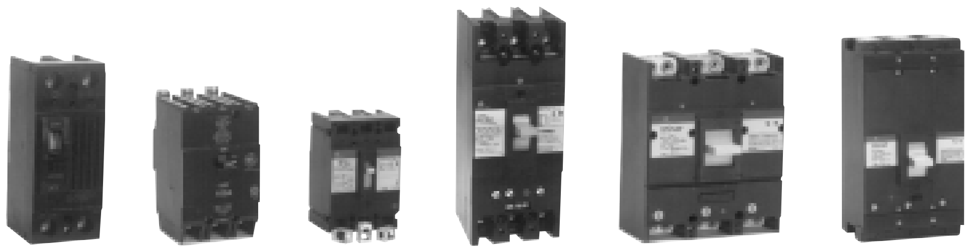
Molded Case Circuit Breakers

Application and Selection

Contents

The GE Family of Molded Case Circuit Breakers

From 10-1200 Amperes



Q-Line *TEY* *E150* *F225* *J600* *K1200*

Application Flexibility

In switchboards, motor control centers and lighting, power and customized control panelboards, General Electric molded case circuit breakers are used to provide reliable circuit protection. Molded case circuit breakers in individual enclosures are also used in numerous applications.

Minimum Downtime

Downtime is reduced and fuse replacement is eliminated with circuit breakers. In case of overload or short circuit, the breaker trips, opening the circuit and protecting the conductors. When normal conditions are restored, the breaker can be closed (“ON”) again.

Trip-Free Mechanism

The breaker’s trip-free mechanism opens the breaker contacts under overload or short circuit conditions, even with the breaker handle held in the ON position.

Eliminates Single-Phasing

Circuit breakers eliminate single-phasing. When an overload or short circuit occurs on any one conductor, a common trip bar simultaneously disconnects all three conductors of a three-phase circuit.

Easy System Upgrading

With General Electric circuit breakers, the circuit can be uprated, even after the breaker has been installed. Interchangeable trips provide a wide range of ratings within the same frame size.

Accessory Functions

Application flexibility of molded case circuit breakers is enhanced by a breaker accessory line. Remote closing or opening, undervoltage protection, indication of “tripped” condition at a remote location, electrical or mechanical interlocking, automatic reclosing, and primary or sequential operation are some of the functions practical with accessories.

Space Savings

Space savings can be an important factor in selecting General Electric molded case circuit breakers as equipment components. Higher rated breakers in particular, offer major space economies over fused switches.

Interrupting Ability

Interrupting ratings of General Electric molded case circuit breakers are based on actual short circuit tests. Breakers are rated for RMS symmetrical ac amperes and for maximum dc amperes.

Standards and Specifications

General Electric molded case circuit breakers meet standards established by Underwriters’ Laboratories, National Electric Manufacturers Association, Federal Specifications, Institute of Electronic Engineers, National Electric Code and General Electric Company’s own high quality standards.

Rugged, Dependable Construction

Circuit Breaker Frame

- **Molded case** is molded from high-mechanical and high-dielectric strength engineered plastic.
- **Trip indication** is shown by handle position midway between ON and OFF. To reset the trip mechanism, move the handle to extreme OFF, then to ON position.
- **Quick-make, quick-break, trip-free mechanism** minimizes arcing during breaker operation. Contacts cannot be "teased" into position. Trip-free mechanism is independent of manual handle control. The breaker trips under short circuit or overload, even though the operating handle is held in ON position.
- **Verifier "Twist-to-Trip" and "Push-to-Trip"** mechanically simulates over-current tripping through actuation of linkages not operated by the ON-OFF handle. Experience has shown that thermal magnetic circuit breakers in industrial applications better maintain their original protective characteristics when regularly exercised.
- **Common-trip bar** assures instant disconnect of all conductors when an overload or short circuit occurs on any one conductor in the circuit, or an accessory trip device operates.
- **Silver alloy contacts** combine the conductive properties of silver with other elements for clean, positive electrical contacting. Pitting and burning are minimized for longer contact life.
- **Arc chutes** of heat-absorbing, insulating material and metal grid plates quickly "extinguish" arcs.
- **UL listed lugs** for copper or aluminum cable, at full frame rating. Easy access and simple, straight-in wiring.

Thermal Magnetic Trip System

- **Front-adjustable magnetic trip** provides instantaneous trip in event of short circuit. Any current surge above the trip setting produces a magnetic field which instantly actuates the trip mechanism and opens the circuit.
- **Thermal trip** provides protection against sustained overloads. A bi-metallic element reacts time-wise in inverse proportion to the current. If a circuit is overloaded, heat resulting from excessive current flow causes the bi-metal to bend, actuating the trip mechanism to open the circuit.
- **Interchangeable trip units** (for frames over 150 ampere rating) simplify stocking and reduce inventory requirements. Field interchangeability assures maximum flexibility.

Electronic Trip System

- **Front adjustable programming functions (Power+ 4, MicroVersaTrip Plus)** provide a high degree of flexibility and convenience in making and checking settings.
- **Long-time pick up indication** is illuminated whenever the breaker is experiencing an overload condition. The light is extinguished by removing the overload or tripping the breaker.
- **Glass epoxy printed circuit boards with epoxy conformal coating** over all assembled components provide long life with error free operation.
- **Switch contacts and board interconnectors** provide corrosion resistance and long product life.
- **Neutral current sensor connections** located between the breaker lugs allow panelboard mounting of breakers without special fillers or increased panel space.
- **Fault trip indicators** for overload, short circuit, and ground fault are available for local indication.

Thermal Magnetic and Solid State Trip Types

Spectra RMS™ circuit breakers with digital rms-sensing electronic trip units provide many features and benefits not offered by thermal magnetic breakers (refer to GET-7002).

Thermal magnetic trip units are available in all GE molded case circuit breakers from Q Line through K frame. Solid state trip units may be alternatively selected for J and K frame circuit breakers. Additionally, non-automatic circuit interrupters, or molded case switches, are available. These interrupters have no automatic overload or short circuit trip elements. They are used for manual switching and isolation.

Enclosure Compensated Thermal Trip: 40°C

An enclosure compensated thermal trip is constructed to permit an enclosed circuit breaker in a 25°C room ambient to carry 100% of its nameplate current *intermittently* and 80% of its nameplate current *continuously* when cabled with conductor sized per the UL 489 standard (see Figure 29.1).

The thermal trip action is accomplished by a bimetallic strip. The movement of the bimetal and thus tripping is proportional to the current — high current fast response, low current slow response. This action provides a time delay which prevents service interruptions from normal inrush currents or temporary overloads. Continuous overloads will cause the bimetal to deflect sufficiently to release the latch and open the breaker contacts. However, the bimetal is also sensitive to ambient temperatures. If the room ambient is above or below 25°C, or the enclosure is warmer than normal, the breaker rating will vary inversely to the temperature: higher ambient-lower current, lower ambient-higher current. Enclosure compensation is furnished on Q-Line, TEB, TEY, TB-1, TED 277 volt and TED 480 volt circuit breakers.

Ambient Temperature Compensated Thermal Trip: 10° TO 50°C

An ambient compensating or “Ambient Compensated” thermal trip is the same as an enclosure compensated trip with one notable exception. It has a reduced sensitivity to changes in ambient temperature. In an ambient compensating thermal trip an additional bimetal is added to the circuit breaker. This bimetal responds to breaker ambient and modifies the characteristics of the current sensing bimetal to compensate for ambient temperature changes.

Ambient compensating thermal trips are provided as standard in all 600 volt thermal-magnetic molded case circuit breakers.

Adjustable Magnetic Trip — F225, J600, K1200 and TEC, TEML, TFC, TJC, TKC, TFL, THLC-2, THLC-4, TLB4

An electromagnet which partially surrounds the bimetal is used to provide instantaneous trip in the event of a short circuit. The high current creates a strong magnetic field attracting the armature and instantaneously releasing the trip latch in the same manner as the bimetal does on overload.

For short circuit protection, the adjustable magnetic trip provides high, low and intermediate trip settings.

Solid State Trip: -20° TO +55°C

Solid state MicroVersaTrip® Plus trip units meet the same standards as thermal trip units. Complete circuit breakers equipped with MicroVersaTrip Plus trip units are rated to carry 100% of their current sensor rating intermittently and 80% continuously in a 40°C breaker ambient. Some MicroVersaTrip Plus equipped breakers are rated to carry 100% continuously and are so marked.

In addition to the protection of conductors as required by codes and standards, MicroVersaTrip Plus can be set to provide protection for equipment such as motors, generators, or transformers and provide improved distribution system selectivity.

