Alarm Switch and	S29452	2
PowerPact T-Frame			
BC	Alarm Switch	S29450	1
BH	Alarm Switch Low-Level	S29452	1
BD	Overcurrent Trip Switch, Standard SDE Actuator	S29450 S29451	1 1
BJ	Overcurrent Trip Switch, Low-Level SDE Actuator	S29452 S29451	1 1
BE	Alarm Switch and Overcurrent Trip Switch, Standard SDE Actuator	S29450 S29451	2 1
BK	Alarm Switch and Overcurrent Trip Switch, Low-Level SDE Actuator	S29452 S29451	2 1

**NOTE:** For a complete list of available accessories, see Section 5.

<b>(3) Shunt Trip</b>		
Suffix	Voltage	Kit No.
SA	120 Vac	S29386
SO	24 Vdc	S29390
SP	48 Vdc	S29392
SR	125 Vdc	S29393

<b>(4) Rotary Handle</b>			
Suffix	Handle Type (color)	T-Frame	U-Frame
RD10	Direct Mount (black)	S29337	S32597
RE10	Extended Door Mount (black)	S29338	S32598

<b>(5) Handle Padlocks</b>			
Suffix	Padlock Type	T-Frame	U-Frame
YP	Handle Padlock, ON or OFF	S29371	S32631

## Section 2—General Information

The PowerPact™ T- and U-frame circuit breakers are designed to protect dc photovoltaic (PV) electrical systems from damage caused by overloads and short circuit using thermal-magnetic trip units.

Thermal-magnetic trip units contain individual thermal (overload) and instantaneous (short circuit) sensing elements. The amperage ratings of the thermal trip elements are calibrated at 122°F (50°C) free air ambient temperature.

### Applications

PowerPact T- and U-frame circuit breakers offer high performance and a wide range of amperage ratings to protect PV applications per the UL489B standard.

### Flexible Configurations

The PowerPact T- and U-frame circuit breakers may be configured with lugs, bus bar connections, or rear connections. They are also available for grounded and ungrounded applications.

### Trip Ranges

Table 4: Circuit Breaker Trip Ranges

T-Frame Circuit Breaker				U-Frame Circuit Breakers		
Circuit Breaker Amperage	Magnetic Trip Range			Circuit Breaker Amperage	Magnetic Trip Range	
	Fixed	Adjustable			Adjustable	
		Low	High		Low	High
50 A	270 A			225 A	1250 A	2500 A
60 A	270 A			250 A	1250 A	2500 A
70 A	270 A			300 A	1600 A	3200 A
80 A	270 A			350 A	2000 A	4000 A
100 A	550 A			400 A	2000 A	4000 A
125 A	550 A			450 A	2500 A	5000 A
150 A	550 A			500 A	2500 A	5000 A
175 A		1000 A	2000A			
200 A		1000 A	2000A			

### Available Devices

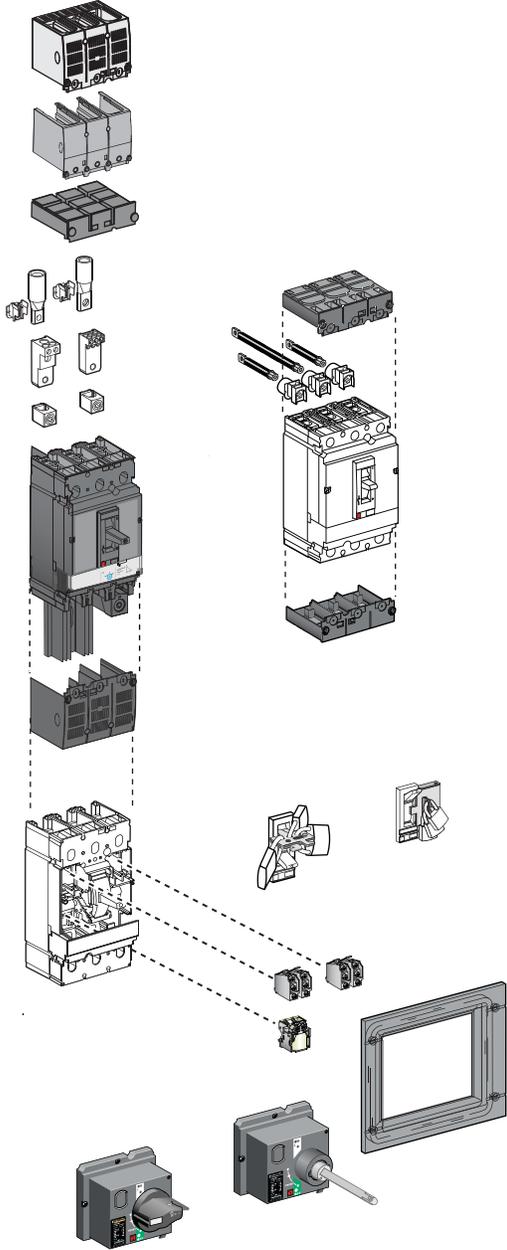
- PowerPact™ T- and U-Frame dc thermal-magnetic circuit breakers are designed to open automatically under overload or short circuit conditions. T- and U-frame thermal-magnetic circuit breakers contain individual thermal (overload) and instantaneous (short circuit) sensing elements. The face of electrically-operated circuit breakers are marked ON/OFF and I/O and equipped with a position indicator to show contact position.
- PowerPact T- and U-frame dc switches are non-automatic switches and only open manually or by using a motor operator.

**NOTE:** All the trip units have a transparent sealable cover that protects access to the adjustment rotary switches.

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches General Information

## Field Installable Accessories

Figure 1: Field Installable Accessories



## General Characteristics

### Faceplate Label

	<p>Characteristics indicated on the faceplate label:</p> <ul style="list-style-type: none"> <li>A. Circuit breaker type</li> <li>B. Circuit breaker disconnecter symbol</li> <li>C. Performance levels</li> <li>D. Standards</li> <li>E. Certification mark</li> </ul> <p><b>NOTE:</b> When the circuit breaker is equipped with an extended rotary handle, the door must be opened to view the faceplate.</p>
--	--

### Codes and Standards

T- and U-frame circuit breakers and non-automatic switches are manufactured and tested in accordance with the following standards.

**NOTE:** Apply circuit breakers according to guidelines detailed in the National Electric Code (NEC) and other local wiring codes.

**Table 5: Codes and Standards (Domestic)**

PowerPact T- and U-Frame Circuit Breakers	PowerPact T- and U-Frame Switches
UL 489B <sup>1</sup>	UL 489B <sup>2</sup>

<sup>1</sup> PowerPact T- and U-frame circuit breakers are in UL File E363533

<sup>2</sup> PowerPact T- and U-frame switches are in UL File E361185.

### Vibration

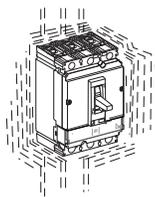
PowerPact T- and U-frame devices resist mechanical vibration.

Tests are carried out in compliance with standard UL 489 SA and SB for the levels required by merchant-marine inspection organizations (Veritas, Lloyd's, etc.):

PowerPact T- and U-frame circuit breaker meet IEC 60068-2-6 for vibration:

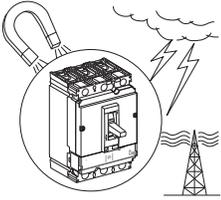
- 2.0 to 25.0 Hz and amplitude +/- 1.6 mm
- 25.0 to 100 Hz acceleration +/- 4.0 g

Excessive vibration may cause tripping, breaks in connections or damage to mechanical parts.



# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## General Information



### Electromagnetic Disturbances

PowerPact T- and U-frame devices are protected against:

- overvoltages caused by circuit switching
- overvoltages caused by an atmospheric disturbances or by a distribution-system outage (such as from failure due to lightning)
- devices emitting radio waves (radios, walkie-talkies, radar, etc.)
- electrostatic discharges produced directly by users

PowerPact T- and U-frame devices have successfully passed the electromagnetic-compatibility tests (EMC) defined by the following international standards:

- IEC/EN 60947-2: Low-voltage switchgear and controlgear, part 2: Circuit breakers:
  - Annex F: Immunity tests for circuit breakers with electronic protection
  - Annex B: Immunity tests for residual current protection
- IEC/EN 61000-4-2: Electrostatic-discharge immunity tests
- IEC/EN 61000-4-3: Radiated, radio-frequency, electromagnetic-field immunity tests
- IEC/EN 61000-4-4: Electrical fast transient/burst immunity tests
- IEC/EN 61000-4-5: Surge immunity tests
- IEC/EN 61000-4-6: Immunity tests for conducted disturbances induced by radio frequency fields
- CISPR 11: Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.

These tests ensure that:

- no nuisance tripping occurs
- tripping times are respected

### Tropicalization

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

PowerPact circuit breakers have passed the test 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

### Operating Conditions

PowerPact™ T- and U-frame circuit breakers may be used between -13°F and 158°F (-25 °C and +70 °C). For temperatures higher than 122° F (50° C°) inside the enclosure, devices must be rerated.

See section 7 for details.

The permissible storage-temperature range for PowerPact T- and U-frame circuit breakers in the original packing is -58°F and 185°F (-50 °C and +85 °C).

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## General Information

### Specifications

**Table 6: Circuit Breakers**

Circuit Breaker		200 A T-Frame	500 A U-Frame
Number of poles		3, 4	3, 4
Amperage Range (A)		50-200	225-500
UL 489B Circuit Breaker Ratings			
UL(kA rms)	600 Vdc	10 kA	10 kA
	1000 Vdc	3 kA	5 kA
Service breaking capacity (Ics)		% Icu	100%
Insulation Voltage		$V_i$	1000
Impulse Withstand Voltage		$V_{imp}$	8
Operational Voltage		$V_e$	600 Vdc, 3P 1000 Vdc 4P
Sensor Rating		$I_n$	200 A
Utilization Category		—	A
Operations (Open-Close Cycles)			
Without Current		10000	10000
With Current		per UL489B specifications	
Protection and Measurements			
Overload/short-circuit protection		Thermal-magnetic	■ ■ ■ ■
Dimensions / Weight / Connections			
Dimensions 3P (Unit mount without serial connector or terminal cover <sup>1</sup> )	Height	6.34 in. (161 mm)	10.0 in. (255 mm)
	Width	4.1 in. (104 mm)	5.51 in. (140 mm)
	Depth	3.4 in. (86 mm)	4.33 in. (110 mm)
Weight 3P - lb. (kg) (without serial connector)		4.5 lb (2 kg)	13 lb (5.9 kg)
Connections / Terminations	Unit Mount	■	■
	Rear Connection	■	■

<sup>1</sup> See Section 9 for complete dimensions of all configurations including terminal covers and serial connectors.

**Table 7: Switches**

Switch		200 A T-Frame	500 A U-Frame
Number of poles		3, 4	3, 4
Amperage Range (A)		100-200	250-500
UL 489B Switch Ratings			
UL(kA rms)	600 Vdc	3 kA	7.5 kA
	1000 Vdc	3 kA	7.5 kA
Service breaking capacity (Ics)		% Icu	100%
Insulation Voltage		$V_i$	1000
Impulse Withstand Voltage		$V_{imp}$	8
Operational Voltage		$V_e$	600 Vdc, 3P 1000 Vdc, 4P
Utilization Category		---	A
Operations (Open-Close Cycles)			
Without Current		10000	10000
With Current		per UL489B specifications	
Protection and Measurements			
Short-circuit protection		Not available	--- --- --- ---
Dimensions / Weight / Connections			
Dimensions 3P (Unit mount without serial connector or terminal cover <sup>1</sup> )	Height	6.34 in. (161 mm)	10.0 in. (255 mm)
	Width	4.1 in. (104 mm)	5.51 in. (140 mm)
	Depth	3.4 in. (86 mm)	4.33 in. (110 mm)
Weight 3P - lb. (kg) (without serial connector)		4.5 lb (2 kg)	13 lb (5.9 kg)
Connections / Terminations	Unit Mount	■	■
	Rear Connection	■	■

<sup>1</sup> See Section 9 for complete dimensions of all configurations including terminal covers and serial connectors.

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## General Information

### Protection Against Ground Faults for Photovoltaic Applications

#### Introduction

Protection against ground faults in photovoltaic applications is provided by:

- Insulation monitoring devices
- overcurrent ground fault protection

#### Double Ground Faults

Breaking a fault current at the operational photovoltaic system voltage requires a minimum number of poles working in series. The minimum number of poles is a function of the system voltage and voltage rating per pole of the protective device (circuit breaker or switch).

Under certain conditions, a double ground fault can occur in photovoltaic systems that are isolated from ground. If an initial ground fault (initial isolation breakdown to ground) exists, without being detected and cleared, a second fault (second isolation breakdown to ground) can lead to a double fault.

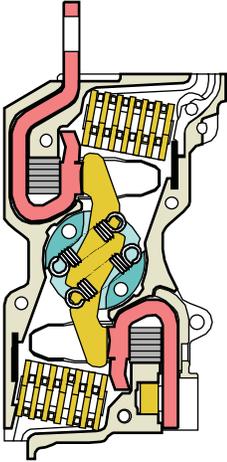
Depending on the location of the faults, it is possible that less than the minimum number of the required poles are involved in the interruption of the fault. Not designed for this situation, property damage or personal injury may occur.

To prevent such double fault scenarios, it is necessary to detect the initial isolation breakdown (first fault) using an isolation monitoring system and clear without delay the initial isolation breakdown to reduce the risk of double fault.

## Section 3—Circuit Breakers

### Dual-Break Rotating Contacts

All PowerPact™ T- and U-frame circuit breakers are equipped with dual-break rotating contacts that reduce the amount of peak current during a short circuit fault. This reduces the let-through currents and enhances equipment protection.



### Reduced Let-Through Currents

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  $I_n$ .

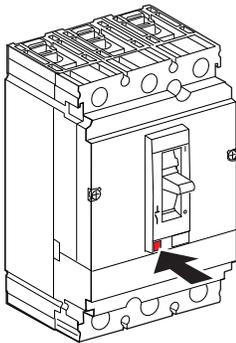
Due to the rotating movement, repulsion is rapid and the device greatly limits short-circuit currents, whatever the interrupting level of the unit (B, C, D, or G). The fault current is extinguished before it can fully develop. Lower let-through currents provide less peak energy, reducing the required bus bar bracing, lowering enclosure pressure, and delivering improved series or combination ratings. See page 16 for UL Current Limiting labels.

### Internal Operating Mechanism

PowerPact T- and U-frame circuit breakers have an over-center toggle mechanism providing quick-make, quick-break operation. The operating mechanism is also trip-free, which allows tripping even when the circuit breaker handle is held in the “ON” position.

Internal cross-bars provide common opening and closing of all poles with a single operating handle.

All PowerPact circuit breakers have an integral push-to-trip button in the cover to manually trip the circuit breaker. This should be used as part of a regular preventive maintenance program.

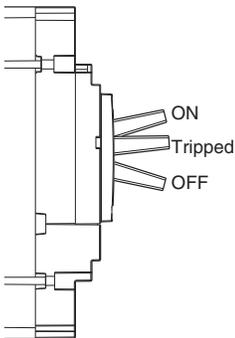


Push-to-Trip

### Handle Position Indication

The circuit breaker handle can assume any of three positions, ON, tripped or OFF as shown. The center tripped position provides positive visual indication that the circuit breaker has tripped.

The circuit breaker can be reset by first pushing the handle to the extreme “OFF” position. Power can then be restored to the load by pushing the handle to the “ON” position.



# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Circuit Breakers

## Circuit Breaker Ratings

The interrupting rating is the highest current at rated voltage 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 Table 6: Circuit Breakers on page 13 and on the faceplate label on the front of the circuit breaker.

## Reverse Feeding of Circuit Breakers

The standard unit-mount T- and U-frame circuit breakers have sealed trip units and may be reverse fed.

## 100% Rated

T- and U-frame circuit breakers are UL Listed to be applied at up to 100% of their current rating. Follow NEC recommendation for proper installation and cabling. Circuit breakers with 100% rating can also be used in applications requiring only standard (80%) continuous loading.

Circuit breakers rated 500 A are 80% rated.

## Catalog Numbers

**Table 8: PowerPact DC Photovoltaic Circuit Breakers**

Ampere Rating	Poles	Ungrounded		Grounded	
		600 Vdc	1000 Vdc	600 Vdc	1000 Vdc
<b>T-Frame PowerPact Circuit Breakers</b>					
50 A	3, 4	TGL36050L	TBL41050L	TGL36050K	TBL41050K
60 A	3, 4	TGL36060L	TBL41060L	TGL36060K	TBL41060K
70 A	3, 4	TGL36070L	TBL41070L	TGL36070K	TBL41070K
80 A	3, 4	TGL36080L	TBL41080L	TGL36080K	TBL41080K
100 A	3, 4	TGL36100L	TBL41100L	TGL36100K	TBL41100K
125 A	3, 4	TGL36125L	TBL41125L	TGL36125K	TBL41125K
150 A	3, 4	TGL36150L	TBL41150L	TGL36150K	TBL41150K
175 A	3, 4	TGL36175L	TBL41175L	TGL36175K	TBL41175K
200 A	3, 4	TGL36200L	TBL41200L	TGL36200K	TBL41200K
<b>U-Frame PowerPact Circuit Breakers</b>					
225 A	3, 4	UGL36225L	UCL41225L	UGL36225K	UCL41225K
250 A	3, 4	UGL36250L	UCL41250L	UGL36250K	UCL41250K
300 A	3, 4	UGL36300L	UCL41300L	UGL36300K	UCL41300K
350 A	3, 4	UGL36350L	UCL41350L	UGL36350K	UCL41350K
400 A	3, 4	UGL36400L	UCL41400L	UGL36400K	UCL41400K
450 A	3, 4	UGL36450L	UCL41450L	UGL36450K	UCL41450K
500 A <sup>1</sup>	3, 4	Not Available	UCL41500J	UGL36500G	UCL41500G

<sup>1</sup> 500 A available 80% rated only.