Figure 4.1
Operation of Thermal-Mag Trip Units

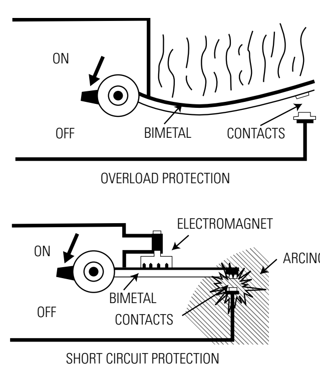


Table 5.1
Breaker Trip Types

	Breaker Type	Trip Type
Q-Line	All	Non-Interchangeable
TEY-100	TEY	Non-Interchangeable
E150	TEB TED THED Hi-Break	Non-Interchangeable Non-Interchangeable Non-Interchangeable
F225	TFJ TFK THFK Hi-Break	Non-Interchangeable Interchangeable Interchangeable
J600	TJJ TJK THJK Hi-Break TJ4V TJH4V Hi-Break TJH Hi-Break MVT Plus	Non-Interchangeable Interchangeable Interchangeable Non-Interchangeable Non-Interchangeable Interchangeable (Rating Plug ①)
K1200	TKM-800 TKM-1200 THKM Hi-Break TK4V TKH Hi-Break MVT Plus	Interchangeable Interchangeable Interchangeable Non-Interchangeable Interchangeable (Rating Plug ①)
Hi-I.C.	TEL, TEML② TFL② TJL4V Hi-I.C. TJL Hi-I.C. MVT Plus TKL4V Hi-I.C. TKL Hi-I.C. MVT Plus TLB-2② TLB-4②	Non-Interchangeable Non-Interchangeable Non-Interchangeable Interchangeable (Rating Plug ①) Non-Interchangeable Interchangeable (Rating Plug ①) Non-Interchangeable Non-Interchangeable
Current Limiting	THLC-1② THLC-2② THLC-4②	Non-Interchangeable Non-Interchangeable Non-Interchangeable
Tri-Break (fused)	TB-1 TB-4 TB-6 TB-8	Non-Interchangeable Non-Interchangeable Non-Interchangeable Non-Interchangeable

① *MicroVersaTrip® Plus incorporates trip units with field replaceable rating plugs providing ease of changing ratings within frame size and sensor rating, with minimum downtime. See Table 5.2 for rating plug selection.*

② *Obsolete type.*

Table 5.2
J/K Rating Plug Selection

Frame Type	Sensor Rating (Amps)	Current Rating (Amps)
J400	150	60, 80, 100, 125, 150
J400	400	150, 200, 225, 250, 300, 400
J600	600	300, 400, 450, 500, 600
K800	800	300, 400, 500, 600, 700, 800
K1200	1200	600, 800, 1000, 1200

Trip Unit Ratings Molded Case Circuit Breakers

Table 6.1
Trip Unit Ratings

Type	Reverse Feed		Trip Unit Type	Trip Unit Ratings (Amperes)	Instantaneous Type
Q-Line (THQB, L, C)	Yes		Non-interchangeable	10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110①, 125①	Fixed
TEY	Yes		Non-interchangeable	15, 20, 30, 40, 50, 60, 70, 80, 90, 100	Fixed
E150	Yes		Non-interchangeable	10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 110, 125, 150	Fixed
TEL②	Yes		Non-interchangeable	15, 20, 25, 30, 35, 40, 50, 50, 60, 70, 80, 90, 100, 125, 150	Fixed
THLC-1②	Yes		Non-interchangeable	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150	Fixed
TB-1	No		Non-interchangeable	15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100	Fixed
TQD	Yes		Non-interchangeable	100, 125, 150, 175, 200, 225	Fixed
F225	TFJ	Yes	Non-interchangeable	70, 80, 90, 100, 110, 125, 150, 175, 200, 225	Adjustable
	TFK	No	Interchangeable		
TFL②	Yes		Non-interchangeable	70, 80, 90, 100, 125, 150, 175, 200, 225	Adjustable
THLC-2②	Yes		Non-interchangeable	125, 150, 175, 200, 225	Adjustable
TJD	Yes		Non-interchangeable	250, 300, 350, 400	Fixed
J400	TJJ	Yes	Non-interchangeable	125, 150, 175, 200, 225, 250, 300, 350, 400	Adjustable
	TJK	No	Interchangeable		
J600	No		Interchangeable	250, 300, 350, 400, 450, 500, 600	Adjustable
TLB-4②	Yes		Non-interchangeable	250, 300, 350, 400	Adjustable
THLC-4②	Yes		Non-interchangeable	250, 300, 350, 400	Adjustable
TB-4	No		Non-interchangeable	125, 150, 175, 200, 225, 250, 300, 350, 400	Adjustable
TB-6	No		Non-interchangeable	300, 350, 400, 500, 600	Adjustable
K800	No		Interchangeable	300, 350, 400, 450, 500, 600, 700, 800	Adjustable
K1200	No		Interchangeable	600, 700, 800, 1000, 1200	Adjustable
TB-8	No		Non-interchangeable	600, 700, 800	Adjustable

① *THQL only (2 pole).*
② *Obsolete type.*

MicroVersaTrip Plus™ Tripping Functions

MicroVersaTrip Plus is a trip unit for J and K frame circuit breakers incorporating the newest technological advances in over-current protection for improved reliability, long-life, and flexibility. Operation is fully automatic and normally no external logic or control power inputs are required. It uses digital rms sensing to accurately measure the waveshape and has an LCD display including overload, short circuit, and ground fault indicators.

Programmable Microelectronic Processor

This forms the basis of the MicroVersaTrip Plus protection programmer. This miniaturization of circuitry provides the increased flexibility required to incorporate nine adjustable time-current functions, three mechanical fault indicators (local), a long-time pickup indicator (local), and zone selective interlocking. All adjustable programmer functions are automatic and self-contained. This compilation of functions provides the basis for the most flexible and useful breaker design presently available anywhere.

Specially Treated Printed Circuit Boards

Each printed circuit board has a protective conformal epoxy coating to prevent moisture absorption, fungus growth, and signal leakage. All electronics are housed within a metallic enclosure designed to protect against hi-fault interruption arcs, magnetic interference, dust, and other contaminants.

Flux-Shift Trip Device

A low energy, positive action tripping device which is self-powered by and controlled by the trip unit.

Current Sensor Package

Three-phase current sensors are incorporated into a single package providing greater flexibility and reliability.

Table 8.1
MicroVersaTrip Plus Trip Unit Functions

		LI	LIG	LIGZ1	LIGZ2	LSI	LSIG	LSIGZI	LSIGZ2
Long-Time	Adjustable Current Setting	X	X	X	X	X	X	X	X
	Adjustable Long Time Delay	X	X	X	X	X	X	X	X
Short-Time	Adjustable Pick-Up					X	X	X	X
	Adjustable Delay					X	X	X	X
	I^2t Switch					X	X	X	X
Adjustable Instantaneous Pick-Up		X	X	X	X	X	X	X	X
Ground Fault	Adjustable Pick-Up		X	X	X		X	X	X
	Adjustable Delay		X	X	X		X	X	X
	I^2t Switch		X	X	X		X	X	X
Zone Interlock	GF			X				X	
	GF-ST				X				X

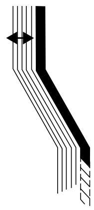
Table 8.2
MicroVersaTrip Plus Trip Unit Function Characteristics

Frame Type	Sensor Rating (Amps)	Current Setting (Multiple of Rating Plug Amp) (X)	Long-Time③	Short-Time		Adjustable Instantaneous Pick-Up (Multiple of Rating Plug Amp) (X)	Ground Fault	
			Delay (Seconds)	Pick-Up (Multiple of Current Setting) (C)	Delay (Seconds)		Pick-Up (Multiple of Sensor Amp Rating) (S)	Delay (Seconds)
J400	150, 400	.50 to 1.00 in steps of .05	2.4, 4.9, 9.8, 20 at 600% of current setting at lower limit of each band	1.5 to 9.0 in steps of .05	I^2T in .40④	1.5 to 10.0 without short-time in steps of 0.5	0.2 to 0.6 in steps of 0.01	I^2T in .40⑤
J600	600							
K800	800				I^2T out① .10, .21, .35	1.5 to 15.0② with short-time in steps of 0.5		I^2T out① .10, .21, .35
K1200	1200							

① *Time delay shown at lower limit of each band. Pick-up tolerances ±10%. Ground fault pick-up not to exceed 1200 amps.*
② *J600 frame with 600-amp sensor for high IC 65kA rating (TJL) limited to 10X.*
③ *Pick-up fixed at 1.05C.*
④ *Time delay at 600% of current setting at lower limit of band.*
⑤ *Time delay at 200% of pick-up setting at lower limit of band.*
X = rating plug amps
S = sensor amp rating
C = current setting

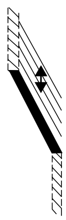
Setup Mode

Set points for all trip unit functions can be entered into the trip system via the 5-function key pad and LCD display. When working in Setup Mode, the trip unit must be provided with control power from the internal battery, or the MicroVersaTrip Portable Power Pack or by loading the breaker to at least 20% of its sensor value. While still in Setup Mode, settings can be automatically scanned by depressing the VALUE key for 5 seconds.



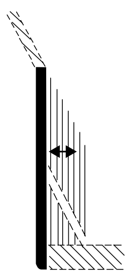
Current Setting (Standard)

The adjustable current setting determines the nominal long time current setting with a ±10% bandwidth. With a 1.0 setting the breaker will carry indefinitely without tripping the rating plug rating. Changing the setting changes the nominal current rating for the breaker.



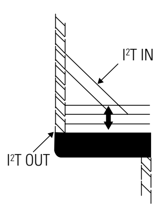
Long-Time Delay (Standard)

This long-time delay adjustment varies the time it will take the breaker to trip under sustained overload conditions. It provides the function of withstanding momentary overloads such as motor starting, welding, or other overcurrent conditions without interrupting the service.



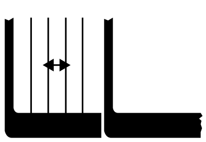
LShort-Time Pickup (Optional)

This short-time pickup adjustment controls the level of high current the breaker can carry for short periods of time without tripping. Permits downstream breakers to clear short circuit faults without tripping out the upstream protective device.



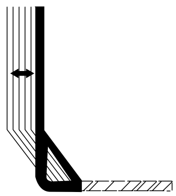
Short-Time Delay (Optional)

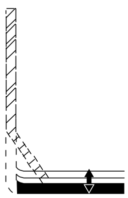
The short-time delay adjustment is used in conjunction with the short-time pickup setting to provide a further refinement of coordination between circuit breakers. It establishes the time interval the breaker will wait before responding to the short-circuit current level selected on the short-time trip point adjustment.



Adjustable Instantaneous Pickup (Standard)

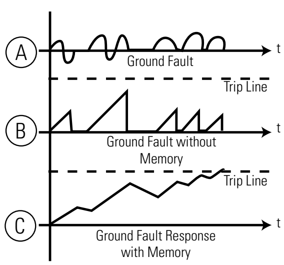
The instantaneous trip point determines the level at which the breaker will trip without intentional time delay (0.025 seconds or less). This immediate interruption occurs only as a result of a severe overcurrent condition, thereby minimizing damage to the electrical system and equipment.





Ground Fault Pickup and Ground Fault Delay (Optional)

The ground fault pickup adjustment controls the level of ground fault current at which circuit interruption will occur. To comply with the National Electrical Code (NEC 230-95), no trip point exceeds 1200 amperes. The common square knee of the curve can be replaced with an I^2t function to facilitate coordination with downstream devices such as thermal-magnetic breakers and fuses. The ground fault delay adjustment is used to add a pre-determined delay in time to the trip point once the ground fault pickup level has been reached. This provides tripping selectivity between main and feeder or other downstream breakers. The ground fault unit also includes as standard an inverse I^2t ramp to substantially improve coordination with downstream protective devices such as fuses and thermal magnetic circuit breakers.



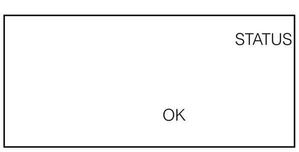
Memory Circuit

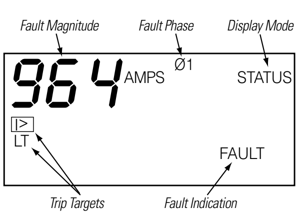
Because of the highly intermittent and erratic nature of arcing ground faults, a memory circuit has been incorporated in all MicroVersaTrip Plus ground fault-sensing circuits as standard. The memory circuit integrates arcing fault current with time, essentially summing the intermittent ground current spikes. In the diagrams, it can be seen how the memory function works.

Diagram A shows a typical ground fault with half-cycles, whole cycles and multiple cycles missing, as normally occurs.

Diagram B shows trip response of a typical ground fault function, which does not include memory. The breaker never trips because the time delay circuits are reset with every missing cycle.

Diagram C shows response of MicroVersaTrip Plus ground fault circuits to the same ground fault; the circuit's memory carries through the missing cycles and generates a trip signal after the preset time delay.

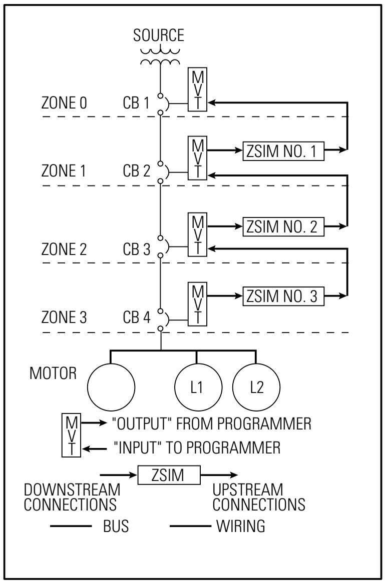




Status Indication

The LCD display provides continuous information on the operating status of the circuit breaker. Under normal conditions the status screen simply displays the OK message. After a fault event occurs, the LCD display indicates the event type, the magnitude, and overcurrent target when appropriate.

Figure 11.1
Multi-Zone Interlocking



Zone Selective Interlocking

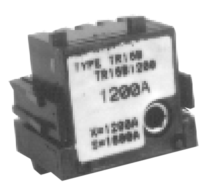
The standard means of obtaining selectivity between main and feeder breakers is by incorporating programmers with time-coordinated trip characteristics. This consists of setting the farthest downstream breaker with a small time delay, and progressively increasing the time delay as you get closer to the main protective device. The disadvantage of this method is that the system must now endure the stress of a high current fault between the main and feeder until time-out occurs.

The Zone Selective Interlock module, Figure 11.1, receives a signal from a downstream MicroVersaTrip Plus programmer (Logic 0) which causes the module to transmit a low-level interlock signal to a MicroVersaTrip Plus programmer upstream. The interlock signal activates the LED portion of an LED-Transistor Opto-isolator in the upstream programmer causing the fixed delay band to shift from "MIN" to the programmer delay band setting. Both the Short-Time and Ground Fault functions are capable of being interlocked.

Zone Selective Interlocking is available for both the short-time function and the ground fault function, or the ground fault function only.

Test Jack

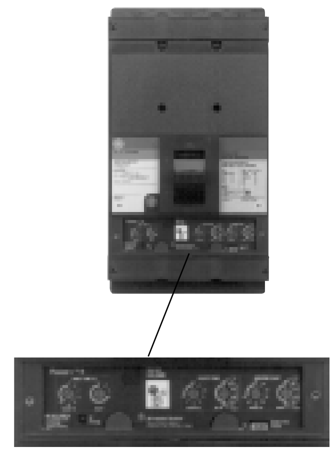
The Test Jack located on the front of the rating plug accepts a test cable supplied with a portable, battery operated (or 120Vac) test kit separately available. The test kit will test the circuit breaker while the circuit breaker is carrying load, and provides either a trip or no trip test. The test kit will simulate a time-over current condition for the long-time, short-time and ground fault functions. It will also read trip unit switch settings and provide a report on the trip unit self-test feature.



Rating Plugs (Standard)

Various rating plugs are available to fix the ampere rating equal to or lower than the sensor ampere rating as in Table 5.2.

Power+™ 4 Tripping Functions



Power+ 4 is the standard electronic trip device for GE J and K frame circuit breakers. This trip unit is integral to the breaker and is not available separately. Operation is fully automatic and, normally, no external logic or control power inputs are required.

Protection Trip Unit

The current sensor-powered solid-state logic unit incorporates rotary adjustment knobs for up to four functions. The functions available are Current Setting (standard), Instantaneous Pickup (standard) or Short-time Pickup with Fixed Instantaneous (optional), Ground Fault Delay (optional), and Ground Fault Pick Up (optional). The Long-time Delay features four user selectable bands, and there are three short time constant delay bands with I^2t in or I^2t out.

Flux Shift Trip Device

A low energy, positive action tripping device is automatically powered and controlled by the protection programmer.

Current Sensor Package

Three phase current sensors are incorporated into a single package for maximum flexibility and reliability.

Table 12.1
Power+ 4 Protection Functions and Setting Values

Protective Function	Pickup Settings	Nominal Midpoint Delay Settings	Delay Curve
Long-Time (C)	.5, .6, .7, .8, .9, .95, 1.0 multiple of Sensor Rating (X)	3, 6, 8, 12, 25 seconds (Bands 1, 2, 3, 4) at 600% C	Fixed
Short-Time	1.5, 2, 2.5, 3, 4, 5, 7, 9 multiple of Long-Time Setting (C)	.13, .26, .42 second (Min, Int, Max) I^2t Out	I^2t In, I^2t Out
Adjustable Instantaneous ①	1.5, 2, 3, 5, 7, 9, 10 multiple of Sensor Rating (X)	No Delay	N/A
Ground-Fault	.2, .25, .3, .35, .4, .45, .5, .6 multiple of Sensor Rating (X)	.13, .26, .42 second (Min, Int, Max) I^2t Out	I^2t In, I^2t Out

① *When short-time protection is provided, instantaneous is fixed at 15X.*

Table 12.2
Power+ 4 Trip Unit Selection

Trip Unit Functions		Suffix			
		None	N	G	NG
Long-Time	Adjustable Current Setting	X	X	X	X
	Fixed Long-Time Pickup	X	X	X	X
	Fixed Long-Time Delay	X	X	X	X
	Long-Time Timing Light	X	X	X	X
Short-Time	Adjustable Short-Time Pickup		X		X
	Fixed Short-Time Delay I^2t Ramp		X		X
Instantaneous	Adjustable Instantaneous Pickup	X		X	
	Fixed Instantaneous Pickup②		X		X
Ground Fault①	Adjustable Group Fault Pickup - Zero Sequence			X	X
	Adjustable Ground Fault Delay			X	X

① *For single-phase, 3-wire or 3-phase, 4-wire applications, select appropriate neutral current sensor.*
② *TJL4V with 500A and 600A sensors available with adjustable instantaneous only.*

Current-Limiting Circuit Breakers

Note: OBSOLETE — for reference use only.