## Section 4—Non-Automatic Switches

### Non-Automatic Switch Functions

A non-automatic switch can be used to open and close a circuit under normal operating conditions. They are similar in construction to circuit breakers, except that the switches do not have protection function (trip unit) to open the circuit automatically in case of overcurrent or short circuit.

Molded case switches are intended for use as disconnect devices only. UL 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.

PowerPact™ T- and U-frame non-automatic switches are available in unit mount versions. They use the same accessories and offer the same connection possibilities as the circuit-breaker versions.

Switches are Listed under UL file E361185.

### Motor Operator

PowerPact T- and U-frame switches equipped with a motor operator module allow remote closing and opening.

### Non-Automatic Switch Protection

The non-automatic switch can make and break its rated current. For an overload or a short-circuit, it must be protected by an upstream device, in compliance with installation standards.

### Switch Catalog Numbers

**Table 9: PowerPact DC Photovoltaic Switches**

Ampere Rating	Poles	Ungrounded		Grounded	
		600 Vdc	1000 Vdc	600 Vdc	1000 Vdc
<b>T-Frame PowerPact Switches</b>					
100 A	3, 4	TBL36000JZ10	TBL41000JZ10	TBL36000GZ10	TBL41000GZ10
150 A	3, 4	TBL36000JZ15	TBL41000JZ15	TBL36000GZ15	TBL41000GZ15
200 A	3, 4	TBL36000JZ20	TBL41000JZ20	TBL36000GZ20	TBL41000GZ20
<b>U-Frame PowerPact Switches</b>					
250 A	3, 4	UDL36000JZ25	UDL41000JZ25	UDL36000GZ25	UDL41000GZ25
300 A	3, 4	UDL36000JZ30	UDL41000JZ30	UDL36000GZ30	UDL41000GZ30
400 A	3, 4	UDL36000JZ40	UDL41000JZ40	UDL36000GZ40	UDL41000GZ40
500 A	3, 4	UDL36000JZ50	UDL41000JZ50	UDL36000GZ50	UDL41000GZ50

**Section 5—Accessories and Auxiliaries**

All PowerPact™ T- and U-frame circuit breakers and non-automatic switches have slots for the electrical auxiliaries

**T-Frame**

- 4 indication contacts
  - 2 ON/OFF (auxiliary switches [OF1 and OF2])
  - 1 trip indication (alarm switch [SD])
  - 1 fault-trip indication (overcurrent trip switch [SDE])
- one remote-tripping release
  - either 1 undervoltage trip (MN)
  - or 1 shunt trip (MX)

**U-Frame**

- 5 indication contacts
  - 3 ON/OFF auxiliary switches (OF1, OF2, and OF3)
  - 1 trip indication (alarm switch [SD])
  - 1 fault-trip indication (overcurrent trip switch [SDE])
- one remote-tripping release
  - either 1 undervoltage trip (MN)
  - or 1 shunt trip (MX)

All these auxiliaries may be installed with a motor operator.

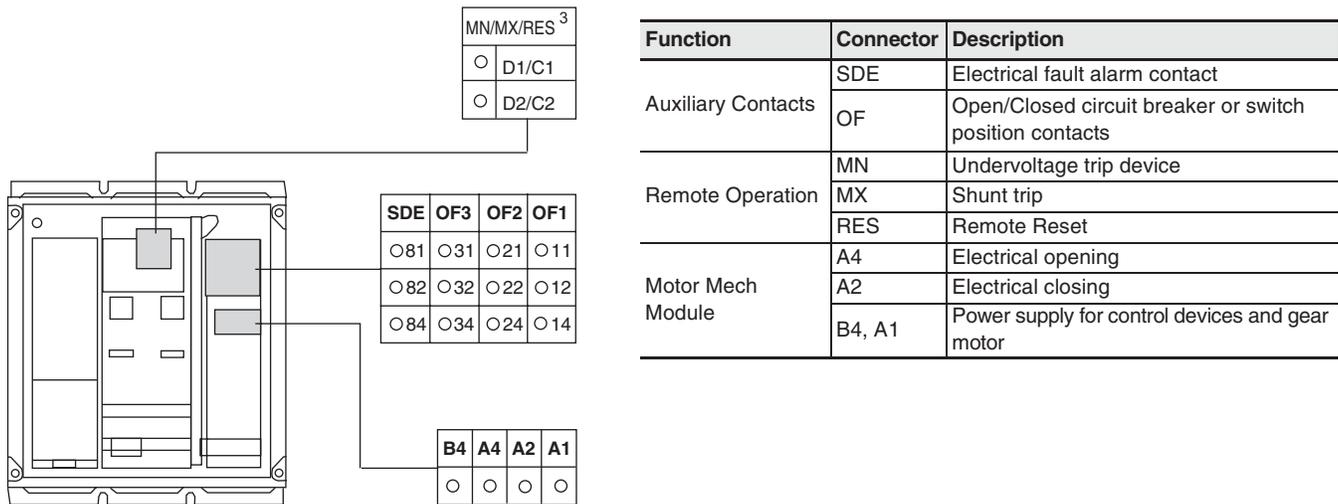
**Table 10: Standard Auxiliary Possibilities Based on Trip Unit**

Type	Auxiliary Possibilities
T-Frame	
U-Frame	

**NOTE:** All diagrams show circuit breaker in tripped position.

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

Figure 2: Accessory Control Wiring Diagrams for Electrically-Operated Circuit Breakers



<sup>1</sup> Remote Reset (RES), Undervoltage Trip (MN), and Shunt Trip (MX) cannot be used together in any combination.

## Accessory Connections

Electrical accessories are fitted with numbered terminal blocks for wires with the following maximum size:

- 16 AWG (1.5 mm<sup>2</sup>) for auxiliary switches (OF1 or OF2), and shunt trip (MX) or undervoltage trip (MN)
- 14 AWG (2.5 mm<sup>2</sup>) for the motor operator

Auxiliary switch wiring exits fixed mounted devices through a knock-out in the front cover.

## Auxiliary and Alarm Indication Contacts

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



Auxiliary Switch (OF)  
Alarm Switch (SD)



Overcurrent Trip  
Switch Actuator (SDE)

Table 11: Auxiliary and Alarm Indication Contacts

	<p><b>Open/Closed—Auxiliary Switches (OF)</b></p> <ul style="list-style-type: none"> <li>• Indicates the position of the circuit breaker contacts</li> </ul> <p><b>Trip Indication—Alarm Switch (SD)</b></p> <ul style="list-style-type: none"> <li>• Indicates that the circuit breaker has tripped due to an overload, short circuit, the operation of a shunt trip or undervoltage trip or the “push-to-trip” button</li> <li>• Resets when the circuit breaker is reset</li> </ul>
<b>Applications</b>	<p><b>Overcurrent Trip Switch (SDE)</b></p> <ul style="list-style-type: none"> <li>• Indicates that the circuit breaker has tripped due to an overload, short circuit or ground fault</li> <li>• Resets when the circuit breaker is reset</li> </ul> <p>The above 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><b>Rotary Handle Indicator: CAO (early-break) and CAF (early-make)</b></p> <ul style="list-style-type: none"> <li>• Fitted in the rotary handle module (see page 24)</li> </ul>
<b>Installation &amp; Connection</b>	<ul style="list-style-type: none"> <li>• The auxiliary switch (OF), alarm switch (SD), and overcurrent trip switch (SDE) indication contacts snap into cavities behind the front accessory cover of the circuit breaker.</li> <li>• One model serves for all indication functions depending on where it is fitted in the circuit breaker.</li> <li>• The overcurrent trip switch (SDE) in a circuit breaker equipped with a thermal-magnetic trip unit requires the SDE actuator.</li> </ul>
<b>Standards</b>	<ul style="list-style-type: none"> <li>• The internal accessories comply with requirements of Underwriters Laboratories® Inc. (UL®).</li> <li>• UL 489 and Canadian Standard Association C22.2 No. 5-02 Standards.</li> <li>• All internal accessories are Listed for field installation per UL file E103955 and Certified under CSA file LR 69561.</li> <li>• Auxiliary indicator contacts comply with UL 489, CSA C22.2 No. 5-02 and IEC 60947-5 Standards. “Low-level” indicator contacts are not UL Recognized.</li> </ul>

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

**Table 12: Electrical Characteristics**

Characteristic	Standard		Low-Level <sup>1</sup>	
Supplied as Standard (Form C)	4		4	
Maximum Number of Contacts	4		4	
Rated Thermal Current	6 A		5 A	
Maximum Load	100 mA at 24 V		1 mA at 4 V	
Operational Current	AC	DC	AC	DC
24 V	6 A	6 A	5 A	5 A
48 V	6 A	2.5 A	5 A	2.5 A
110 V	6 A	0.6 A	5 A	0.6
220/240 V	6 A	—	5 A	—
250 V	—	0.6 A	5 A	0.3 A
380/440 V	6 A	—	5 A	—
480 V	6 A	—	5 A	—
660/690 V	6 A	—	—	—

<sup>1</sup> 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.

**Table 13: Auxiliary Switch Catalog Numbers**

Contacts	Factory-Installed Suffix	Field-Installable Kit No.	Kit Qty.
1A/1B Standard	AA	S29450	1
2A/2B Standard	AB	S29450	2
3A/3B Standard <sup>1</sup>	AC	S29450	3
1A/1B Low-Level (Gold)	AE	S29452	1
2A/2B Low-Level (Gold)	AF	S29452	2
3A/3B Low-Level <sup>1</sup>	AG	S29452	3

<sup>1</sup> U-frame only.

**Table 14: Alarm/Overcurrent Trip Switch Catalog Numbers**

Suffix	Switch	Kit No.	Kit Qty.
PowerPact U-Frame			
BC	Alarm Switch	S29450	1
BH	Alarm Switch Low-Level	S29452	1
BD	Overcurrent Trip Switch Standard	S29450	1
BJ	Overcurrent Trip Switch Low-Level	S29452	1
BE	Alarm Switch and Overcurrent Trip Switch, Standard	S29450	2
BK	Alarm Switch and Overcurrent Trip Switch, Low-Level	S29452	2
PowerPact T-Frame			
BC	Alarm Switch	S29450	1
BH	Alarm Switch, Low-Level	S29452	1
BD	Overcurrent Trip Switch, Standard SDE Actuator	S29450 S29451	1 1
BJ	Overcurrent Trip Switch, Low-Level SDE Actuator	S29452 S29451	1 1
BE	Alarm Switch and Overcurrent Trip Switch, Standard SDE Actuators	S29450 S29451	2 1
BK	Alarm Switch and Overcurrent Trip Switch, Low-Level SDE Actuators	S29452 S29451	2 1

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



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

**Table 15: Shunt Trip and Undervoltage Trip**

<b>Applications</b>	<b>Shunt Trip (MX)</b>
	<ul style="list-style-type: none"> <li>Trips the circuit breaker when the control voltage rises above 70% of its rated voltage</li> <li>Impulse type <math>\geq 20</math> ms or maintained control signals</li> <li>AC shunt trips are suitable for ground-fault protection when combined with a Class I ground-fault sensing element</li> <li>Continuous duty rated coil</li> </ul>
	<b>Undervoltage Trip (MN)</b>
	<ul style="list-style-type: none"> <li>Trips the circuit breaker when the control voltage drops below a tripping threshold</li> <li>Drops out between 35% and 70% of the rated voltage</li> <li>Continuous duty rated coil</li> <li>Circuit breaker closing is possible only if the voltage exceeds 85% of the rated voltage. 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".</li> </ul>
<b>Installation and Connection</b>	<ul style="list-style-type: none"> <li>Accessories are common to T- and U-frame circuit breakers and snap into cavities under the front accessory cover of the circuit breaker</li> <li>Each terminal may be connected by one 18–14 AWG (1.0–2.5 mm<sup>2</sup>) stranded copper wire</li> </ul>
<b>Operation</b>	<ul style="list-style-type: none"> <li>The circuit breaker must be reset locally after being tripped by shunt trip (MX) or undervoltage trip (MN)</li> <li>Tripping by the shunt trip or undervoltage trip 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</li> <li>Endurance: 50% of the rated mechanical endurance of the circuit breaker</li> </ul>

**Table 16: Electrical Characteristics**

		AC	DC
Rated Voltage (V)		24, 48, 120, 208/277, 380/480, 525, 600	12, 24, 30, 48, 60, 125, 250
Power	Pickup (shunt trip)	< 10 VA	< 5 W
Requirements	Seal-in (undervoltage trip)	< 5 VA	< 5 W
Clearing Time (ms)		< 50	< 50

**Table 17: Shunt Trip and Undervoltage Trip Suffix Codes and Kit Numbers**

Voltage	Shunt Trip (MX)		Undervoltage Release (MN)
	Factory-Installed Suffix	Field-Installable Kit No.	Field-Installable Kit No.
24 Vac	—	S29384	S29404
48 Vac	—	S29385	S29405
120 Vac	SA	S29386	S29406
208/277 Vac	—	S29387	S29407
380/480 Vac	—	S29388	S29408
525/600 Vac	—	S29389	S29409
12 Vdc	—	S29382	S29402
24 Vdc	SO	S29390	S29410
30 Vdc	—	S29391	S29411
48 Vdc	SP	S29392	S29412
60 Vdc	—	S29383	S29403
125 Vdc	SR	S29393	S29413
250 Vdc	—	S29394	S29414

**Table 18: Adjustable and Fixed Time Delay Units for Undervoltage Trip**

Rated Voltage	Field-Installable Kit No.	
	Adjustable	Fixed
48 Vac/dc	S33680	S29426
100/130 Vac/dc	S33681	—
220/250 Vac/dc	S33682	S29427

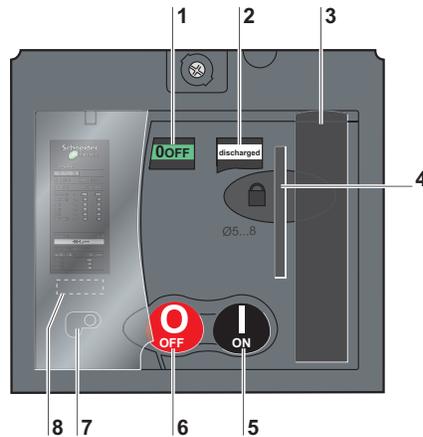
# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

## 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



1. Contact position indicator (suitability for isolation)
2. Spring status indicator (charged, discharged)
3. Manual spring-charging handle
4. Keylock device  
Locking device (off position) using one to three padlocks, diameter 0.2–0.32 in. (5–8 mm), not supplied
5. ON push button
6. OFF push button
7. Manual/auto mode selection switch; the position of the switch can be indicated remotely
8. Operation counter

### Applications:

- Local motor-driven operation, centralized operation, automatic distribution control

### Installation and Connection

- All installations are available for T-frame circuit breakers.  
All installations are available for U-frame circuit breakers
- Connections of the motor operator module are to a built-in terminal block behind its front cover
- Stranded copper wire 14 AWG (2.5 mm<sup>2</sup>)

### Automatic Operation

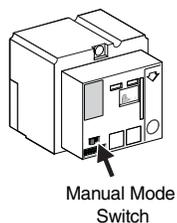
The motor operator is connected in series with the overcurrent trip switch (SDE).

- 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 overcurrent trip switch)

### Manual Operation

- 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
- Padlocking in off position

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries



**Table 19: Motor Operator Characteristics**

Response Time (ms)	Opening	< 600	
	Closing	< 80	
Operating Frequency	cycles/minute max.	4	
Power Requirements <sup>1</sup>	AC (VA)	Opening	≤500
		Closing	≤500
	DC (W)	Opening	≤500
		Closing	≤500

<sup>1</sup> For T-frame, the inrush current is 2x operating current for 10 ms.