To meet increased demands for electrical service by residential, commercial, and industrial users, and to reduce system power losses and cost, larger low-impedance transformers are being installed by power companies. The result is systems with higher available short circuit currents. Traditional branch circuit equipment cannot handle the fault currents available in these systems which can reach 150,000 rms symmetrical amperes or more.

THLC current-limiting circuit breakers (CLB) react far more quickly to high-level short circuits than conventional breakers. In fact, the *higher the short circuit current, the faster the THLC operates*, because of its magnetic repulsion design.

Example: if a 150,000 RMS symmetrical ampere short circuit at 480 volts ac were to threaten your system, the THLC1 would interrupt it in *just 3 milliseconds*. At the same time, the THLC1 would limit peak let-through current to less than 42,000 amperes – only 13% of the destructive energy that would flow through without THLC1 protection, and a small enough current to be controlled by standard series-connected circuit breakers.

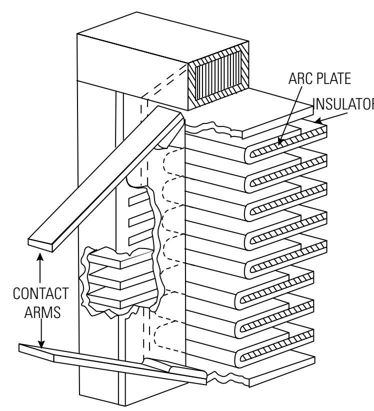
But a fast break isn't enough; a CLB must control arc voltage quickly and efficiently, too.

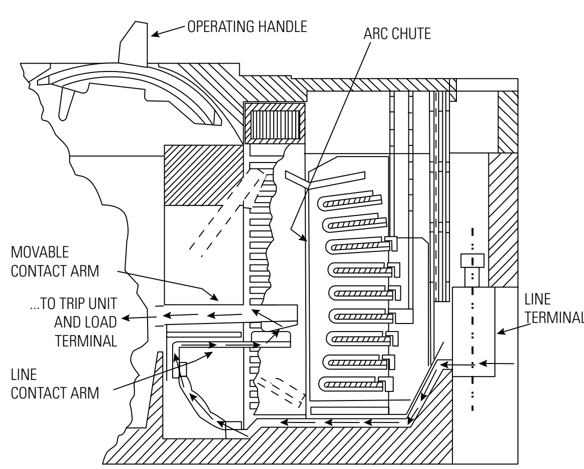
GE THLC current limiting breakers force the arc into patented, U-shaped arc plates where sufficient voltage is developed to "dominate" the short circuit *fast*. During a 480 volt interruption, for example, the THLC1 quickly counters the driving voltage with a peak arc-voltage in the range of 800 volts – sufficient voltage to quench the short circuit without causing unwanted dielectric breakdown elsewhere down the line.

And for long, reliable life, the THLC is also equipped with special baffles to vent hot gases out of the breaker during the arc-quenching process.

The THLC current-limiting circuit breaker is designed to protect standard circuit breakers with ratings as low as 10,000 AIC on systems with available currents up to 200,000 RMS symmetrical amps at 240 Vac or at 480 Vac. It's available in amp ratings ranging from 15 to 400 amps.

- *UL-listed and CSA certified IC ratings* of 200kAIC at 240 and 480 volts and 50kAIC at 600 volts
- *Patended arc plates* provide fast, efficient control of short-circuit conditions
- *Resettable, fuse-free construction* minimizes downtime
- *Magnetic repulsion contact design* interrupts short-circuit currents of up to 200,000 amperes at 480 volts in less than 3 milliseconds – the higher the current, the faster the breaker operates
- *Standard circuit breaker protection* with ratings as low as 10,000 AIC on systems with available currents up to 200,000 symmetrical rms amperes
- *150-ampere frame size* with ampere ratings ranging from 15-150 amperes
- *225-ampere frame size* with ampere ratings ranging from 125-225 amperes
- *400-ampere frame size* with ampere ratings ranging from 250-400 amperes





Adjustable Magnetic Ratings — Molded Case Circuit Breakers

Table 14.1
Adjustable Magnetic Ranges① (In RMS Symmetrical Amperes, Nominal)

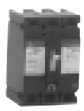
F225, TFL②			J400			J600			K800			K1200		
Trip Unit	Lo	Hi	Trip Unit	Lo	Hi	Trip Unit	Lo	Hi	Trip Unit	Lo	Hi	Trip Unit	Lo	Hi
70	600	900	125	375	1250	250	750	2500	300	900	3000	600	1800	6000
80	600	900	150	450	1500	300	900	3000	350	1050	3500	700	2100	6400
90	600	900	175	525	1750	350	1050	3500	400	1200	4000	800	2400	6400
100	600	1250	200	600	2000	400	1200	4000	450	1350	4500	1000	3000	10,000
110	600	1250	225	675	2250	450	1350	4500	500	1500	5000	1200	3600	10,000
125	600	1250	250	750	2500	500	1500	5000	600	1800	6000			
150	700	1500	300	900	3000	600	1800	6000	700	2100	6400			
175	800	1750	350	1050	3500				800	2400	6400			
200	900	2000	400	1200	4000									
225	1000	2250												

THLC-2②			THLC-4②, TLB-4②			TB-4, TB-6			TB-8		
Trip Unit	Lo	Hi	Trip Unit	Lo	Hi	Trip Unit	Lo	Hi	Trip Unit	Lo	Hi
125	600	1250	250	1100	2500	125	375	1250	600	1800	3000
150	700	1500	300	1400	3000	150	450	1500	700	2100	4000
175	800	1750	350	1600	3500	175	525	1750	800	2400	4000
200	900	2000	400	1800	4000	200	600	2000			
225	1000	2250				225	675	2250			
						250	750	2500			
						300	900	3000			
						350	1050	3500			
						400	1200	3500			
						500	1500	3000 TB-6			
						600	1800	3000 TB-6			

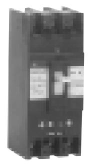
① *Consult published trip-time curves for tolerances.*
② *Obsolete type.*

Mag-Break® Motor Circuit Protectors

Standard Interrupting Devices

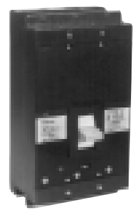


TEC
3-150 amperes



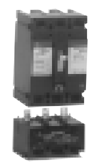
TFC
225 amperes

TJC
400-600 amperes

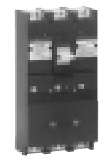


TKC
800-1200 amperes

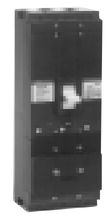
Limiter Assisted Devices



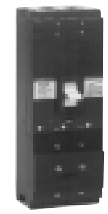
TEC & TECL
3-150 amperes



TBC4
400 amperes



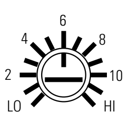
TBC6
600 amperes



TBC8
800 amperes

Mag-Break motor circuit protectors provides accurate and fast clearing of faults on motor circuits — including low level faults — the type most prevalent in motor installations. Mag-Break serves to minimize damage to motors and motor control apparatus in addition to protecting motor branch circuit conductors. Continuous current ratings and adjustable instantaneous trip ranges have been designed to meet NEC requirements concerning motor full load and locked rotor current. The Mag-Break instantaneous trip point can be set low and precisely (just above asym. motor inrush) assuring fault protection and eliminating nuisance tripping.

Each pole of the Mag-Break motor circuit protector contains a current sensing element to trip the breaker instantaneously when the preselected current setting is exceeded. Mag-Break's unique magnetic system permits independent factory calibration of both the Hi and Lo ends of the trip range. This provides field adjustability with accuracy and repeatability at all Mag-Break trip scale positions.



In addition to the two independent factory calibrations, Mag-Break is field adjustable by screwdriver adjustments on the front of each breaker. The field adjustable setting is continuous over the entire range from Hi to Lo, and each breaker rating label contains a table converting setting position to amperes. An overcurrent on any pole will cause all three poles to trip simultaneously, thus preventing costly single phasing problems.

Table 15.1
Trip Set Positions to Trip Amperes

Catalog Number 3-Pole	Cont. Amperes	Trip Setting Positions②						
		Lo	2	4	6	8	10	Hi
TEC36003	3	8	13	18	23	28	33	38
TEC36007	7	18	30	42	54	66	78	90
TEC36015	15	42	68	94	120	146	172	198
TEC36030	30	90	140	190	240	290	340	390
TEC36050	50	180	260	340	420	500	580	660
TEC36100	100	300	468	636	804	972	1140	1300
TEC36150	150	600	950	1300	1650	2000	2350	2700
TFC36225	225	600	780	1020	1200	—	—	1400
TFC36225A	225	1000	1200	1630	1920	—	—	2250
TJC36400B	400	1200	1400	1850	3250	—	—	4000
TJC36400E	400	330	435	600	860	—	—	1100
TJC36400F	400	550	720	945	1280	—	—	1670
TJC36400G	400	1000	1280	1780	2360	—	—	3300
TJC36600G	600	1000	1280	1780	2360	—	—	3300
TJC36600H	600	1800	2100	2600	3600	—	—	6000
TKC36800L①	800	3000	3600	4300	5100	—	—	6000
TKC36800M①	800	5000	6000	7000	8400	—	—	10000
TKC361200L①	1200	3000	3600	4300	5100	—	—	6000
TKC361200M①	1200	5000	6000	7000	8400	—	—	10000
Limiter Assisted Devices								
TBC43225F14F	225	550	720	945	1280	—	—	1670
TBC43400F14G	400	1000	1280	1780	2360	—	—	3300
TBC63600J14L	600	3000	3600	4300	5100	—	—	6000
TBC83800K18	800	2400	—	—	—	—	—	6000

① *For motors above 350 Hp use Power+ 4 or MicroVersaTrip Plus equipped breakers.*
② *Tolerance ±20% of nominal value.*

Accesories

Undervoltage Protection

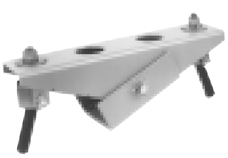
The Undervoltage Release instantaneously trips the breaker when voltage drops to 35-70% of normal rating. The device retrips the breaker if it is closed before normal voltage is restored.

Standard duty and heavy-duty types are available.

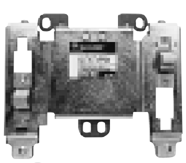
Time Delay Unit — for use with UVR. This unit prevents nuisance tripping due to momentary loss of voltage.

A separate, externally mounted unit has 120 volt ac input and 125 volt dc output with delay adjustable from .1 to .5 seconds. It is used in conjunction with 125-volt dc undervoltage release, which must be ordered separately.

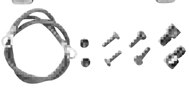
Mechanical Interlocking



Mechanical interlocks permit only one of two interconnected circuit breakers in a switchboard to be on at a time. Both circuit breakers can be OFF at the same time.



The walking beam interlock interconnects two circuit breakers from the rear, making it ideal for use in applications where a dead front would make it impossible to mount a mechanism on the face of the breaker.

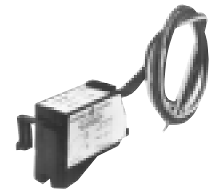


The face mounted interlock interconnects the handles of two circuit breakers. This makes it possible to use the interlock with a motor operator.

Auxiliary Switch

An auxiliary switch can be used to operate other accessories, indicating lights, relays, automatic reset, etc. It is available with one to four SPDT (form C) elements for flexibility. Switches open and close as the breaker is either manually or remotely tripped or turned OFF.

Bell Alarm



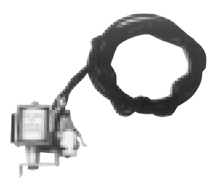
A bell alarm actuates a warning signal or other circuitry when the breaker is tripped under overload, short circuit, shunt trip, undervoltage trip, and 3 coil shunt trip conditions. Not actuated during normal ON-OFF operation.

Motor Operator for Remote "On-Off"

A motor-operated mechanism can open, close, or reset a breaker remotely. This convenient attachment mounts integrally with the breaker, without modification to the breaker or its handle. Just lift the cover of the accessory mechanism to operate the breaker manually. Breaker ON-OFF is indicated in the operating mechanism cover.

Shunt Trip for Remote Tripping

Standard



A Shunt Trip Device can be used to trip and open a breaker by remote control. When the breaker opens, the shunt trip coil circuit is de-energized by means of an auxiliary switch. They meet UL requirements for operation at 55% of rated voltage for use on ground fault systems.

Three-coil (Blown Fuse Detector)

(not illustrated)

This provides single-phase protection for fused circuit breaker combinations, factory installed only.

It mounts in right pole for TEB, TED, and in left pole for TFK, TJK, TKM. Installed internally similar to standard shunt trip with leads connected across the fuses, it trips the breaker when a fuse blows or if the breaker is closed under load with a fuse open and fits all breaker types including molded case switches. Suitable for system voltages 208 to 600 volts ac.

Accessory Data

Breaker Type	Bell Alarm Switch				Auxiliary Switch③ or Shunt Trip			Undervoltage Release			Blown Fuse Trip Device			Combination Accessories			Total Number of Accessories
	Mounting Pole			Inst. Sheet	Mounting Pole		Inst. Sheet	Mounting Pole		Inst. Sheet	Mounting Pole		Inst. Sheet	Mounting Pole		Inst. Sheet	Within Any One Circuit
	L	C	R	GEH-	L	R	GEH-	L	R	GEH-	L	R	GEH-	L	R	GEH-	Breaker
Q-Line					UL⑧		N/A										One only
TQD, THQD						UL											One only
E150, TEB, TEC, TED, THED, TEL, TEML, TB1②, THLC-1	UL①	—	UL	4576 5402	UL①	UL	3418 Aux. 3416 S.T. 5403 Aux. 5401 S.T.	—	UL	3417 5400	—	UL⑤	3434	—	—	—	2-pole circuit breaker – any one 3-pole circuit breaker – any two except UVR and 3-coil shunt trip
F225⑥, TFC, TFJ, TFK, THFK, TFL, TLB-2, TLB-4 THLC-4	—	—	UL⑤ ⑥	4620 5406	UL	UL	4653 5406	UL	UL	4653 5406	UL⑤	—	4622	—	—		Any two
J600 TJC, TJD, TJJ, TJK, THJK, TB4②, TBC4②	—	UL⑤	—	3320	UL	UL	3321 Aux. 3435 S.T.		UL	5407	UL⑤	—	3346	—	—	—	Any two plus bell alarm
K1200 TKC, TKM. THKM, TB6②, TBC6②, TB8, TBC8		UL⑤	—	4305	UL	UL	3321 Aux. 3344 S.T.		UL	5408	UL⑤	—	3346	—	—	—	Any two plus bell alarm
MicroVersaTrip™ 4 and RMS-9, TJ4V, THJ4V, TJL4V, TK4V, TKL4V, TJH, TJL, TKH, TKL	—	UL	—	4626 4663	—	UL	4623 Aux. 4623 S.T.	—	UL	4623	—	UL	4624⑦	—	UL	4323	Any one plus bell alarm. UL Listed for field installation except bell alarm
Accessory Lead⑨ Color Coding	Purple Yellow Brown Bell Alarm Switch				Auxiliary Switch: Red White Brown/White④ Shunt Trip: Black Black			Blue Blue Undervoltage Release			Red Brown/White Blue White Yellow Black			Same as individual accessories			All accessory contacts shown with the circuit breaker in tripped position.⑩

① *Left pole mounting not available for 2 pole TEB, TED.*
② *UL listed at 200,000 AIC without internal accessories. 100,000 AIC with internally mounted accessories.*
③ *600 volts AC auxiliary switches are not UL listed.*
④ *Formerly green.*
⑤ *Not available with lead exit from the back of breaker.*
⑥ *UL listed interrupting capacity with accessories: 10K AIC at 600 volts, AC, 22K AIC at 480 volts AC, 22K AIC at 240 volts AC.*
⑦ *Maximum available short circuit application is 85,000 sym rms A.*
⑧ *Accessory mounts in a one-inch frame and increases overall breaker size by one pole added to left side.*
⑨ *Leads are #18 AWG 125°C Vulkene® insulated.*
⑩ *Auxiliary switch is activated in both OFF and tripped positions.*

Accessories Electrical Data

Q-Line
THQL, THQB, THQC, TQD, THQD

Auxiliary Switch

Circuit Breaker	Catalog Number	Number of Switches	Switch Rating
TQB, THQB, TQL, THQL	TQAS2A1	1-SPST (A)	6 amperes-120 Vac 3 amperes-24 Vac
TQC, THQC	TQCAS2A1	1-SPST (A)	6 amperes-120 Vac 3 amperes-24 Vac
TQD, THQD	TQDAS2AB1RS	1-SPDT (AB)	6 amperes-240 Vac 1/2 ampere-125 Vdc 1/4 ampere-250 Vdc

Shunt Trip

Circuit Breaker	Catalog Number	Volts		Amperes (Inrush)	
		ac 50-60 Hz	dc	ac	dc
TQB, THQB, TQL, THQL	TQST 1	120-240		2.0	
	TQST 7		12		4.0
	TQST 8		24-48		2.4
TQC, THQC	TQCST 1	120-240		2.0	
	TQCST 7		12		4.0
	TQCST 8		24		2.4
TQD, THQD	TQDST 1	120		.9	
	TQDST 2	240		.8	
	TQDST 7		12		7.5
	TQDST 8		24		4.8
	TQDST 9		48		2.4

E150
TED, THED, TEB, TEC, THLC-1, TB1, TEL, TEML

Auxiliary Switch (Installation Instructions GEH-3418 or GEH-5403)

Catalog Number①	Number of Switches	Switch Rating
TEDAS2AB1R	1	6 amperes, ½ horsepower, 120, 240 volts ac 5 amperes, 120 volts ac "Lamp Load"
TEDAS2AB2	2	½ ampere, 125 volts dc ¼ ampere, 250 volts dc

① *For TEL, TEML breakers substitute TEL for TED in Catalog Number (second installation instruction noted applies.)*

Shunt Trip (Installation Instructions GEH-3416 or GEH-5401)