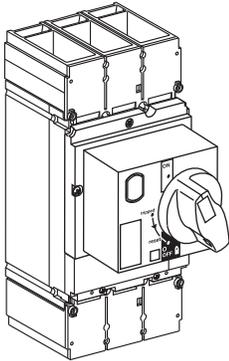
**Table 20: Motor Operator and Accessory Catalog Numbers**

Device	Control Voltage	Field-Installable Kit No.	
		T-Frame	U-Frame
Motor Operator	48/60 Vac 50/60 Hz	S31548	S432639
	110/130 Vac 50/60 Hz	S31540	S432640
	208/277 Vac 60 Hz	S31541	S432641
	380/415 Vac 50/60 Hz	—	S432642
	440/480 Vac 60 Hz	S31542	S432647
	24/30 Vdc	S31543	S432643
	48/60 Vdc	S31544	S432644
	110/130 Vdc	S31545	S432645
	250 Vdc	S31546	S432646
Lock Mounting Hardware	—	—	S32649
Ronis® Lock	—	S41940	S41940
Profalux® Lock	—	S42888	S42888
Mounting Hardware with Ronis Lock	—	S429449	—
Operations Counter	—	—	S32648

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

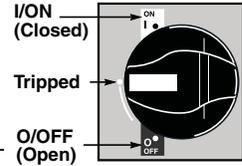
## Rotary Operating Handles

### Directly Mounted Rotary Operating Handles

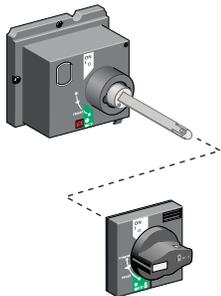


Directly Mounted Rotary Operating Handle

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



### Door-Mounted (Extended) Rotary Operating Handle



Door Mounted Rotary Operating Handle

<b>Installation</b>	<p>The door-mounted (extended) rotary operating handle is made up of:</p> <ul style="list-style-type: none"> <li>A unit that replaces the front accessory cover of the circuit breaker (secured by screws)</li> <li>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</li> <li>An adjustable extension shaft</li> <li>The handle mechanism can be used in NEMA 3R and 12 enclosure applications</li> </ul>
<b>Operation</b>	<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"> <li>Suitability for isolation</li> <li>Indication of the three positions OFF (O), ON (I) and tripped</li> <li>Visibility of and access to trip unit settings when the door is open</li> <li>Degree of protection: IP40 as per IEC 529</li> </ul> <p>Defeatable interlock prevents opening of door when circuit breaker is on</p> <p>The circuit breaker may be locked in the 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 enclosure door</p>
<b>Shaft Length</b>	<p>The shaft length is the distance between the back of the circuit breaker and the door:</p> <ul style="list-style-type: none"> <li>Minimum shaft length is 7.4 (185 mm)</li> <li>Maximum shaft length is 24 in. (600 mm)</li> <li>Extended shaft length must be adjusted</li> </ul>
<b>Models</b>	<ul style="list-style-type: none"> <li>Standard with black handle</li> <li>VDE type with red handle and yellow bezel for machine tool control</li> </ul>
<b>Variations</b>	For drawout configurations, the extended rotary handle is also available with a telescopic shaft containing two stable positions
<b>Standards</b>	The door-mounted rotary operating handle is UL Listed under file E103955 and CSA Certified under file LR 69561

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

**Table 21: Rotary Operated Handles**

Device		Description	T-Frame		U-Frame	
			Factory Installed Suffix	Field-Installable Kit No.	Factory Installed Suffix	Field-Installable Kit No.
Direct Mounted	Standard Handle Black	Handle only	RD10	S29337	RD10	S32597
	Standard Black Handle with	One early-break switch	—	S29337 + S29345	—	S32597 + S32605
		Two early-make switches	—	S29337 + S29346	—	S32597 + S29346
	Red handle on yellow bezel	Handle Only	—	S29339	—	S32599
		One early-break switch	—	S29339 + S29345	—	S32599 + S32605
		Two early-make switches	—	S29339 + S29346	—	S32599 + S29346
	MCC Conversion Accessory		—	S429341	—	S32606
	CNOMO Conversion Accessory		—	S29342	—	S32602
Door Mounted	Standard black handle	Handle Only	RE10	S29338	RE10	S32598
	Standard Black Handle with:	Two early make switches	—	S29338 + S29345	—	S32598 + S32605
	Red handle on yellow bezel	Handle Only	—	S29340	—	S32600
Telescoping		—	S29343	—	S32603	
Accessories	Key lock adapter		—	S429344	—	S32604
	Key locks	Ronis 1351.500	—	S41940	—	S41940
		Profalux KS5 B24 D4Z	—	S42888	—	S42888
		2 Ronis keylocks with 1 key	—	S41950	—	S41950
		2 Profalux keylocks with 1 key	—	S42878	—	S42878
	Indication Auxiliary Switch	One early-break switch	—	S29345	—	S32605
Two early-make switches		—	S29346	—	S29346	

## Class 9421 NEMA Door Mounted Rotary Operating Handles



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

## T-Frame Class 9421 Door-Mounted Operating Mechanism

Description	Catalog No.
Standard Shaft Kit	9421LJ1
Long Shaft Kit	9421LJ4

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

**Table 22: T-Frame Component Parts**

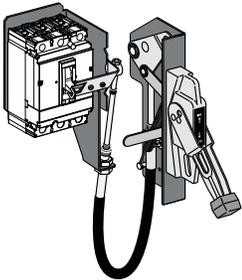
Description		Catalog No.
Standard Handle Assembly	Type 1, 3R, 12	9421LH6
	NEMA Type 3 and 4, Painted	9421LH46
	NEMA Type 3 and 4, Chrome Plated	9421LC46
Operating Mechanism	Includes Lockout	9421LJ7
Standard Shaft	Support Bracket Not Required	9421LS8
Long Shaft	Support Bracket Included	9421LS13

**Table 23: U-Frame NEMA Door-Mounted Rotary Operated Handles**

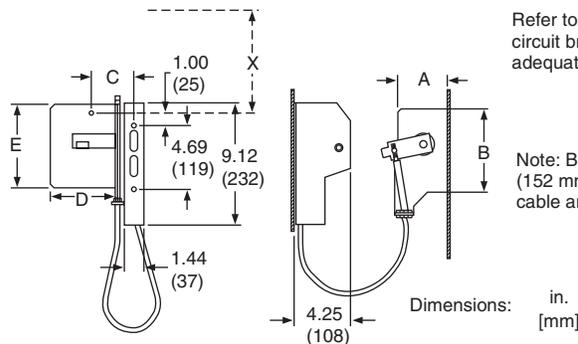
Handle Type	Poles	Operating Mechanism Included in Kit	Mounting Depth Min–Max	Kit Number
Painted 6 in.	3	9421LS8 and 9421LC46	7-1/4 to 12-1/16 in. (184 to 306 mm)	9421LD1
		9421LS13 and 9421LH46	7-1/4 to 22-5/8 in. (184 to 575 mm)	9421LD4

## Class 9422 Cable Operating Handle

Flange-mounted handle cable operating mechanism is for use with Class 9422 Type A handle operators especially designed for tall, deep enclosures where placement flexibility is required.



<b>Applications</b>	<ul style="list-style-type: none"> <li>The cable operator maintains:                             <ul style="list-style-type: none"> <li>Suitability for isolation</li> <li>Indication of three positions: O (OFF), I (ON) and tripped</li> <li>Access to push-to-test</li> </ul> </li> <li>The circuit breaker may be locked in the off position by one to three padlocks</li> <li>Door can be locked closed due to interlocking features of the handle operator</li> </ul>
<b>Installation</b>	<ul style="list-style-type: none"> <li>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</li> <li>Cable lengths available in 3-, 5- or 10-foot lengths to accommodate a variety of mounting locations</li> <li>Handles are available in painted NEMA 1, 3, 3R, 4 (sheet steel) and 12 ratings or chrome (NEMA 4, 4X)</li> </ul>



Refer to NEC Article 430-10 for minimum dimension X from circuit breaker top mounting hole to wall or barrier to ensure adequate wire bending space.

Note: Bend radius in cable must never be less than 6 in. (152 mm). Electrical clearances must be maintained between cable and live electrical parts.

**Table 24: Class 9422 Cable Operating Mechanisms and A1 Handles**

Description	T-Frame Kit Number	U-Frame Kit Number
Cable Mechanism Length	36 in. (914 mm)	9422CSF30
	60 in. (1524 mm)	9422CSF50
	84 in. (2134 mm)	9422CSF70
	120 in. (3048 mm)	9422CSF10
A1 painted flange handle	—	9422A1
Operating Mechanism Only	—	9422RSI

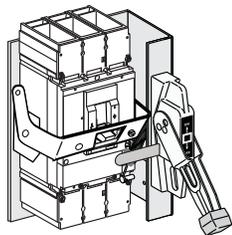
### Class 9422 Flange-Mounted Variable-Depth Operating Mechanism



Threaded-rod 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 on the job.
- T-frame variable mounting depth range: 5.88–17.75 in. (149–451 mm).
- T-frame operating mechanism 9422RQ1 does not include handle mechanism.



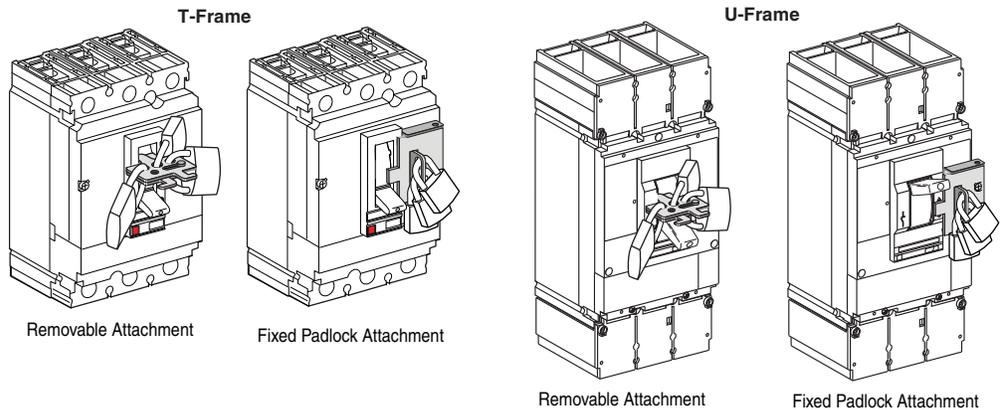
Designed for installation in custom-built control enclosures where main or branch circuit protective devices are required. All circuit breaker operating mechanisms are suitable for either right- or left-hand flange mounting, convertible in the field.

**Table 25: U-Frame Flange-Mounted Operating Mechanism**

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

### Locking Systems

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



**Table 26: Device Locking, Interlocking Options**

Device	Description	Field-Installed Cat. No.	
		T-Frame	U-Frame
Handle Padlocking Device <sup>1</sup>	Removable (lock OFF only)	S29370	S29370
	Fixed (lock OFF or ON)	S29371	S32631
	Fixed (lock OFF only)	S37422	NJPAF
Key Locking	Provision and 2 locks keyed alike	Ronis	S41950
		Profalux	S42878

<sup>1</sup> Rotary handles and motor operators have integral padlocking capability.

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

## Manual Mechanical Interlocking Systems

Some installations use two power supply sources to counter any temporary loss in the main supply. A mechanical interlocking system is required to safely switch between the two sources. The replacement source can be a generator set or another network.

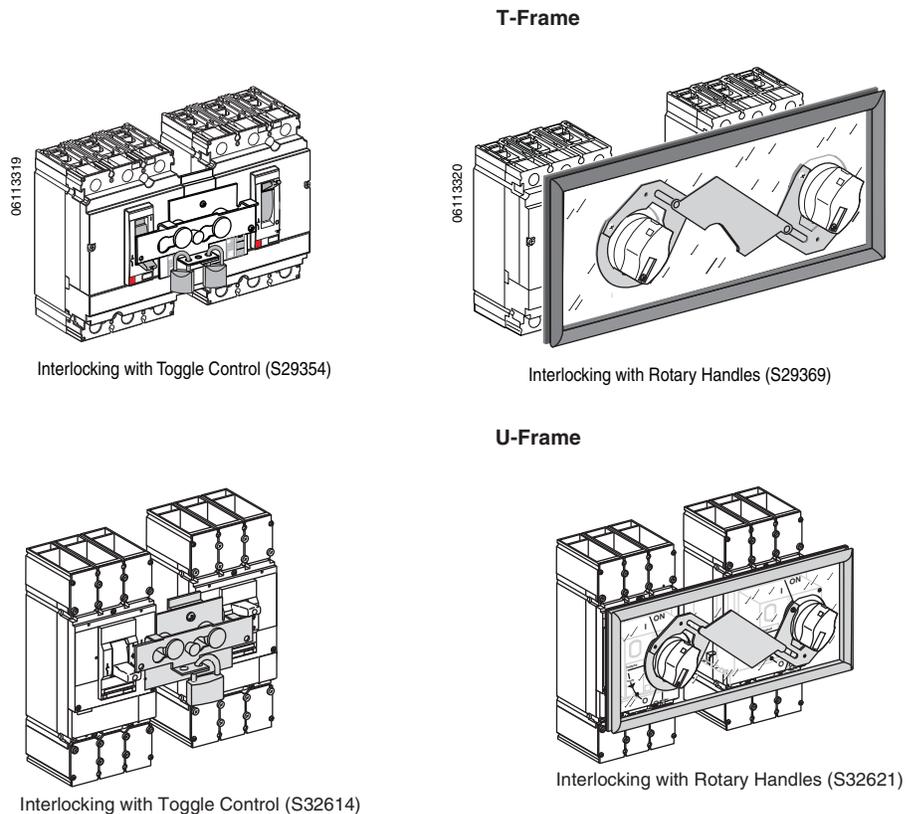
Managing multiple power sources can be controlled manually by mechanical interlocks.

The mechanical interlocking system is made up of:

- two T-, or U-frame devices (circuit breakers or switches) controlled manually
- mechanical interlocking, which prevents handle movement from the OFF position while the other device is in the ON position.

Since it is controlled manually by a maintenance technician, switchover time from the normal source to the replacement source can vary.

**Figure 3: Interlocking Systems**



# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

## Interlocking of Circuit Breakers With Toggle Control

Two devices can be interlocked using this system. Two identical interlocking systems can be used to interlock three devices installed side by side.

Authorized positions:

- one device closed (ON), the others open (OFF)
- all devices open (OFF)

The system is locked using one or two padlocks (shackle diameter 0.19–0.31 in. [5 to 8 mm]). This system can be expanded to more than three devices.

There are two interlocking-system models:

- one for PowerPact T-frame circuit breakers
- one for PowerPact U-frame circuit breakers

All toggle-controlled unit-mount PowerPact T- and U-frame circuit breakers and non-automatic switches of the same frame size can be interlocked. The devices must be either all unit-mount constructions.

The toggle interlock system can receive one or two padlocks with diameters of 0.19–0.31 in. (5–8 mm). Both interlocked circuit breakers must be unit-mount or both plug-in. 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 (I) position and the two others in the OFF (O) position. (Kit S29354.)

## Interlocking of Two Devices with Rotary Handles

Interlocking involves padlocking the rotary handles on two devices which may be either circuit breakers or non-automatic switches.

Authorized positions:

- one device closed (ON), the other open (OFF)
- both devices open (OFF).

The system is locked using up to three padlocks (shackle diameter 0.19–0.31 in. [5 to 8 mm]).

There are two interlocking-system models:

- one for PowerPact T-frame circuit breakers
- one for PowerPact U-frame circuit breakers

All rotary-handle unit-mount or plug-in PowerPact T- and U-frame circuit breakers and non-automatic switches of the same frame size can be interlocked. The devices must be either all unit-mount or all plug-in versions.

The rotary handles are padlocked with the devices in the OFF (I) position. The interlock mechanism inhibits the two devices from being closed (ON/I) at the same time, but allows for both devices to be open (OFF/O) simultaneously. (Kit S29369.)

**Table 27: Interlocking Accessories**

Accessory	Means	Kit Number	
		T-Frame	U-Frame
Interlocking (UL listed)	Mechanical for circuit breakers with rotary handles	S29369	S32621
	Mechanical for circuit breakers with toggles	S29354	S32614

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

## Interlocking Devices using Keylocks (Captive Keys)

Interlocking using keylocks makes it possible to interlock two or more devices that are physically distant or that have very different characteristics, for example medium-voltage and low-voltage devices or a PowerPact T- and U-frame circuit breaker and non-automatic switch.

Each device is equipped with an identical keylock and the key is captive on the closed (ON) device. A single key is available for all devices. It is necessary to first open (OFF position) the device with the key before the key can be withdrawn and used to close another device.

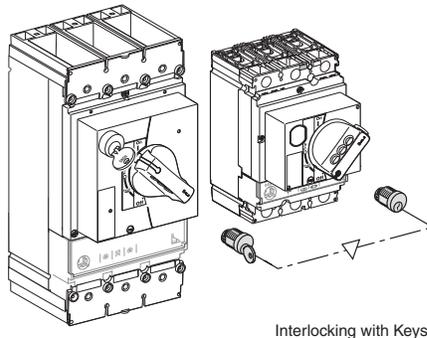
All rotary-handle PowerPact T- and U-frame circuit breakers and non-automatic switches can be interlocked between each other or with any other device equipped with the same type of keylock.

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 unit-mount or drawout, 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

See Table 21 for more information.



## Sealing Accessory

The sealing accessory kits 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

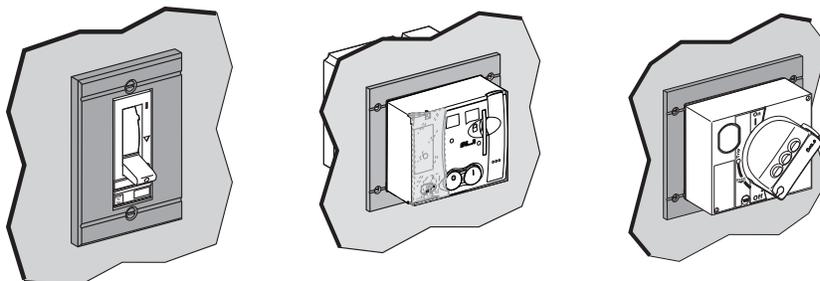
**Table 28: Sealing Accessory Kits**

Description	Kit No.	Qty.
Trip Unit Sealing Accessory Kit	MICROTUSEAL	6
Front Cover Screws Sealing Accessory Kit	S29375	6

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

## Front-Panel Escutcheons

- For unit-mount or plug-in installation.
- 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.