Catalog Number①	Volts		Amperes (Inrush)	
	ac 50-60 Hz	dc	ac	dc
TEDST12	120/240	125	1.0/1.9	1.0
TEDST13	480/600	—	1.5/1.9	—
TEDST7	—	12	—	7.5
TEDST8	—	24	—	4.6
TEDST9	—	48	—	2.4
TEDST11	—	250	—	.4

① *For TEL, TEML breakers substitute TEL for TED in Catalog Number (second installation instruction noted applies.)*

Undervoltage Release (Installation Instructions GEH-5400 or GEH-3417)

Catalog Number①② Heavy Duty/Std. Duty	Current mA	Volts		Dropping (25 watt) Resistor
		ac 50-60 Hz	dc	
TEDXUVAR/—	100	24	—	—
TEDXUVBR/UV 1	18	120	—	—
TEDXUVCR/UV2	18	240	—	7,500
—/UV 4	18	480	—	20,000
—/UV 6	18	600	—	30,000
TEDXUVDR/UV 7	200	—	12	—
TEDXUVER/UV 8	100	—	24	—
—/UV 9	50	—	48	—
TEDXUVER/—	33	—	60	—
TEDXUVGR/UV 10	18	—	125	—
TEDXUVHR/UV 11	18	—	250	7,500

① *For TEL, TEML breakers substitute TEL for TED in Catalog Number (second installation instruction noted applies.)*
② *For TEL, TEML breakers standard duty only.*

Bell Alarm (Installation Instructions GEH-4576 or GEH-5402)

Catalog Number①	Mounting	Switch Rating
TEDBAR	Right Pole	5 amperes, 240 volts ac
TEDBAL	Left Pole	5 amperes resistive, 2½ amperes inductive at 28 volts dc

① *For TEL, TEML breakers substitute TEL for TED in Catalog Number (second installation instruction noted applies.)*

Motor Operators (Installation Instructions GEH-5007)

Catalog Number	Control			Timing (Seconds)		Recommended Fuse
	Volts 50-60 Hz	Amperes		Closing	Opening Reset	
		Inrush	Running			
TEDMOMA1	120 Vac	10.5	5.0	1.5	1.75	.5 Ampere (Time Delay)
TEDMOMA2	240 Vac	2.2	.57	1.5	1.75	
TEDMOMA8	24 volts	2.0	1.0	1.5	1.75	

F225
TFJ, TFC, TFK, THFK, THLC-2, THLC-4, TFL, TLB-4

Auxiliary Switch (Installation Instructions GEH-4653 or GEH-5406)

Catalog Number①	Number of Switches	Switch Rating
TFKASA2AB2	2	6 amperes, 1/2 horsepower, 120, 240 volts ac 5 amperes, 120 volts ac "Lamp Load"
TFKASA2AB4	4	1/2 ampere, 125 volts dc 1/4 ampere, 250 volts dc

① *For TFL breakers substitute TFL for TFK in Catalog Number (second installation instruction noted applies.)*

Shunt Trip (Installation Instructions GEH-4653 or GEH-5406)

Catalog Number①	Volts		Amperes (Inrush)	
	ac 50-60 Hz	dc	ac	dc
TFKSTA12	120/240	125	2.6/5.2	2.7
TFKSTA13	480/600	—	1.5/1.9	—
TFKSTA 7	—	12	—	4.2
TFKSTA 8	—	24	—	4.2
TFKSTA 9	—	48	—	1.0
TFKSTA11	—	250	—	.2

① *For TFL breakers substitute TFL for TFK in Catalog Number (second installation instruction noted applies.)*

Undervoltage Release (Installation Instructions GEH-4653 or GEH-5406)

Catalog Number①	Current mA	Volts		Dropping (25 watt) Resistor
		ac 50-60 Hz	dc	
TFKUVA 1	18	120	—	—
TFKUVA 2	18	240	—	7,500
TFKUVA 4	18	480	—	20,000
TFKUVA 6	18	600	—	30,000
TFKUVA 7	200	—	12	—
TFKUVA 8	100	—	24	—
TFKUVA 9	50	—	48	—
TFKUVA10	18	—	125	—
TFKUVA11	18	—	250	7,500

① *For TFL breakers substitute TFL for TFK in Catalog Number (second installation instruction noted applies.)*

Bell Alarm (Installation Instructions GEH-4620 or GEH-5406)

Catalog Number①	Switch Rating
TFKBAAR②③	5 amperes, 240 volts ac 5 amperes resistive, 2 1/2 amperes inductive at 28 volts dc

① *For TFL breakers substitute TFL for TFK in Catalog Number (second installation instruction noted applies.)*
② *Changes circuit breaker interrupting capacity to: 10KA @ 600 Vac, 22KA @ 480 Vac, 22KA @ 240 Vac.*
③ *UL listed for field installation with model 4 frames and trips.*

Motor Operators① (Installation Instructions GEH-3313)

Catalog Number	Control			Timing (Seconds)		Recommended Fuse
	Volts 50-60 Hz	Amperes Inrush	Amperes Running	Closing	Opening Reset	
TFKMOMA1	120 Vac	9.5	5.5	.25	.25	1 Ampere (Time Delay)
	125 Vdc	7.0	4.5			
TFKMOMA2	240 Vac	5.0	2.5			
	250 Vdc	6.0	4.0			
TFKMOMA8	24 Vdc	24.0	16.0	.45	.50	2 Ampere (Time Delay)
TFKMOMA9	48 Vdc	14.0	9.0	.25	.25	

① *Not available for THLC-2, THLC-4.*

J600
TJC, TJJ, TJK, THJK, TJD, TB4, TBC4

Auxiliary Switch (Installation Instructions GEH-3321)

Catalog Number	Number of Switches	Switch Rating
TJKASA2AB1	1	6 amperes, 1/2 horsepower, 120, 240 volts ac
TJKASA2AB2	2	5 amperes, 120 volts ac "Lamp Load"
TJKASA2AB3	3	1/2 ampere, 125 volts dc
TJKASA2AB4	4	1/4 ampere, 250 volts dc

Shunt Trip (Installation Instructions GEH-3435)

Catalog Number	Volts		Amperes (Inrush)	
	ac 50-60 Hz	dc	ac	dc
TJKSTA12	120-240	125	.9-1.9	1.0
TJKSTA13	480-600	—	1.5-1.9	—
TJKSTA7	—	12	—	7.5
TJKSTA8	—	24	—	4.6
TJKSTA9	—	48	—	2.4
TJKSTA11	—	250	—	.4

Undervoltage Release (Installation Instructions GEH-5408)

Catalog Number	Current mA	Volts		Dropping (25 watt) Resistor
		ac 50-60 Hz	dc	
TJUV1R	18	120	—	—
TJUV2R	18	240	—	7,500
TJUV4R	18	480	—	20,000
TJUV6R	18	600	—	30,000
TJUV7R	200	—-	12	—
TJUV8R	100	—	24	—
TJUV9R	50	—	48	—
TJUV10R	18	—	125	—
TJUV11R	18	—	250	7,500

Bell Alarm (Installation Instructions GEH-3320)

Catalog Number	Mounting	Switch Rating
TJKBAAL	Center Pole	5 amperes, 240 volts ac, 5 amperes resistive, 2 1/2 amperes inductive at 28 volts dc

Heavy Duty Undervoltage Release (Installation Instructions GEH-5409)

Catalog Number	Current mA	Volts		Dropping (25 watt) Resistor
		ac 50-60 Hz	dc	
TJMDVAS	100	24	—	—
TJMDVBS	18	120	—	—
TJMDVCS	18	240	—	7,500
TJMDVDS	200	—	12	—
TJMDVES	100	—	24	—
TJMDVFS	33	—	60	—

Motor Operators (Installation Instructions GEH-4676)

Catalog Number①	Control			Timing (Seconds)		Recommended Fuse
	Volts ac 50-60 Hz	Amperes Inrush	Amperes Running	Closing	Opening Reset	
TJKMOMA1	120 Vac	9.5	5.5	.30	.30	1 Ampere (Time Delay)
	125 Vdc	10.0	3.5			
TJKMOMA2	240 Vac	5.0	3.0			
	250 Vdc	5.5	2.5			
TJKMOMA8	24 Vdc	22.0	15.0	.60	.50	2 Ampere (Time Delay)
TJKMOMA9	48 Vdc	14.0	10.0	.35	.35	

① *TJ4V, TJH-S breaker requires mounting plate Catalog Number 286A7558G8.*

K1200
TKC, TKMA, THKMA, TB6, TBC6, TB8, TBC8

Auxiliary Switch (Installation Instructions GEH-3321)

Catalog Number	Number of Switches	Switch Rating
TKMAAS2AB1	1	6 amperes, ½ horsepower, 120, 240 volts ac
TKMAAS2AB2	2	5 amperes, 120 volts ac "Lamp Load"
TKMAAS2AB3	3	¼ ampere, 250 volts dc
TKMAAS2AB4	4	½ ampere, 125 volts dc

Shunt Trip (Installation Instructions GEH-3344)

Catalog Number	Pole Mounting Suffix		Volts		Amperes (Inrush)	
			ac 50-60 Hz	dc	ac	dc
TKMASTA12			120-240	125	.9-1.9	1.0
TKMASTA13			480-600	—	1.5-1.9	—
TKMASTA7	R	L	—	12	—	7.5
TKMASTA8			—	24	—	4.3
TKMASTA9			—	48	—	2.4
TKMASTA11			—	250	—	.4

Undervoltage Release (Installation Instructions GEH-5408)

Catalog Number	Pole Mounting Suffix	Current mA	Volts		Dropping (25 watt) Resistor
			ac 50-60 Hz	dc	
TKUV1		18	120	—	—
TKUV2		18	240	—	7,500
TKUV4		18	480	—	20,000
TKUV6		18	600	—	30,000
TKUV7	R	200	—	12	—
TKUV8		100	—	24	—
TKUV9		50	—	48	—
TKUV10		18	—	125	—
TKUV11		18	—	250	7,500

Bell Alarm

Catalog Number	Mounting	Switch Rating
TKMABAAL	Center Pole	5 amperes, 240 volts ac, 5 amperes resistive, 2½ amperes inductive at 28 volts dc

Heavy Duty Undervoltage Release (Installation Instructions GEH-5410)

Catalog Number	Current mA	Volts		Dropping (25 watt) Resistor
		ac 50-60 Hz	dc	
TKMDVAS	100	24	—	—
TKMDVBS	18	120	—	—
TKMDVCS	18	240	—	7,500
TKMDVDS	200	—	12	—
TKMDVES	100	—	24	—
TKMDVFS	33	—	60	—

Motor Operators (Installation Instructions GEH-4675)

Catalog Number All K1200①	Control			Timing (Seconds)		Recommended Fuse
	Volts ac 50-60 Hz	Amperes Inrush	Amperes Running	Closing	Opening Reset	
TKMMOMA1	120 Vac	9.0	6.0	.30	.30	1 Ampere (Time Delay)
	125 Vdc	10.5	4.5			
TKMMOMA2	240 Vac	5.0	3.0			
	250 Vdc	4.5	3.0			
TKMMOMA8	24 Vdc	22.0	15.0	.60	.35	2 Ampere (Time Delay)
TKMMOMA9	48 Vdc	14.0	10.0	.40	.30	

① *TK4V, TKH-S breaker requires mounting plate Catalog Number 286A7558G7.*

J600 & K1200
MicroVersaTrip Accessories Right Pole Mounting

Auxiliary Switch (Installation Instructions GEH-4623)

Catalog Number	Number of Switches	Switch Rating
TVAS2AB2R	2	6 amperes – 240 volts ac, 1/2 ampere – 125 volts dc, 1/4 ampere – 250 volts dc
TVAS2AB4R	4	
TVAS6AB2R①	2	6 amperes – 600 volts ac, 1/2 ampere – 125 volts dc, 1/4 ampere – 250 volts dc
TVAS6AB4R①	4	

① *Not UL listed.*

Shunt Trip (Installation Instructions GEH-4623)

Catalog Number	Volts		Amperes (Inrush)		Coil
	ac 50-60 Hz	dc	ac	dc	Resistance
TVST7R		12		2.5	1.6
TVST8R		24		4.6	5.2
TVST9R		48		2.4	46.0
TVST11R		250		0.4	1250.0
TVST12R	120	125	1.0	1.0	130.0
	240		1.9		
TVST13R	480		1.5		313.0
	600		1.9		

Undervoltage (Installation Instructions GEH-4623)

Catalog Number	Volts		Current mA		Coil	Bridge	External Resistor	
	ac 50-60 Hz	dc	ac	dc	Resistance	Rectifier	Ohms	Watts
TVUV1R	120		18		7100	Yes	None	
TVUV2R	240		18		7100		7,100	12W
TVUV3R	380		18		7100		15,000	25W
TVUV4R	480		18		7100		20,000	25W
TVUV6R	600		18		7100		30,000	25W
TVUV7R		12		200	60	No	None	
TVUV8R		24		100	240			
TVUV9R		48		50	960			
TVUV10R		125		18	7100			
TVUV11R		250		18	7100		7500	12W

Combination Shunt Trip/Two Auxiliary Switches (Installation Instructions GEH-4623)

Catalog Number 600 Volt Auxiliary Switch	Catalog Number 250 Volt Auxiliary Switch	Shunt Trip Volts		Coils	Switch Rating
		ac 50-60 Hz	dc		
TV6AB2ST7R	TV2AB2ST7R		12	Same as Shunt Trips	Same as Auxiliary Switches
TV6AB2ST8R	TV2AB2ST8R		24		
TV6AB2ST9R	TV2AB2ST9R		48		
TV6AB2ST11R	TV2AB2ST11R		250		
TV6AB2ST12R	TV2AB2ST12R	120	125		
		240			
TV6AB2ST12R	TV2AB2ST12R	480			
		600			

Combination Undervoltage/Two Auxiliary Switches (Installation Instructions GEH-4623)

Catalog Number 600 Volt Auxiliary Switch	Catalog Number 250 Volt Auxiliary Switch	Volts ac 50-60 Hz	Volts dc	Coils	Switch Rating
TV6AB2UV1R	TV2AB2UV1R	120		Same as Undervoltage Release	Same as Auxiliary Switches
TV6AB2UV2R	TV2AB2UV2R	240			
TV6AB2UV3R	TV2AB2UV3R	380			
TV6AB2UV4R	TV2AB2UV4R	480			
TV6AB2UV6R	TV2AB2UV6R	600			
TV6AB2UV7R	TV2AB2UV7R		12		
TV6AB2UV8R	TV2AB2UV8R		24		
TV6AB2UV9R	TV2AB2UV9R		48		
TV6AB2UV10R	TV2AB2UV10R		125		
TV6AB2UV11R	TV2AB2UV11R		250		

Motor Operators (Installation Instructions GEH-4676)

Catalog Number① All J600	Control Volts②	Control Amperes Inrush	Control Amperes Running	Timing (Seconds) Closing	Timing (Seconds) Opening Reset	Recommended Fuse
TJKMOMA1	120 Vac	9.5	5.5	.30	.30	1 Ampere (Time Delay)
	125 Vdc	10.0	3.5			
TJKMOMA2	240 Vac	5.0	3.0			
	250 Vdc	5.5	2.5			
TJKMOMA8	24 Vdc	22.0	15.0	.60	.35	2 Ampere (Time Delay)
TJKMOMA9	48 Vdc	14.0	10.0	.35	.30	

① *Requires mounting plate Catalog Number 286A7758G8.*
② *AC voltages are 50-60 Hz.*

Motor Operators

Catalog Number All K1200①	Control Volts②	Control Amperes Inrush	Control Amperes Running	Timing (Seconds) Closing	Timing (Seconds) Opening Reset	Recommended Fuse
TKMMOMA1	120 Vac	9.0	6.0	.30	.30	1 Ampere (Time Delay)
	125 Vdc	10.5	4.5			
TKMMOMA2	240 Vac	5.0	3.0			
	250 Vdc	4.5	3.0			
TKMMOMA8	24 Vdc	22.0	15.0	.60	.35	2 Ampere (Time Delay)
TKMMOMA9	48 Vdc	14.0	10.0	.40	.30	

① *Requires mounting plate Catalog Number 286A7558G7.*
② *AC voltages are 50-60 Hz.*

Center Pole Mounting Only

Bell Alarm

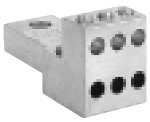
Catalog Number	Single-Pole Double-Throw Switch Rating	Installation Instructions
TFKBAAR	5 amperes, 240 volts ac	GEH-4626
TFKBAAR	2½ amperes, 28 volts ac	GEA-4663

Accessories — Mechanical Data

Mounting Hardware

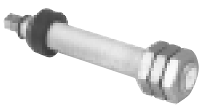
Front Connections

Front-connected Cu-Al lugs allow easy cable feed. The lug mounts directly to the mounting surface with screws and lockwashers.



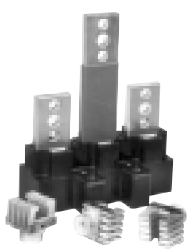
Power Distribution Lugs

Multi-termination lugs enable wiring to multiple devices in UL 508 applications. The lugs are for use on the load side of the breaker only and mount directly to the mounting surface.



Back Connections

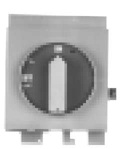
Back-connected studs need to be supported by a sub-base, but make positive contact with each line and load terminal. Studs stay in place while the breaker can be removed or installed.



Plug-In Mounting

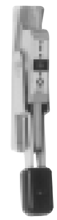
A plug-in base assembly provides for quick changeout of breakers. The assembly backplate mounts to angle-iron cross-pieces. Breaker plug-in terminals align with one-piece backplate assembly.

Handles and Operating Mechanisms



TDR Rotary Operating Handle

The Rotary-Operating Integral Handle mounts directly to the breaker, and operates through the door of the enclosure. A mechanical interlock prevents unauthorized opening of the enclosure when the handle is in the ON position. The locking hasp accommodates up to three padlocks. Suitable for horizontally or vertically mounted breakers. Suitable for NEMA 12K and NEMA 12 enclosures when used with gasket kit.