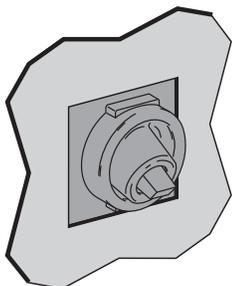


**Table 29: Front-Panel Escutcheons**

Description	Kit Number	
	T-Frame	U-Frame
Front Panel Escutcheon for Toggle Circuit Breakers	S29315	32556
Front Panel Escutcheon for Rotary Handle, Motor Operator or Extended Escutcheon	S29317	S32558

## Toggle Boot

- NEMA 1, 2, 3, 3R protection
- Fits on front of circuit breaker

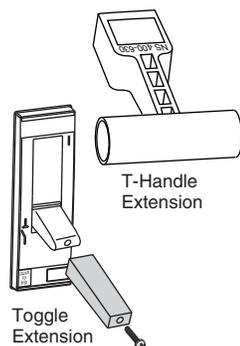


**Table 30: Toggle Boot**

Description	Kit Number	
	T-Frame	U-Frame
Toggle Boot	S29319	S32560

## Handle Extension

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



**Table 31: Handle Extensions**

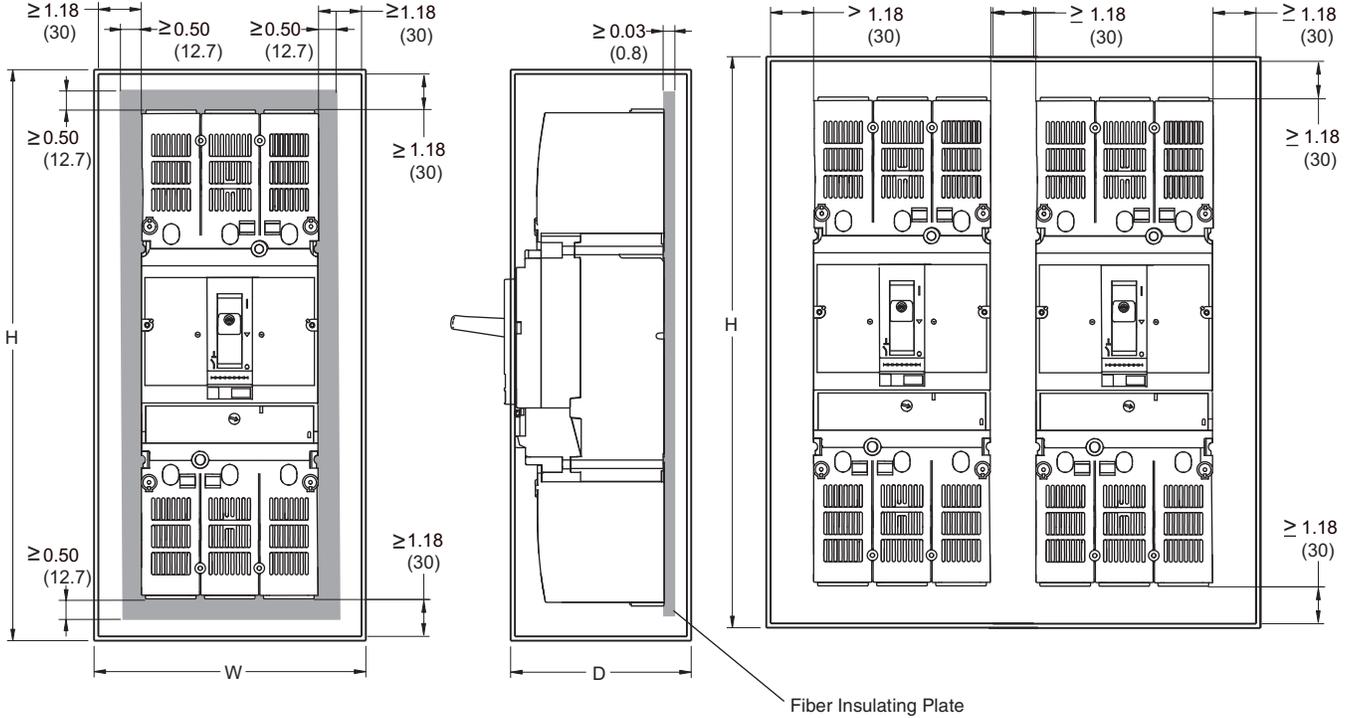
Description	Qty.	Kit Number	
		T-Frame	U-Frame
T-Handle Extension (Temporary)	1	—	32595
Toggle Extension (Fixed)	5	S29313	S432553

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

## Circuit Breaker Enclosure Dimensions

Figure 4: T-Frame Enclosure Requirements

Minimum Enclosure Clearances Between Circuit Breaker and Grounded Metal



Minimum Enclosure Dimensions for Thermal Requirements

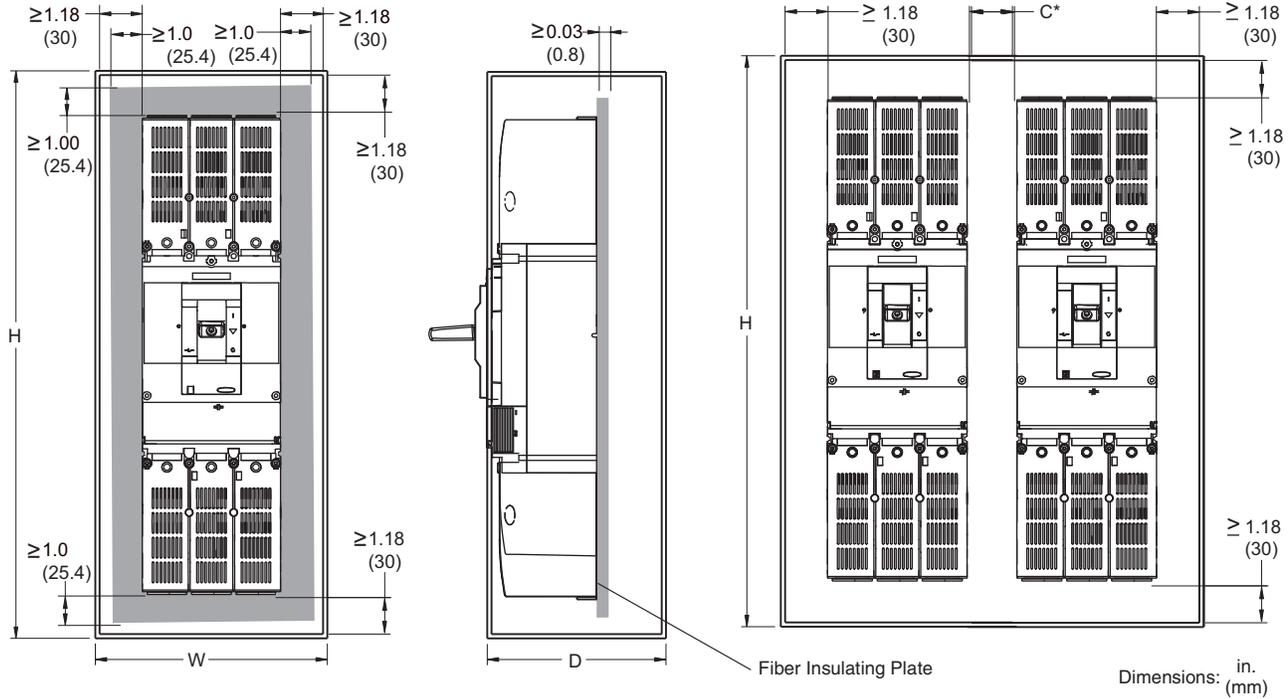
Amperage	Enclosure Dimensions (h x w x d)
50–200 A	40.5 x 13.78 x 4.33 in. (1030 x 350 x 110 mm)

Dimensions in. (mm)

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Accessories and Auxiliaries

**Figure 5: U-Frame Enclosure Requirements**

Minimum Enclosure Clearances Between Circuit Breaker and Grounded Metal

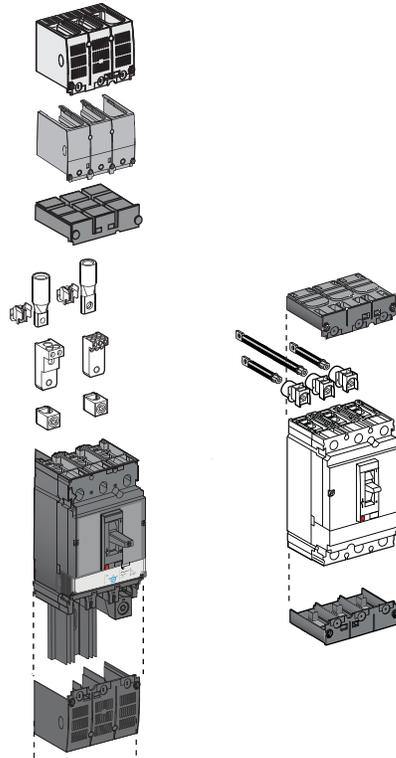


Minimum Enclosure Dimensions for Thermal Requirements

Amperage	Enclosure Dimensions (h x w x d)
225–500 A	40.5 x 13.75 x 4.33 in. (1030 x 350 x 110 mm)

\* C ≥ 1.18 in (30 mm) for 600 Vdc applications  
C ≥ 2.00 in (50.8 mm) for 1000 Vdc applications.

## Section 6—Circuit Breaker Mounting and Connections



### Mounting Configurations

The PowerPact™ T- and U-frame circuit breakers are available in a variety of configurations.

**Table 32: Mounting Options**

Termination Letter	Poles	Options Code Suffix																										
F = Bus Bar L = Lugs on Both Ends S = Rear Connection	3 Pole 4 Pole	For factory-installed terminations, place termination letter in the third block of the circuit breaker catalog number.  <div style="text-align: center;"> <table border="0"> <tr> <td style="border: 1px solid black; padding: 2px;">T</td> <td style="border: 1px solid black; padding: 2px;">B</td> <td style="border: 1px solid black; padding: 2px;">L</td> <td style="border: 1px solid black; padding: 2px;">4</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">5</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">K</td> <td style="border: 1px solid black; padding: 2px;">A</td> <td style="border: 1px solid black; padding: 2px;">B</td> <td style="border: 1px solid black; padding: 2px;">S</td> <td style="border: 1px solid black; padding: 2px;">P</td> </tr> <tr> <td colspan="8" style="text-align: center;">└─ Termination No.</td> <td colspan="5" style="text-align: center;">└─ Options Code</td> </tr> </table> </div>	T	B	L	4	1	1	5	0	K	A	B	S	P	└─ Termination No.								└─ Options Code				
T	B	L	4	1	1	5	0	K	A	B	S	P																
└─ Termination No.								└─ Options Code																				

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

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## Circuit Breaker Mounting and Connections

### Unit-Mount Circuit Breakers

The standard lugs can be removed for the installation of compression-type lugs or bus connections. All lugs are UL Listed/CSA Certified for their proper application and marked for use with aluminum and copper (Al/Cu) or copper only (Cu) conductors. Lugs suitable for copper and aluminum conductors are made of tin-plated aluminum.

### Mounting

T- and U-frame circuit breakers may be mounted vertically, horizontally or flat on their back without any rerating of characteristics.

Unit-mount T-frame circuit breakers are supplied with two mounting screws, unit-mount U-frame circuit breakers are supplied with four mounting screws. These mounting screws are inserted through mounting holes molded into the circuit breaker case and threaded into the mounting enclosure, rails or through the panel door for flush mounting.

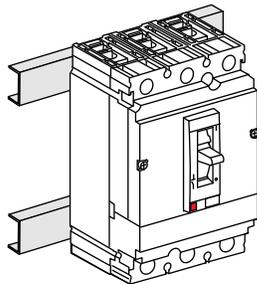
A DIN rail mounting bracket (catalog no. S29305) is available for the T-frame circuit breakers.

**NOTE:** DIN rail mounting is not compatible with motor operated applications.

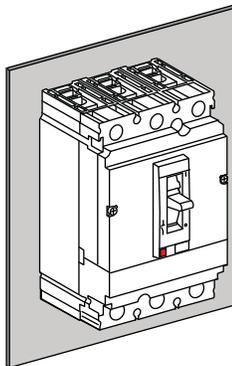
**Figure 6: Unit-Mounting Options**

#### T-Frame Circuit Breakers (2 Mounting Screws)

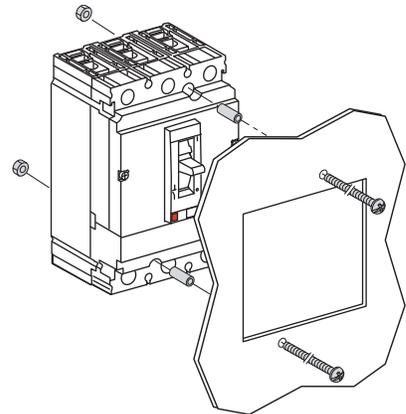
Mounting on Rails



Mounting on Backplate

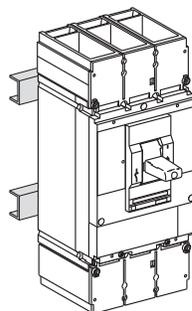


Flush Mounting

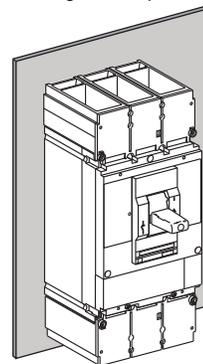


#### U-Frame Circuit Breakers (4 Mounting Screws)

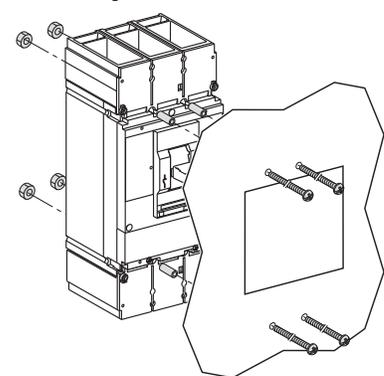
Mounting on Rails



Mounting on Backplate



Flush Mounting



# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## Circuit Breaker Mounting and Connections

Figure 7: Terminal Cover Types

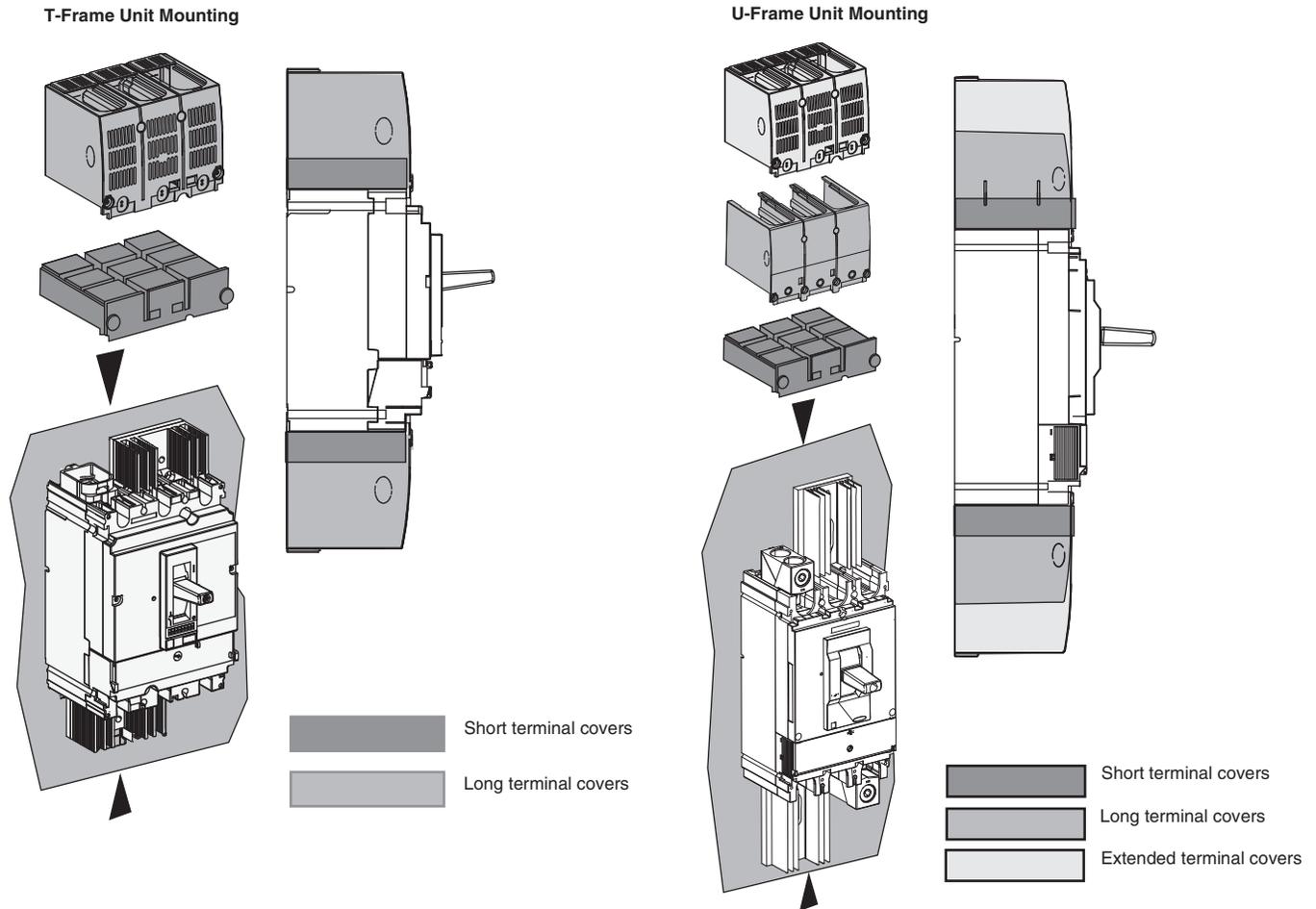


Table 33: Terminal Covers (Lugs and Bus Connections)<sup>1</sup>

Frame	Description	Poles	Configuration				Field-Installable Cat. No.
			Ungrounded		Grounded		
			Top	Bottom	Top	Bottom	
T-Frame	Long Terminal Cover (3P)	3	X	—	—	—	S35175
	Long Terminal Cover (3P/1SC)	3	—	X	X	X	S35176
	Long Terminal Cover (4P)	4	—	X	—	—	S35177
	Long Terminal Cover (4P/2SC)	4	X	—	X	—	S35178
	Long Terminal Cover (4P/1SC)	4	—	—	—	X	S35179
U-Frame	Long Terminal Cover (3P)	3	X	—	—	—	S32593
	Extended Terminal Cover (3P/1SC)	3	—	X	X	X	S38291
	Long Terminal Cover (4P)	4	—	X	—	—	S32594
	Extended Terminal Cover (4P/2SC)	4	X	—	X	—	S38293
	Extended Terminal Cover (4P/1SC)	4	—	—	—	X	S38294

<sup>1</sup> Parts included as standard in all circuit breaker and switch configurations.

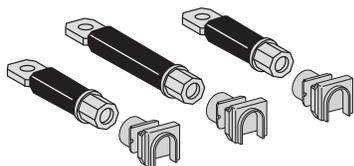
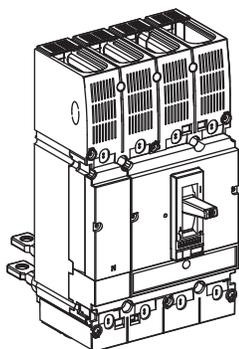
# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## Circuit Breaker Mounting and Connections

### Connection

#### 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 34: Rear Connections**

Circuit Breaker	Description <sup>2</sup>	Poles	Configuration <sup>1</sup>				Field-Installable Cat. No.
			Ungrounded		Grounded		
			Top	Bottom	Top	Bottom	
T-Frame	Short Terminal Cover (3P)	3	X	—	—	—	S29515
	Long Terminal Cover (3P/1SC)	3	—	X	X	X	S35169
	Short Terminal Cover (4P)	4	—	X	—	—	S29516
	Long Terminal Cover (4P/1SC)	4	—	—	—	X	S36170
	Long Terminal Cover (4P/2SC)	4	X	—	X	—	S35178
	Short Rear Connector (Set of 2) <sup>3</sup>	3, 4		X		X	S29235
	Long Rear Connector (Set of 2) <sup>3</sup>	3, 4		X		—	S29236
U-Frame	Short Terminal Cover (3P)	3	X	—	—	—	S32562
	Extended Terminal Cover (3P/1SC)	3	—	X	X	X	S35171
	Short Terminal Cover (4P)	4	—	X	—	—	S32563
	Extended Terminal Cover (4P/1SC)	4	—	—	—	X	S35172
	Extended Terminal Cover (4P/2SC)	4	X	—	X	—	S38293
	Short Rear Connector (Set of 2) <sup>3, 4</sup>	3, 4		X		X	S432475
Long Rear Connector (Set of 2) <sup>3, 4</sup>	3, 4		X		—	S432476	

<sup>1</sup> Parts included with circuit breaker or switch if rear connection configuration is selected.

<sup>2</sup> P: Poles; SC: Serial Connector

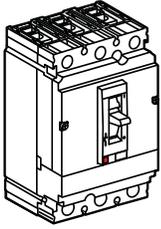
<sup>3</sup> The ungrounded configurations (3P or 4P) need 2 short and 2 long rear connectors. The grounded configurations only use 2 short rear connections.

<sup>4</sup> For U-frame kits, no hardware is included. See Table 35.

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## Circuit Breaker Mounting and Connections

### Mechanical Lugs



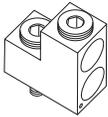
Unit-mount T- and U-frame circuit breakers can be ordered with mechanical line and load side lugs. The standard lugs can be removed for the installation of compression-type lugs or bus connections. All lugs are UL Listed/CSA Certified for their proper application and marked for use with aluminum and copper (Al/Cu) or copper only (Cu) conductors. Lugs suitable for copper and aluminum conductors are made of tin-plated aluminum. Lugs suitable for use with copper conductors only are made of copper.

Mechanical Lugs for the T-frame circuit breakers lay on top of the circuit breaker terminals and can be installed without the use of any tools. The lugs are held in place with snap features built into the insulating retainer and are secured with the clamp force applied to the wire binding screw.

Mechanical lugs are sold either factory installed or as field installable kits.

**Table 35: Mechanical Lug Kits for T- and U-Frame Circuit Breakers**

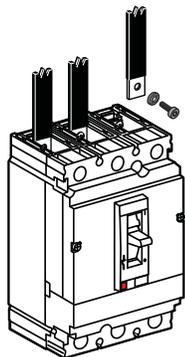
Frame	Lug Catalog Number	Rating	Conductor			Lugs per Kit
			Type	Number per Lug	Size	
T-Frame	S35167	50–60 A	Al	1	#12–#4 AWG (4–25 mm <sup>2</sup> )	2
			Cu	1	#14–#4 AWG (2.5–25 mm <sup>2</sup> )	
	S29255	70–150 A	Al/Cu	1	#4–#4/0 AWG (25–95 mm <sup>2</sup> )	2
	S35168	175–200 A	Al	1	250–350 kcmil (120–185 mm <sup>2</sup> )	2
Cu			1	2/0–350 AWG (70–185 mm <sup>2</sup> )		
U-Frame	S35180	225–500 A	Al	2	2/0 AWG–500 kcmil (70–240 mm <sup>2</sup> )	2
			Cu	2	2/0 AWG–500 kcmil (70–240 mm <sup>2</sup> )	



S35180

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Circuit Breaker Mounting and Connections

## Bus-Bar Connections



The T- and U-frame circuit breakers may be equipped with captive nuts and screws for direct connection to bars or to compression (crimp) lugs

For T-frame, these are readily field-installable, simply by removing the mechanical lug and replacing with the appropriate terminal nut inset described in Table 36. They are also available factory-installed, using the Product Selector or by using the catalog suffixes below.

For U-frame, the mechanical lug can be removed, leaving the threaded nut insert intact. This configuration may be ordered with the suffixes described below. Connection hardware (terminal screws) must be ordered as in table 36.

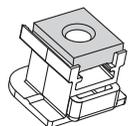
**Table 36: Factory-Installed Terminal Nut Inserts for Bus or Crimp Lug Connection**

Cat. No. Termination (Position 4)	Description
F	Terminal nut insert in all open connections not used to connect the serial connectors included with the products.

**Table 37: Terminal Nuts for Bus Bar Connection of T-Frame Circuit Breakers**

Description <sup>1</sup>	Tap	Cat. No.	Qty Per Kit	Torque
T-Frame Terminal Nut Insert–Metric	M8	S30554	2	130 lb-in (15 N•m)

<sup>1</sup> Screws not included.

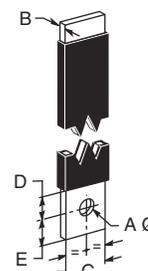


Terminal Nut Insert (T-Frame Only)



**Table 38: Bar Dimensions**

Dimension	T-Frame	U-Frame
A	0.314 in. (8 mm)	≥ 0.39 in. (≥ 10 mm)
B	0.126–0.374 in. (3.2–9.5 mm)	0.12–0.39 in. (3–10 mm)
C	0.50–0.75 in. (12.7–1.1 mm)	≤ 1.26 in. (≤ 32 mm)
D	0.625 in. (15.9 mm)	0.12–0.39 in. (3–10 mm)
E	0.374 in. (9.5 mm)	≤ 0.59 in. (≤ 15 mm)



**Table 39: U-Frame Bus Bar Connections Hardware**

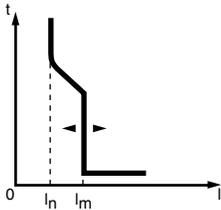
Description	Cat. No.
Set of 4 M10 x 25 terminal screws and washers.	S36967

## Section 7—Installation Recommendations

### Operating Conditions

#### Temperature Rerating

- PowerPact™ T- and U-frame circuit breakers and switches may be used between -13°F and 158°F (-25 °C and +70 °C). For temperatures higher than 122° F (50° C°) inside the enclosure, devices must be rerated.
- Circuit breakers and switches should be put into service under normal ambient, operating-temperature conditions.
- The permissible storage-temperature range for PowerPact T- and U-frame circuit breakers switches in the original packing is -58°F and 185°F (-50°C and +85°C).



#### T-Frame Trip Unit

- ( $I_n$ ) Fixed threshold thermal protection against overload
- ( $I_m$ ) Adjustable instantaneous protection against short circuits

**Table 40: Temperature Rerating for T- and U-Frame Trip Unit Thermal Protection**

Maximum Ambient Temperature											
°F	158	140	122	104	86	68	50	32	14	-4	-13
°C	70	60	50	40	30	20	10	0	-10	-20	-25
Current Rerating Factor	0.64	0.84	1.00	1.14	1.26	1.37	1.48	1.57	1.66	1.75	1.79

#### Altitude Rerating

Altitude does not significantly affect the characteristics of PowerPact T- and U-frame devices up to 6560 ft (2000 m). Above this altitude, it is necessary to take into account the decrease in the dielectric strength and cooling capacity of air.

The following table gives the corrections to be applied for altitudes above 6560 ft (2000 m). The breaking capacities remain unchanged.

**Table 41: Altitude Rerating**

Altitude (m)	2000	3000	4000	5000
Impulse Withstand Voltage $U_{imp}$ (kV)	8	7.1	6.4	5.6
Rated Insulation Voltage ( $U_i$ )	1000	900	800	700
Maximum Rated Operational DC Voltage	1000	900	800	700
Rated Current	1 x $I_n$	0.96 x $I_n$	0.93 x $I_n$	0.90 x $I_n$

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Installation Recommendations

## Installation in Equipment

Follow installation instructions shipped with the product and also available on the Schneider Electric website.

## Weight

The table below presents the weights of the circuit breakers and the main accessories, which must be summed to obtain the total weight. The values are valid for all performance categories.

**Table 42: Weights**

Type of Device		Circuit Breakers <sup>1</sup>	Motor Operator	Circuit Breaker with Copper Field Installed
T-frame, 250 A	3P (UNG)	5.0 lb (2.3 kg)	2.65 lb (1.2 kg)	—
	4P (UNG)	6.3 lb (2.8 kg)	2.65 lb (1.2 kg)	—
U-frame, 500 A	3P (UNG)	15 lb (6.8 kg)	6.17 lb (2.8 kg)	—
	4P (UNG)	21 lb (9.5 kg)	6.17 lb (2.8 kg)	—

<sup>1</sup> Weight includes serial connectors, terminal covers and lugs shipped with the products.

## Safety Clearances and Minimum Distances

When installing a circuit breaker, minimum distances (safety clearances) must be maintained between the device and panels, bars or other metal installed nearby (see “T-Frame Enclosure Requirements” on page 32 and “U-Frame Enclosure Requirements” on page 33). These distances, which depend on the voltage, are defined by tests carried out in accordance with UL standards.

## Control Wiring

### Remote Tripping by Undervoltage Trip (MN) or Shunt Trip (MX)

Power requirements are approximately:

- for pick-up of the undervoltage trip (MN) and shunt trip (MX):
  - T-frame: 30 VA
  - U-frame: 30 VA
- for the motor operator:
  - T-frame: 300–500 VA
  - U-frame: 300–500 VA

**Table 43: Recommended Maximum Cable Lengths<sup>1</sup>**

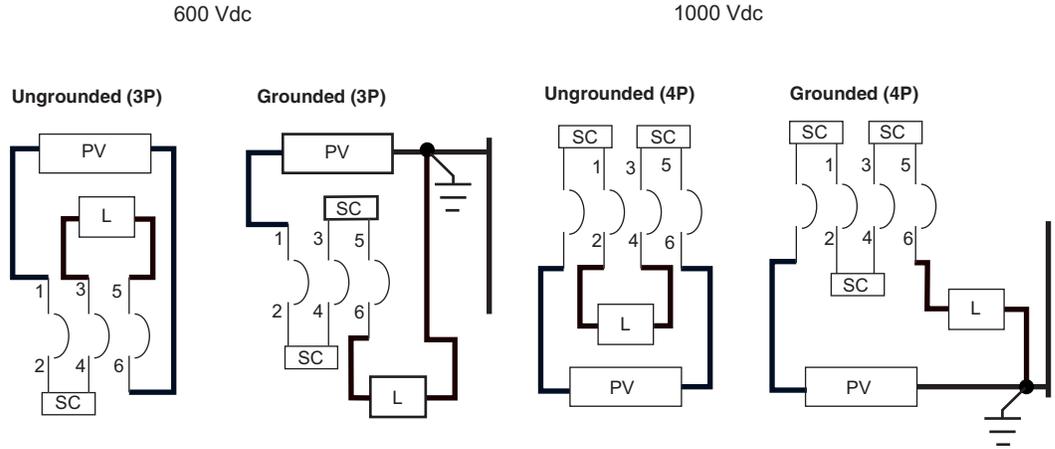
Power Supply Voltage (Vdc)		12 Vdc		24 Vdc		48 Vdc	
Cable cross-section		16 AWG (1.5 mm <sup>2</sup> )	14 AWG (2.5mm <sup>2</sup> )	16 AWG (1.5 mm <sup>2</sup> )	14 AWG (2.5 mm <sup>2</sup> )	16 AWG (1.5 mm <sup>2</sup> )	14 AWG (2.5mm <sup>2</sup> )
Undervoltage Trip (MN)	V source 100%	49 ft (15 m)	—	525 ft (160 m)	—	2100 ft (640 m)	—
	V source 85%	23 ft (7 m)	—	131 ft (40 m)	—	525 ft (160 m)	—
Shunt Trip (MX)	V source 100%	197 ft (60 m)	—	787 ft (240 m)	—	3150 ft (960 m)	—
	V source 85%	98 ft (30 m)	—	394 ft (120 m)	—	1575 ft (480 m)	—
Motor Operator	V source 100%	—	—	33 ft (10 m)	52.5 (16 m)	213 ft (65 m)	361 ft (110 m)
	V source 85%	—	—	6.6 ft (2 m)	13.1 (4 m)	56 ft (17 m)	82 ft (25 m)

<sup>1</sup> The indicated length is that of each of the two wires.

## Section 8—Wiring Diagrams

### Certified Wiring Configurations

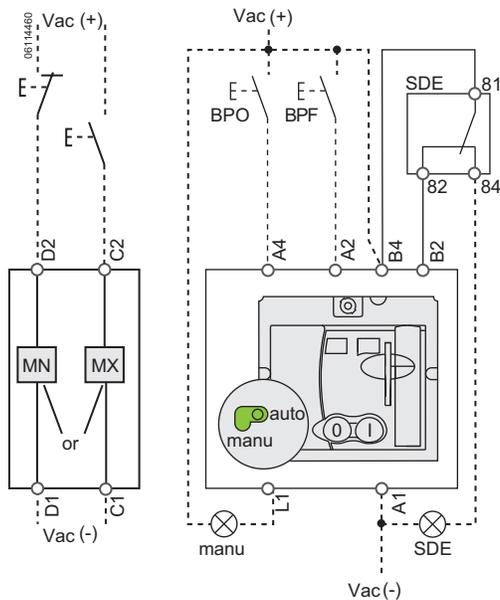
Figure 8: T-, U-Frame Wiring



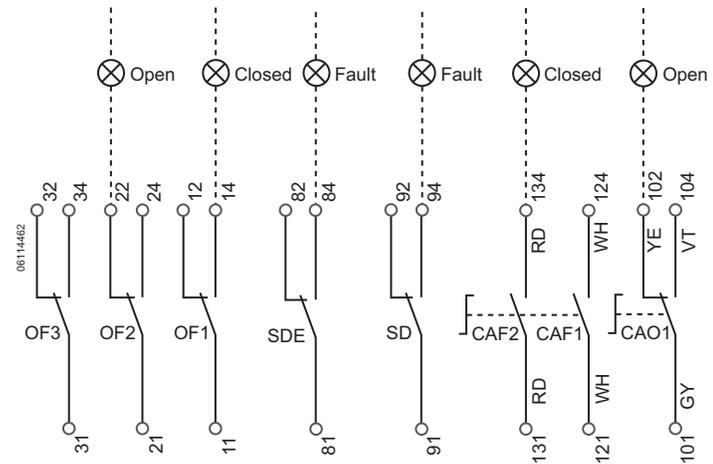
# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Wiring Diagrams

## Unit-Mount Circuit Breakers

### Remote Operation



### Indication Contacts



The diagram is shown with circuits de-energized, relays in normal position, and all devices open, connected, and charged.

Terminal connections shown as O must be connected by the customer.

### Color Code for Auxiliary Wiring

RD: Red	VI: Violet
WH: White	GY: Gray
YE: Yellow	OR: Orange
BK: Black	BL: Blue
GN: Green	

### Remote Operation

<b>MN</b>	Undervoltage Release
or	
<b>MX</b>	Shunt Release

### Motor Operator

<b>A4</b>	Opening Order
<b>A2</b>	Closing Order
<b>B4, A1</b>	Power Supply to Motor Operator
<b>L1</b>	Manual Position (manu)
<b>B2</b>	Overcurrent Trip Switch Interlocking (mandatory for correct operation)
<b>BPO</b>	Opening Pushbutton
<b>BPF</b>	Closing Pushbutton

### Indication Contacts

<b>OF2/OF1</b>	Device ON/OFF Auxiliary Switches
<b>OF3</b>	Device ON/OFF Auxiliary Switches (U-Frame)
<b>SDE</b>	Overcurrent Trip Switch (short-circuit, overload, ground fault, earth leakage)
<b>SD</b>	Alarm Switch
<b>CAF2/CAF1</b>	Early-Make Contact (rotary handle only)
<b>CAO1</b>	Early-Break Contact (rotary handle only)

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Wiring Diagrams

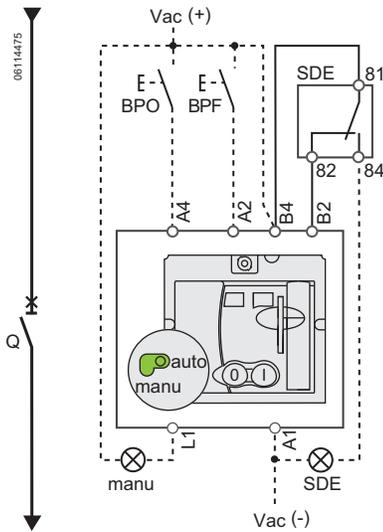
## Motor Operator

**NOTE:** The diagram is shown with circuits de-energized, relays in normal position, and all devices open, connected, and charged.

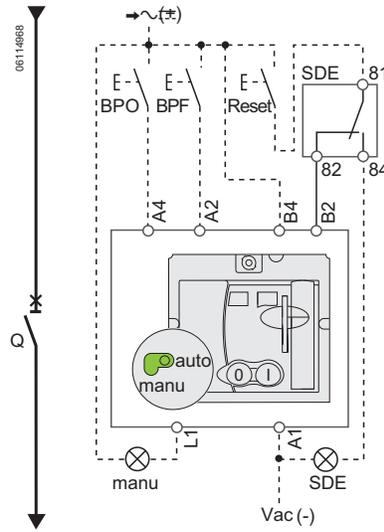
After tripping initiated by the “Push to trip” button, the undervoltage release (MN), or the shunt release (MX), device can be reset automatically, remotely, or manually.

Following tripping due to an electrical fault, reset must be carried out manually.

**Motor Operator with Automatic Reset**



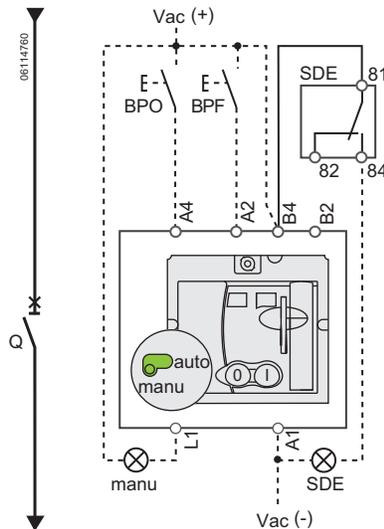
**Motor Operator with Remote Reset**



**Symbols**

- Q: Circuit Breaker
- A4: Opening Order
- A2: Closing Order
- B4, A1: Motor Operator Power Supply
- L1: Manual Position (manu)
- B2: Overcurrent Trip Switch Interlocking (mandatory for correct operation)
- BPO: Opening Pushbutton
- BPF: Closing Pushbutton
- SDE: Fault-Trip Indication Contact (short-circuit, overload, ground fault, earth leakage)

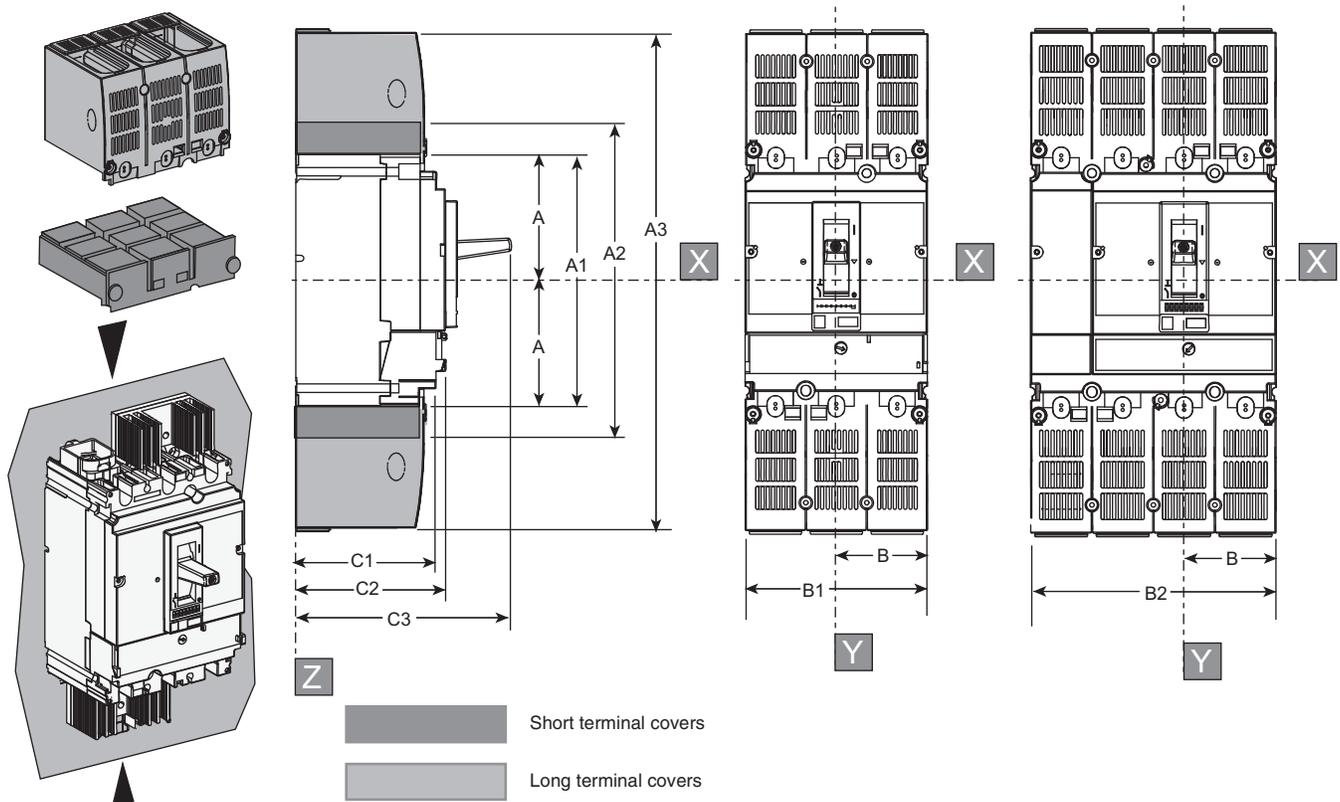
**Motor Operator with Manual Reset**



## Section 9—Dimensions

### PowerPact T-Frame Circuit Breaker

Figure 9: PowerPact T-Frame Circuit Breaker Dimensions



**Dimensions**

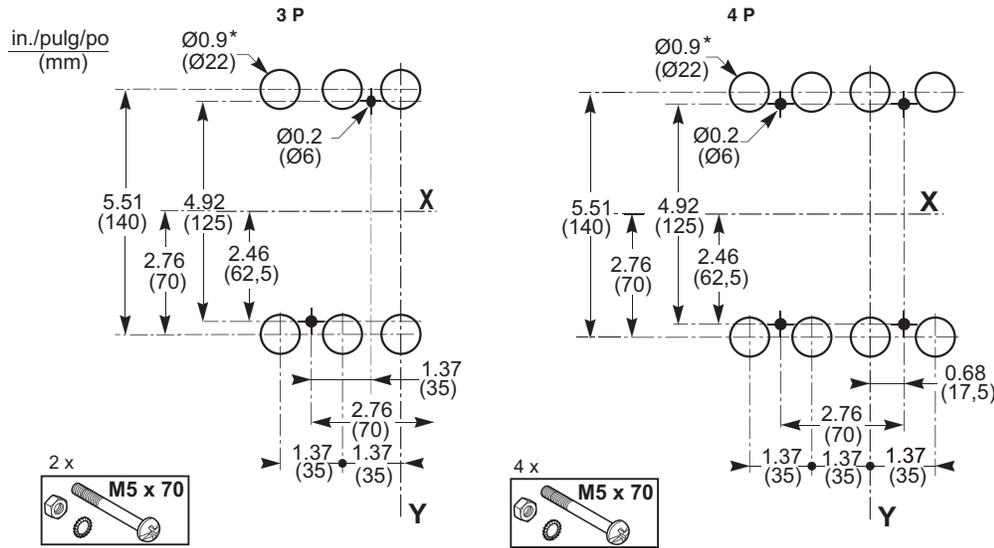
	A	A1	A2	A3	B	B1	B2	C1	C2	C3
in.	3.17	6.34	7.40	11.42	20.67	4.13	5.51	3.19	3.39	4.96
mm	80,5	161	188	290	525	105	140	81	86	126

**Terminal Cover Configuration According to Wiring Configuration**

Wiring Configuration	Connection Type		Terminal Cover Configuration	
	Unit Mount/Bus	Rear Connected	Top	Bottom
3P Ungrounded	X	—	Long	Long
	—	X	Short	Long
3P Grounded	X	X	Long	Long
4P Ungrounded	X	—	Long	Long
	—	X	Long	Short
4P Grounded	X	X	Long	Long

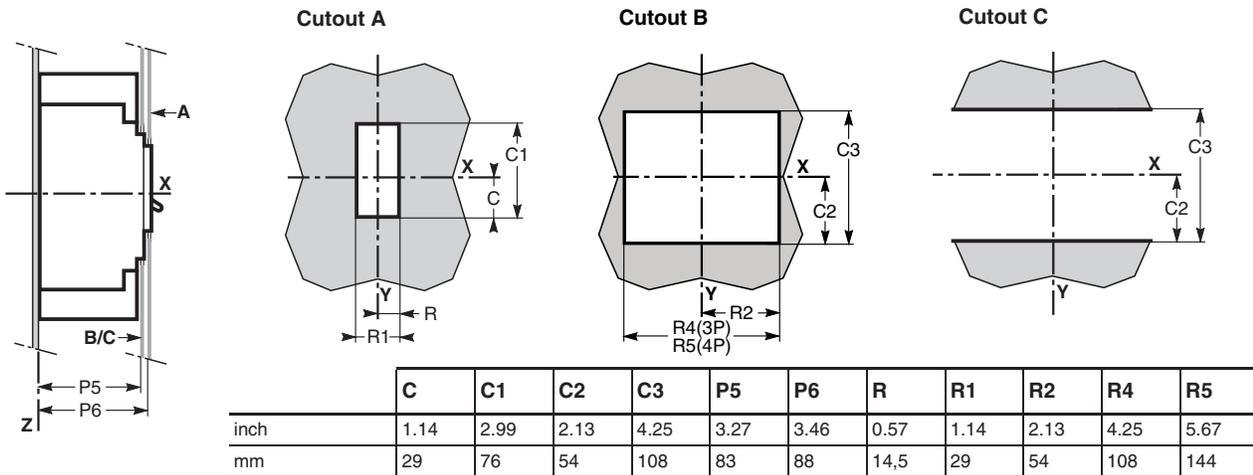
# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Dimensions

Figure 10: PowerPact T-Frame Mounting Holes



\* For rear-connected circuit breakers, punch rear wire holes according to wiring requirements.

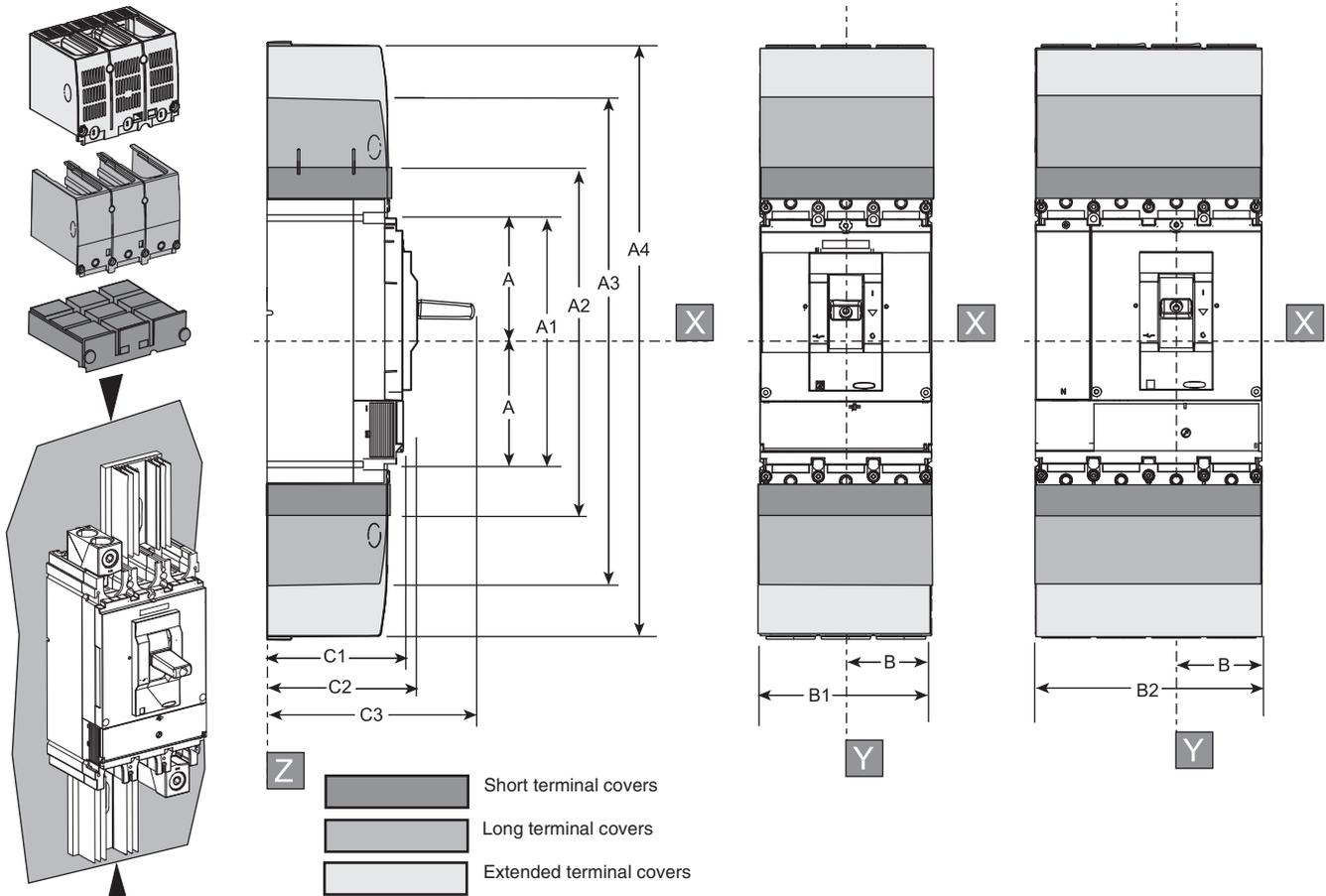
Figure 11: PowerPact T-Frame Fixed Circuit Breaker Panel Cutouts



# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Dimensions

## PowerPact U-Frame Circuit Breaker

Figure 12: PowerPact U-Frame Circuit Breaker Dimensions



Dimensions

	A	A1	A2	A3	A4	B	B1	B2	C1	C2	C3
in.	5.0	10.0	11.2	15.7	19.1	2.8	5.5	7.2	3.8	4.3	6.6
mm	127,5	255	285	400	484	70	140	183	95,5	110	168

### Terminal Cover Configuration According to Wiring Configuration

Wiring Configuration	Connection Type		Terminal Cover Configuration	
	Unit Mount/Bus	Rear Connected	Top	Bottom
3P Ungrounded	X		Long	Extended
		X	Short	
3P Grounded	X	X	Extended	Long
4P Ungrounded	X			Short
4P Grounded	X	X		Extended

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Dimensions

Figure 13: PowerPact U-Frame Mounting Holes

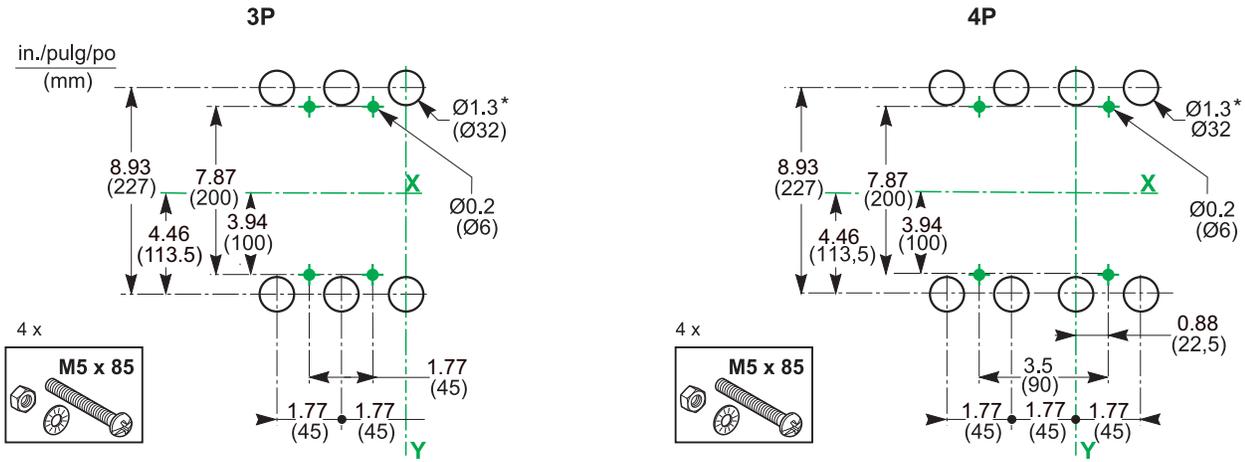
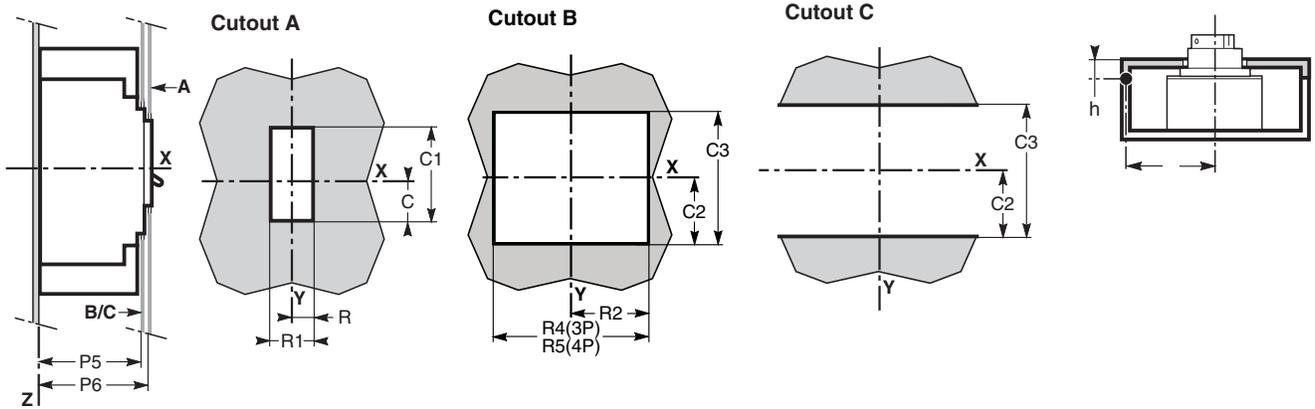


Figure 14: PowerPact U-Frame Fixed Circuit Breaker Panel Cutouts

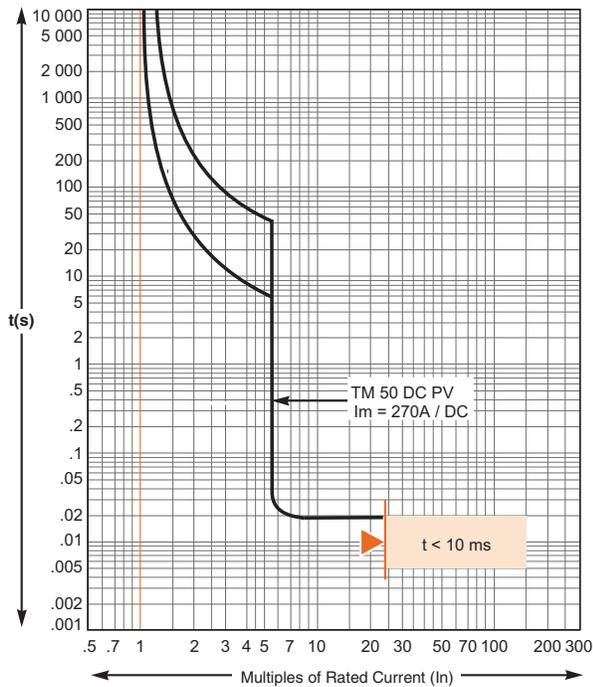


	C	C1	C2	C3	P5	P6	R	R1	R2	R4	R5	Δ
inch	1.63	4.56	3.64	7.24	4.21	4.40	1.24	2.48	2.81	5.62	7.40	3.93 + (5 x h)
mm	41,5	116	92,5	184	107	112	31,5	63	71,5	143	188	100 + (5 x h)

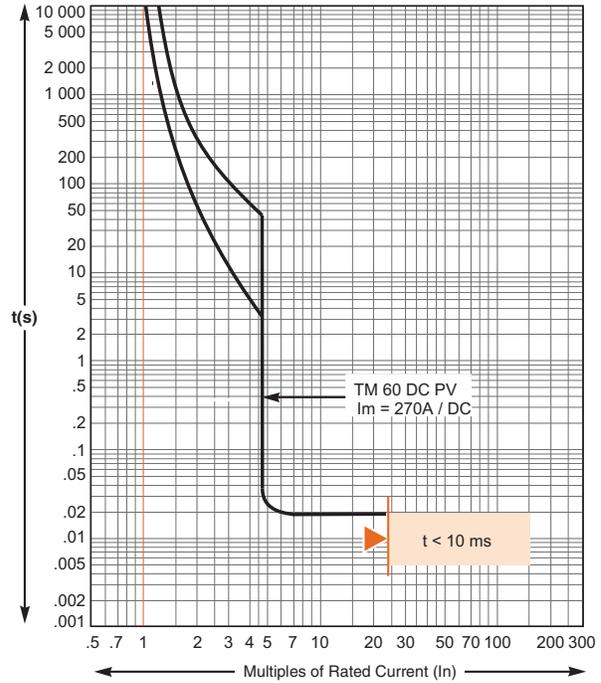
## Section 10—Trip Curves

Figure 15: T-Frame 50–80 A DC Photovoltaic Circuit Breakers

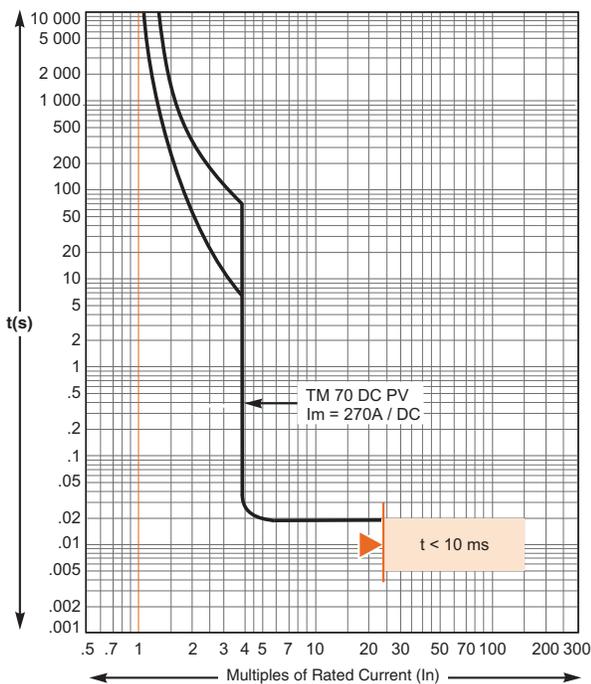
TM 50 DC PV



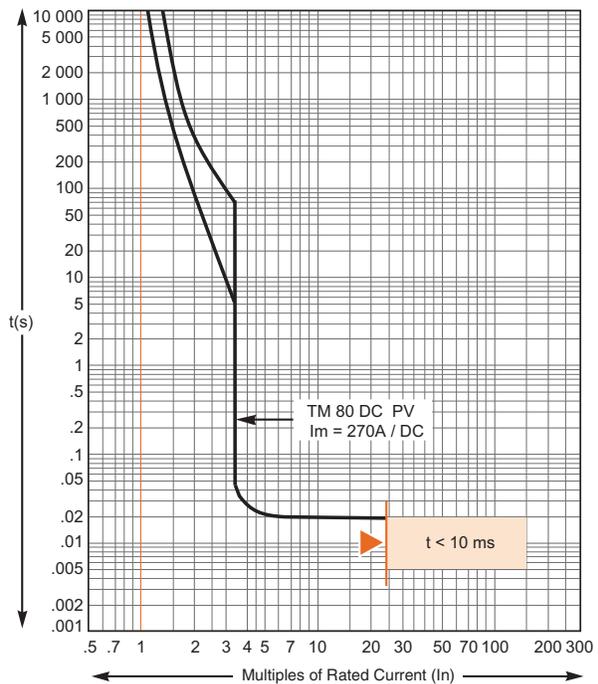
TM 60 DC PV



TM 70 DC PV



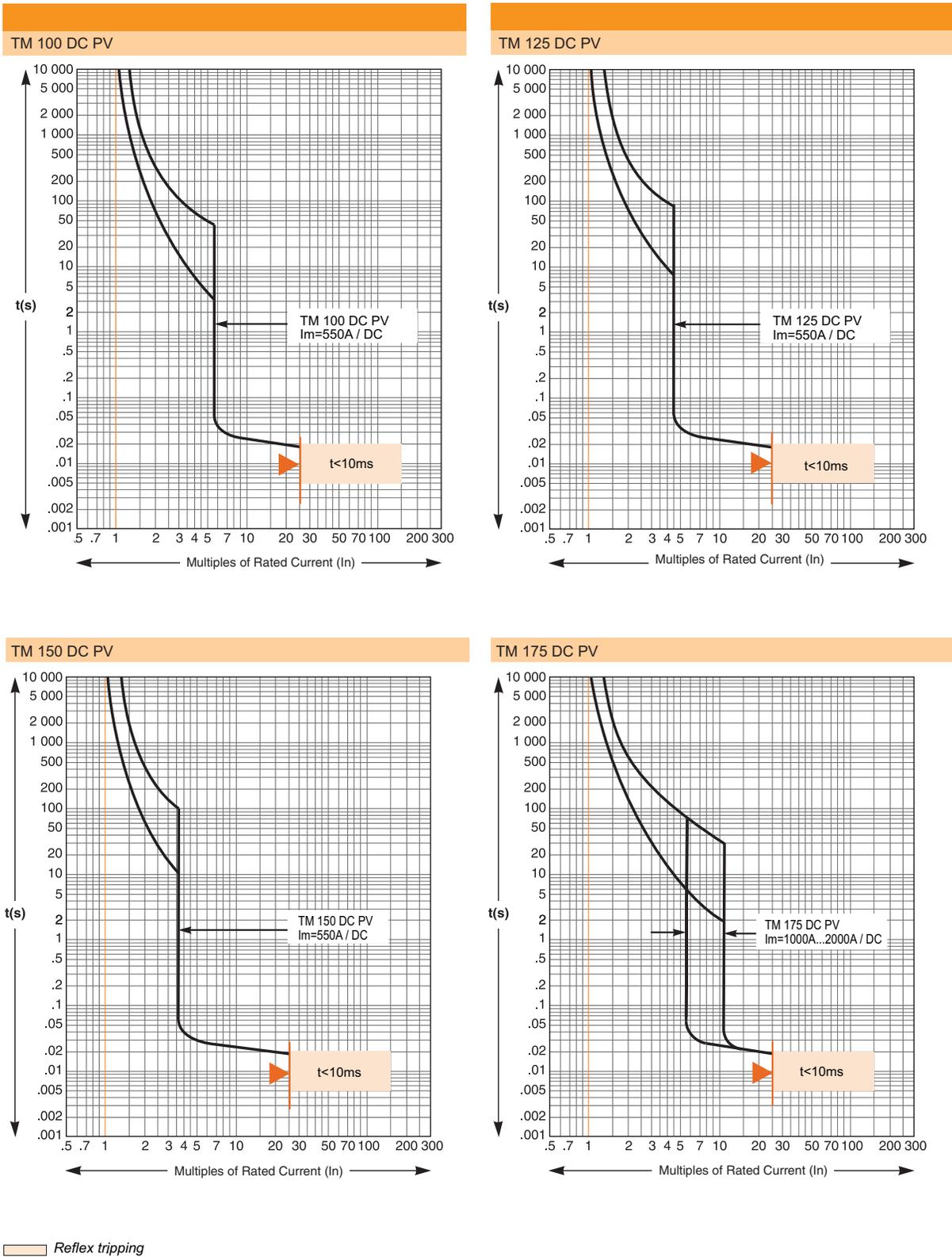
TM 80 DC PV



Reflex tripping

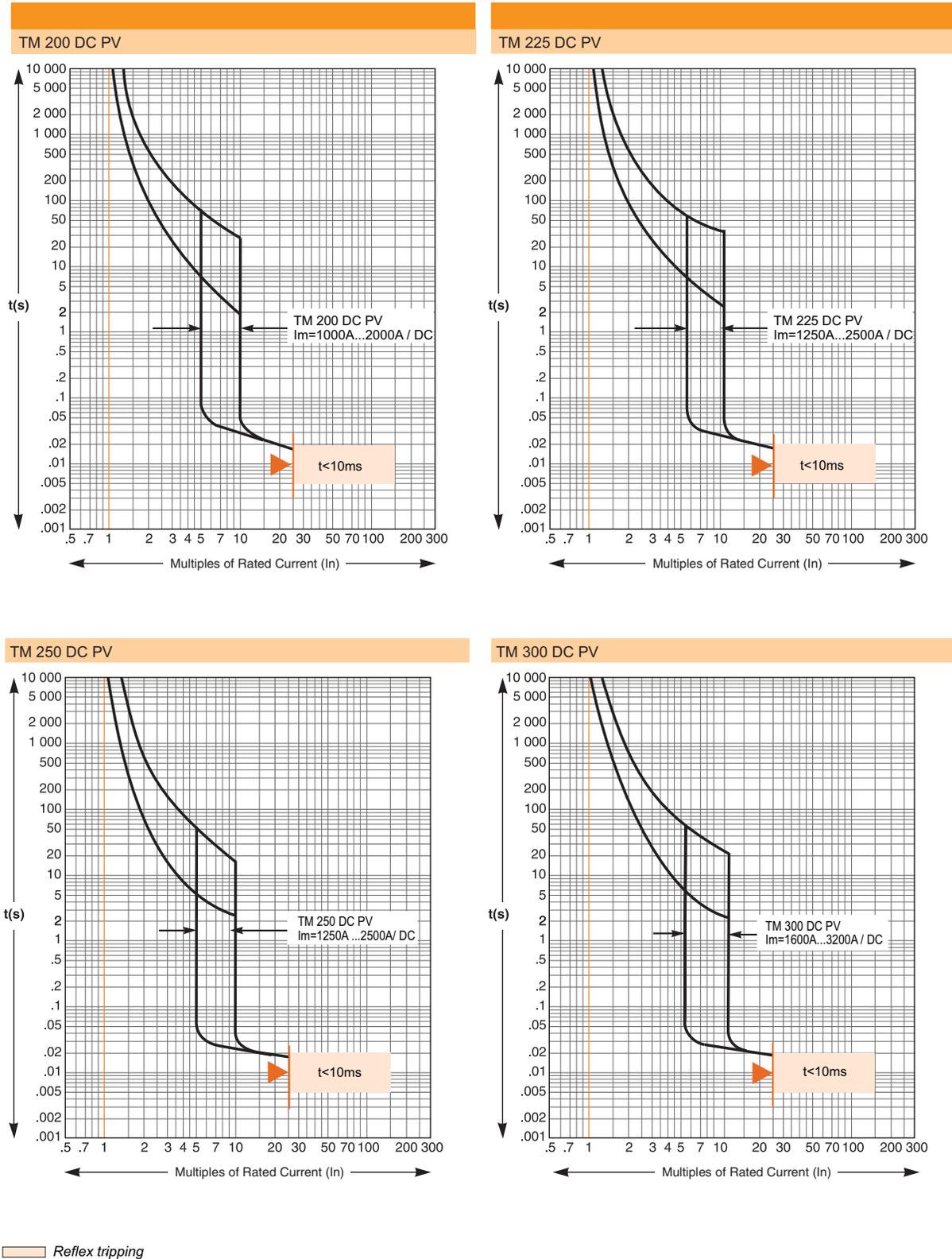
# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Trip Curves

Figure 16: T-Frame 100–175 A DC Photovoltaic Circuit Breakers



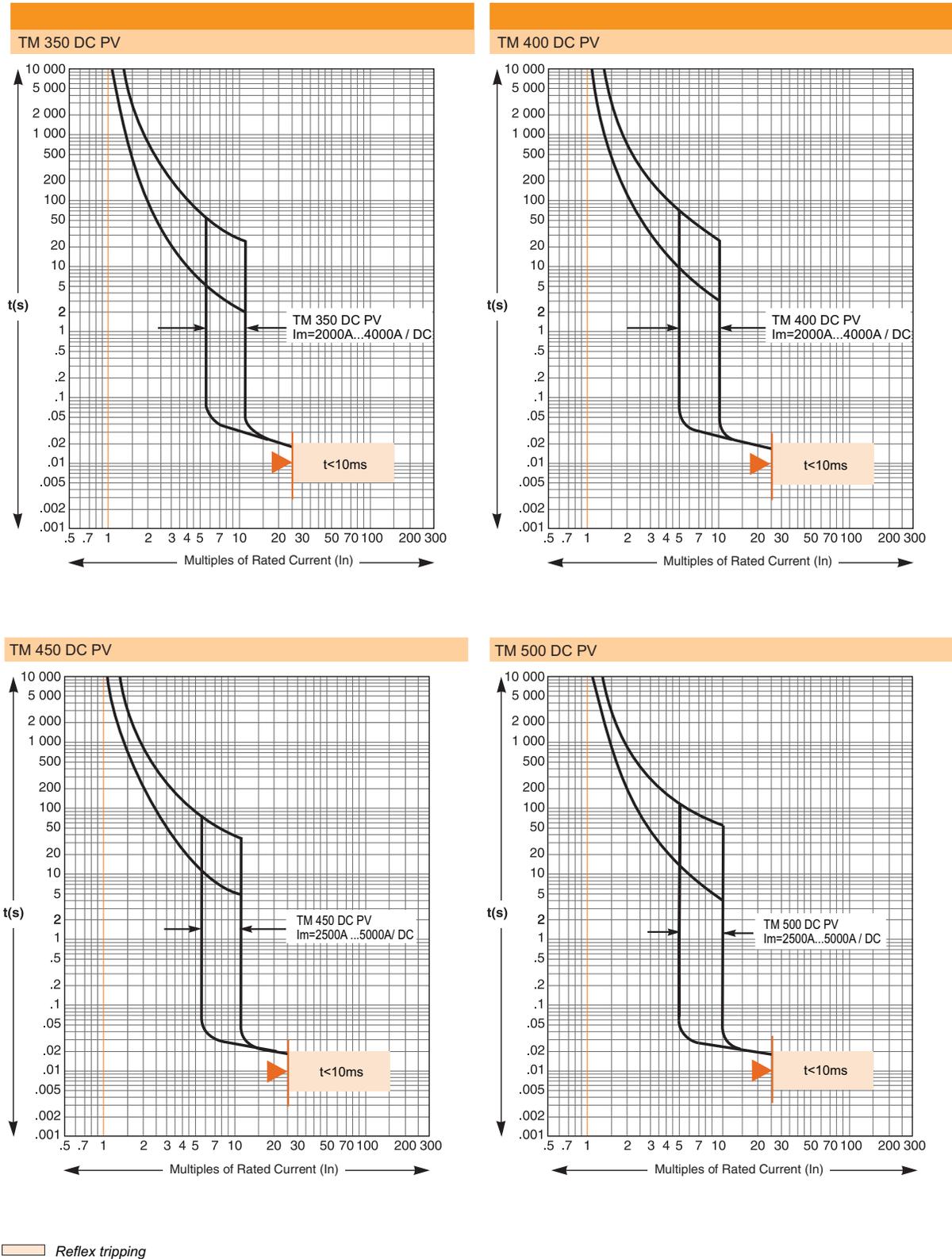
# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Trip Curves

Figure 17: T-Frame 200 A DC and U-Frame 225–300 A DC Photovoltaic Circuit Breakers



# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Trip Curves

Figure 18: U-Frame 350–500 A DC Photovoltaic Circuit Breakers



## Catalog Numbers

32556	31	S29427	21	S38293	36	TGL36200K	16
32595	31	S29450	20	S38293	37	TGL36200L	16
9421LC46	26	S29450	20	S38294	36	UCL41225K	16
9421LD1	26	S29450	20	S41940	23	UCL41225L	16
9421LD4	26	S29450	20	S41940	23	UCL41250K	16
9421LH46	26	S29450	20	S41940	25	UCL41250L	16
9421LH6	26	S29450	20	S41940	25	UCL41300K	16
9421LJ1	25	S29450	20	S41950	25	UCL41300L	16
9421LJ4	25	S29450	20	S41950	25	UCL41350K	16
9421LJ7	26	S29451	20	S41950	27	UCL41350L	16
9421LS13	26	S29450	20	S42878	25	UCL41400K	16
9421LS8	26	S29451	20	S42878	25	UCL41400L	16
9422A1	26	S29452	20	S42878	27	UCL41450K	16
9422CSF10	26	S29452	20	S42888	23	UCL41450L	16
9422CSF30	26	S29452	20	S42888	23	UCL41500G	16
9422CSF50	26	S29452	20	S42888	25	UCL41500J	16
9422CSF70	26	S29452	20	S42888	25	UDL36000GZ25	17
9422CSJ10	26	S29452	20	S429341	25	UDL36000GZ30	17
9422CSJ30	26	S29452	20	S429344	25	UDL36000GZ40	17
9422CSJ50	26	S29452	20	S429449	23	UDL36000GZ50	17
9422RSI	26	S29451	20	S432475	37	UDL36000JZ25	17
9422RSI	27	S29452	20	S432476	37	UDL36000JZ30	17
MICROTUSEAL	30	S29451	20	S432553	31	UDL36000JZ40	17
NJPAF	27	S29515	37	S432639	23	UDL36000JZ50	17
S29235	37	S29516	37	S432640	23	UDL41000GZ25	17
S29236	37	S30554	39	S432641	23	UDL41000GZ30	17
S29255	38	S31540	23	S432642	23	UDL41000GZ40	17
S29313	31	S31541	23	S432643	23	UDL41000GZ50	17
S29315	31	S31542	23	S432644	23	UDL41000JZ25	17
S29317	31	S31543	23	S432645	23	UDL41000JZ30	17
S29319	31	S31544	23	S432646	23	UDL41000JZ40	17
S29337	25	S31545	23	S432647	23	UDL41000JZ50	17
S29337 S29345	25	S31546	23	TBL36000GZ10	17	UGL36225K	16
S29337 S29346	25	S31548	23	TBL36000GZ15	17	UGL36225L	16
S29338	25	S32558	31	TBL36000GZ20	17	UGL36250K	16
S29338 S29345	25	S32560	31	TBL36000JZ10	17	UGL36250L	16
S29339	25	S32562	37	TBL36000JZ15	17	UGL36300K	16
S29339 S29345	25	S32563	37	TBL36000JZ20	17	UGL36300L	16
S29339 S29346	25	S32593	36	TBL41000GZ10	17	UGL36350K	16
S29340	25	S32594	36	TBL41000GZ15	17	UGL36350L	16
S29342	25	S32597	25	TBL41000GZ20	17	UGL36400K	16
S29343	25	S32597 S29346	25	TBL41000JZ10	17	UGL36400L	16
S29345	25	S32597 S32605	25	TBL41000JZ15	17	UGL36450K	16
S29346	25	S32598	25	TBL41000JZ20	17	UGL36450L	16
S29346	25	S32598 S32605	25	TBL41050K	16	UGL36500G	16
S29354	29	S32599	25	TBL41050L	16		
S29369	29	S32599 S29346	25	TBL41060K	16		
S29370	27	S32599 S32605	25	TBL41060L	16		
S29370	27	S32600	25	TBL41070K	16		
S29371	27	S32602	25	TBL41070L	16		
S29375	30	S32603	25	TBL41080K	16		
S29382	21	S32604	25	TBL41080L	16		
S29383	21	S32605	25	TBL41100K	16		
S29384	21	S32606	25	TBL41100L	16		
S29385	21	S32614	29	TBL41125K	16		
S29386	21	S32621	29	TBL41125L	16		
S29387	21	S32631	27	TBL41150K	16		
S29388	21	S32648	23	TBL41150L	16		
S29389	21	S32649	23	TBL41175K	16		
S29390	21	S33680	21	TBL41175L	16		
S29391	21	S33681	21	TBL41200K	16		
S29392	21	S33682	21	TBL41200L	16		
S29393	21	S35167	38	TGL36050K	16		
S29394	21	S35168	38	TGL36050L	16		
S29402	21	S35169	37	TGL36060K	16		
S29403	21	S35171	37	TGL36060L	16		
S29404	21	S35172	37	TGL36070K	16		
S29405	21	S35175	36	TGL36070L	16		
S29406	21	S35176	36	TGL36080K	16		
S29407	21	S35177	36	TGL36080L	16		
S29408	21	S35178	36	TGL36100K	16		
S29409	21	S35178	37	TGL36100L	16		
S29410	21	S35179	36	TGL36125K	16		
S29411	21	S35180	38	TGL36125L	16		
S29412	21	S36170	37	TGL36150K	16		
S29413	21	S36967	39	TGL36150L	16		
S29414	21	S37422	27	TGL36175K	16		
S29426	21	S38291	36	TGL36175L	16		

## Glossary

**accessory** = An electrical or mechanical device that performs a secondary or minor function apart from overcurrent protection.

**accessory cover** = A removable cover on the front of a circuit breaker behind which are mounted the trip unit and all electrical accessories.

**AIC** = Amperes interrupting capacity.

**AIR** = See *amperes interrupting rating*.

**alarm switch (bell alarm)** = See *overcurrent trip switch*.

**ambient temperature rating** = Temperature at which the continuous current rating (handle rating) of a circuit breaker is based; the temperature of the air immediately surrounding the circuit breaker which can affect the thermal (overload) tripping characteristics of thermal-magnetic circuit breakers. Electronic trip circuit breakers, however, are insensitive to normal (-10° to 50°C) ambient conditions.

**ampacity** = The current, in amperes, that a conductor or circuit breaker can carry continuously under the conditions of use without exceeding its temperature rating.

**ampere** = The equivalent of one coulomb per second or the steady current produced by one volt applied across a resistance of one ohm.

**amperes interrupting rating** = The highest current at rated voltage that an overcurrent protective device is intended to interrupt under specified test conditions (NEC).

**ANCE (National Association of Standardization and Certification for the Electrical Sector)** = The standards and certification agency accredited by the Mexican government.

**ANSI®** = American National Standards Institute.

**automatic molded case switch** = A switch with construction similar to a molded case circuit breaker except that the switch opens only instantaneously at a non-adjustable trip point calibrated to protect only the molded case switch itself.

**auxiliary switch** = A switch mechanically operated by the main device for signaling, interlocking, or other purposes.

**bell alarm** = A mechanically-operated switch used to indicate the main contact position of a circuit breaker, which indicates when a circuit breaker has tripped. Also see *overcurrent trip switch*.

**BPFE** = See *electrical closing push button*.

**branch circuit** = The circuit between the final overcurrent device protecting the circuit and the outlet(s).

**Canadian Standards Association® (CSA®)** = Canadian product safety testing and certification organization.

**CDM** = See *mechanical operation counter*.

**CH** = A spring-charged contact inside of the spring charging motor on insulated-case and low-voltage power circuit breakers.

**charging handle** = See *spring charging handle*.

**circuit breaker** = A device designed to open and close a circuit by non-automatic means and to open the circuit automatically on an overcurrent without damage to itself when properly applied within its rating.

**circuit breaker frame** = (1) The circuit breaker housing which contains the current carrying components, the current sensing components, and the tripping and operating mechanism. (2) That portion of an interchangeable trip molded case circuit breaker remaining when the interchangeable trip unit is removed.

**close button** = A button for manually closing the main contacts after the closing springs are charged.

**close button cover** = A cover which fits over the close button and blocks access to it. Access to the close button may be permitted through the use of a tool or rod inserted through a small hole in the front of the close button cover.

**closing coil (shunt close)** = A coil which closes the circuit breaker electrically using an external voltage source when a specified voltage is applied across the coil.

**coil clearing switch** = A mechanically-operated switch in series with the coil of a shunt trip device which breaks the coil current when the circuit breaker opens.

**conductor** = A substance or body that allows a current of electricity to pass continuously along it.

**continuous current rating (handle rating) (ampere rating)** = The designated RMS alternating or direct current in amperes which a device or assembly will carry continuously in free air without tripping or exceeding temperature limits.

**continuous load** = A load where the maximum current on the circuit is expected to continue.

**CSA®** = See *Canadian Standards Association*.

**CT** = Current transformer. See also *cell switch*.

**current path (of a circuit breaker)** = The current-carrying conductors within a circuit breaker between, and including, line and load terminations.

**current transformer (current sensor) (CT)** = An instrument to measure current, encircling a conductor carrying the current to be measured or controlled.

**electrical closing push button (BPFE)** = A push button used to electrically close a circuit breaker using a shunt close with communication option. This takes into account all safety functions that are part of the control and monitoring system of the installation.

**electrical operator (motor operator)** = An electrical device used to open and close a circuit breaker or switch and reset a circuit breaker. See also *spring charging motor*.

**fixed-mounted circuit breaker** = A circuit breaker so mounted that it cannot be removed without removing primary and sometimes secondary connections and/or mounting supports.

**frame size** = The largest ampere rating available in a group of circuit breakers of similar physical configuration.

**ground fault** = An unintentional current path, through ground, back to the source.

**handle rating** = Continuous current rating.

**IEC®** = International Electrotechnical Commission.

**IEEE®** = Institute of Electrical and Electronics Engineers.

**Im** = See *magnetic protection*.

**In** = See *sensor rating*.

**individually-mounted circuit breaker** = A circuit breaker so mounted that it cannot be removed without removing primary and sometimes secondary connections and/or mounting supports.

**insulated case circuit breaker (ICCB)** = UL Standard 489 Listed non-fused molded case circuit breakers which utilize a two-step stored energy closing mechanism, electronic trip system and drawout construction.

**interrupting rating** = The highest current at rated voltage available at the incoming terminals of the circuit breaker. When the circuit breaker can be used at more than one voltage, the interrupting rating will be shown on the circuit breaker for each voltage level. The interrupting rating of a circuit breaker must be equal to or greater than the available short-circuit current at the point at which the circuit breaker is applied to the system.

**inverse time** = A qualifying term indicating there is purposely introduced a delay in the tripping action of the circuit breaker, which delay decreases as the magnitude of the current increases.

**I<sub>t</sub>** = See *thermal protection*.

**I<sup>2</sup>t** = See *let-through current*.

## PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches Glossary

**latch check switch** = A mechanically-operated switch which senses if the trip latch is reset.

**let-through current** = The peak current (measured in amperes) which passes through an overcurrent protective device during an interruption.

**let-through  $I^2t$**  = An expression related to energy (measured in ampere-squared seconds) which passes through an overcurrent protective device during an interruption.

**limit switch** = A switch mechanically operated by a device.

**low voltage power circuit breaker (LVPCB)** = A circuit breaker tested to the ANSI C37 Standards with a two-step stored-energy mechanism, an electronic trip system, and drawout construction.

**magnetic protection ( $I_m$ )** = Short-circuit protection provided by thermal-magnetic trip units. The pick-up setting,  $I_m$ , may be fixed or adjustable.

**manual charging handle** = A manually-operated handle which charges the circuit breaker closing springs.

**MCH** = See *spring-charging motor*.

**mechanical operation counter (CDM)** = A mechanical device which indicates the total number of circuit breaker operating cycles.

**MN** = See *undervoltage release*.

**molded case circuit breaker (MCCB)** = A circuit breaker which is assembled as an integral unit in a supportive and enclosed housing of insulating material, generally 20 to 3000 A in size and used in systems up to 600 Vac and 500 Vdc.

**MX** = See *shunt trip*.

**National Association of Standardization and Certification for the Electrical Sector** = See *ANCE*.

**NMX® (Norma Mexicana X)** = Listing mark indicating certification to non-mandatory Mexican safety standards.

**NOM** = Listing mark indicating certification to mandatory Mexican safety standards

**OF** = See *auxiliary switch*.

**open/closed indicator** = An indicating means which displays the position (open or closed) of the main contacts.

**operating mechanism** = An internal mechanical system which opens and closes the circuit breaker contacts.

**OTS** = Overcurrent trip switch (alarm switch, bell alarm). A mechanical switch that operates when the circuit breaker is tripped by the trip system.

**overcurrent** = Any current in excess of the rated continuous current of equipment or the ampacity of a conductor.

**overcurrent mechanism** = An internal mechanical system which trips the circuit breaker during an overcurrent.

**overcurrent trip element** = A device which detects an overcurrent and transmits the energy necessary to open the circuit automatically (UL only).

**overcurrent trip switch (SDE)** = A mechanically-operated switch which indicates when a circuit breaker has tripped due to overcurrent conditions.

**peak let-through current** = The maximum peak current flowing in a circuit during an overcurrent condition.

**PF** = A switch used to indicate a circuit breaker is ready to close.

**push-to-close button** = A button for manually closing the main contacts after the closing springs are charged.

**push-to-open button** = A button for manually opening the circuit breaker.

**push-to-trip button** = A button for manually tripping the circuit breaker.

# PowerPact™ T- and U-Frame DC Photovoltaic (PV) Circuit Breakers and Switches

## Glossary

**remote reset after fault (RES)** = A component which resets the overcurrent trip switch (SDE) and the mechanical operator after tripping.

**RES** = See *remote reset after fault*.

**SDE** = See *overcurrent trip switch*.

**sensor** = The current sensing element within the circuit breaker which provides the sensing function for that circuit breaker.

**sensor size** = Maximum ampere rating possible for a specific circuit breaker, based on the size of the current sensor inside the circuit breaker. Sensor size is less than or equal to frame size.

**shunt close (closing coil) (XF)** = An accessory which closes the circuit breaker from a remote location using an external voltage source.

**shunt trip (MX)** = An accessory which trips the circuit breaker from a remote location using an external voltage source.

**spring-charging handle** = A handle located on the front of the circuit breaker used to manually charge the stored energy mechanism.

**spring charging motor** = A motor which electrically charges the stored energy closing spring(s).

**stored energy mechanism (SEM)** = A spring mechanism that is compressed or “charged” and then released or “discharged” to close the circuit breaker.

**terminal block** = The connections for control wiring.

**thermal-magnetic circuit breaker** = A general purpose term for circuit breakers that use bimetals and electromagnetic assemblies to provide both thermal and magnetic overcurrent protection.

**thermal protection (Ir)** = Overload protection provided by thermal-magnetic trip units using an inverse time curve ( $I^2t$ ), tripping occurs after a time delay that decreases with increasing current.

**two-step stored energy mechanism** = See *stored energy mechanism*.

**trip button** = See *push-to-trip button*.

**trip curve** = A graphical representation of the response of a circuit breaker to current over a period of time.

**trip unit** = A programmable device which measures and times current flowing through the circuit breaker and initiates a trip signal when appropriate.

**UL®** = See *Underwriters Laboratories Inc.*

**undervoltage trip (MN, UVR)** = An accessory which trips the circuit breaker automatically when the monitored circuit voltage falls below a predetermined percentage of its specified value.

**Underwriters Laboratories Inc.® (UL®)** = An independent, not-for-profit standards development, product safety testing and certification organization.

**unit-mount circuit breaker** = A circuit breaker mounted such that it cannot be removed without removing primary and sometimes secondary connections or mounting supports.

**withstand rating** = 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.

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