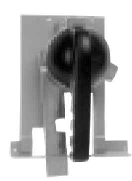


STDA Flange Handle and Variable Depth Operating Mechanism

The STDA Flange Handle is for use with 150-1200 ampere frame circuit breakers. It is designed to meet automotive duty specifications, and NEMA 12 and NEMA 4/4X. UL recognized components are used. The mechanism is of Quick-Make, Quick-Break type with an integral mounting plate and low operating force. Mounting dimensions fit standard flange enclosures 8″-24″ deep. Detailed installation instructions are provided.

SCH Cable Operators

Cable operators make it simple to switch circuit breakers mounted in a wide variety of applications. The handle mechanism is combined with one of eight operating cables, ranging in length from 3 to 10 feet, to cover a broad range of possible breaker mounting locations. The breaker operating mechanism mounts directly to the face of the breaker using hardware included with the mechanism. Flange mounted handles are available for NEMA Type 1, 3R, 12, 13, and 4/4X applications.

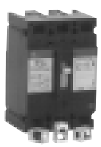


TDM Adjustable Depth Handles

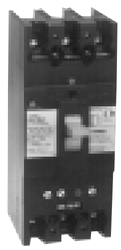
TDM Door-Mounting Handles are available in shallow mounting types and extended shaft type for vertical or horizontal breaker mounting. The mechanism provides interlocking. The door-mounted handle accommodates up to three padlocks. Suitable for NEMA 12K and NEMA 12 enclosures.

NOTE: A pendulum-type handle designated Catalog Number THCH45 is also available for NEMA 4, NEMA 4X, and NEMA 5 enclosures.

Application Data – Molded Case Circuit Breakers

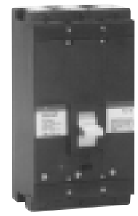


E150
10-150 Amperes



F225
70-225 Amperes

J600
125-600 Amperes



K1200
300-1200 Amperes

Molded case circuit breakers are circuit protective devices that primarily perform two functions: (1) manual switching operation to open and close a circuit by means of a toggle handle and (2) automatic opening of the circuit under sustained overload and/or short circuit conditions. Circuit breakers inherently provide the automatic protective function of opening the circuit under abnormal sustained overload, or short circuit conditions, without the use of fuses. When a circuit breaker opens to clear a fault, the toggle handle goes to a TRIPPED position mid-way between the ON and OFF positions, thus clearly indicating that a circuit breaker has opened. When the cause of the fault has been removed, the circuit breaker can again be closed simply by moving the toggle handle to the RESET position, and then moving the handle to the ON position.

Circuit breakers have an advantage over fusible elements. A fault on one pole of a multi-pole breaker actuates a common trip bar that opens all poles simultaneously, thus avoiding single phasing a motor circuit, as could occur in a fusible device. Molded case circuit breakers are “trip free” in construction. This means that the circuit breaker contacts cannot be held closed against a fault condition. Molded case circuit breakers are designed to protect insulated conductors against unsafe overheating that would ultimately damage the insulation and conductor.

Thermal-magnetic molded case circuit breakers are not designed to provide motor running overload protection. This function is normally performed by overload relays supplied in manual or magnetic motor starters. However, for infrequently started motors, MicroVersaTrip Plus equipped molded case circuit breakers can be used to provide motor overload, overcurrent, and ground fault protection.

Molded case circuit breakers meet UL Standard 489 covering “Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures.”

UL Standard 489 makes provision for two classes of products — UL Standard rated and UL 100 percent rated. The basis of these ratings for molded case and insulated case circuit breakers is as follows:

A. Standard rated under UL 489

1. Circuit breakers are rated to carry 100 percent of their nameplate current continuously in free air at 25°C when cabled per Table 31.1.
2. Enclosed circuit breakers are rated to carry 100 percent of their nameplate current intermittently (up to 3 hours maximum) and 80 percent continuously, with the enclosure in a 25°C ambient, and cabled per Table 32.1.
3. Group mounted circuit breakers may require derating of the circuit breaker and cable in room ambient temperatures other than 25°C and with cable other than specified in Table 32.1.

B. 100-percent rated under UL489

1. Circuit breakers are rated to carry 100 percent of their nameplate current continuously in an enclosure with ventilation and volume as specified on the device in a room ambient of 25°C when cabled as specified in Table 31.1 using 90°C insulation, sized to 75°C ampacity.
2. Room ambient temperatures other than 25°C, cable other than specified in Table 31.1, or enclosure volume and/or ventilation other than specified on the devices may require derating of the system.

100% Rated Circuit Breakers

Frame Type	Catalog Number	
	100% 65kAIC	100% Hi-Break®
J600	TJL1SS	TJH1SS
	TJL3SS	TJH3SS
	TJL4SS	TJH4SS
	TJL6SS	TJH6SS
K1200	TKL8SS	TKH8SS
	TKL12SS	TKH12SS

Standards and References

Underwriters Laboratories
UL 489 Branch Circuit and Service Circuit Breakers
Order from UL Publications Stock, 333 Pfingsten Road, Northbrook, Illinois 60062.

Federal Specifications
WC-375 Circuit Breaker, Molded Case; Branch Circuit and Service

National Electrical Code (NEC) (NFPA 70)
Latest Issue
Order from National Fire Protection Association, One Batterymarch Park, Quincy, Ma. 02269.

Federal Specifications

WC375a

<table>
<tr><th>Federal Class</th><th>Circuit Breaker Type</th><th>Poles</th><th>Volts (ac)</th></tr>
<tr><td>1a</td><td>THQL, THQAL, THQB, THQC</td><td>1</td><td>120/240</td></tr>
<tr><td>1b</td><td>THQL, THQAL, THQB, THQC</td><td>2 and 3</td><td>240</td></tr>
<tr><td>2a</td><td>TED, TEY</td><td>1</td><td>277</td></tr>
<tr><td>2b</td><td>THQL, THQAL, THQB, THQC</td><td>1</td><td>120</td></tr>
<tr><td>2c</td><td>THQL, THQAL, THQB, THQC</td><td>2 and 3</td><td>240</td></tr>
<tr><td>2d</td><td>TED</td><td rowspan="13">2 and 3</td><td rowspan="13">600 maximum</td></tr>
<tr><td>2e</td><td>TB1</td></tr>
<tr><td>2f</td><td>THED</td></tr>
<tr><td>3a</td><td>TFJ, TFK</td></tr>
<tr><td>3b</td><td>THFK</td></tr>
<tr><td>3c</td><td>TB4</td></tr>
<tr><td>3d</td><td>TJJ, TJK</td></tr>
<tr><td>4a</td><td>TB4</td></tr>
<tr><td>4b</td><td>TJJ, TJK</td></tr>
<tr><td>4c</td><td>THJK</td></tr>
<tr><td>5a</td><td>TJK6, TKM8</td></tr>
<tr><td>5b</td><td>THJK6, THKM8</td></tr>
<tr><td>6</td><td>TB6</td></tr>
</table>

WC375b

<table>
<tr><th>Federal Class</th><th>Circuit Breaker Type</th><th>Poles</th><th>Volts</th></tr>
<tr><td>10a①, 10b,
11a, 11b, 12a</td><td>THQB, THQL, THQC, THHQB, THHQL,
THHQC, THQBGF, THQLGF, THQCGF,
THHQLGF, THHQBGF TEB, TED, TEY</td><td>1 or 2
2 or 3</td><td>120/240
240</td></tr>
<tr><td>12b①</td><td>TQD, THQD, THQL, THQG, THQC, TEY, TED4</td><td>2 and 3</td><td>240</td></tr>
<tr><td>12c</td><td>TEY, TED4</td><td>1</td><td>277</td></tr>
<tr><td>13a</td><td>TEY, TED4</td><td>1</td><td>277</td></tr>
<tr><td rowspan="2">13b</td><td>TED4, 15-30 amps</td><td>1</td><td>480④</td></tr>
<tr><td>TEY, TED-4, 15—100 amps</td><td>1, 2, and 3</td><td>277/480</td></tr>
<tr><td>14a①</td><td>THHQL, THHQB, THHQC, TEY</td><td>1 and 2</td><td>120/240</td></tr>
<tr><td>14b</td><td>THQP, TID, TEY</td><td>2 and 3</td><td>240</td></tr>
<tr><td>15a①</td><td>TXQL, TXQB, TXQC, TEY</td><td>1 and 2</td><td>120/240</td></tr>
<tr><td>15b</td><td>TEY, THFK</td><td>2 and 3</td><td>240</td></tr>
<tr><td>16a②</td><td>TB1, TB4</td><td>2 and 3</td><td>480</td></tr>
<tr><td>16b②</td><td>TB1, TB4, TB6</td><td>2 and 3</td><td>600</td></tr>
<tr><td>17a②</td><td>TB4, TB6, TB8</td><td>2 and 3</td><td>600</td></tr>
<tr><td>18a</td><td>TED6 15—100 amps</td><td rowspan="8">2 and 3</td><td rowspan="8">600 maximum</td></tr>
<tr><td>19a</td><td>TFJ③, TFK③</td></tr>
<tr><td>20a</td><td>TFJ③, TFK③</td></tr>
<tr><td>21a</td><td>TJJ, TJK, TKM, TJ4V, TK4V</td></tr>
<tr><td>22a</td><td>THED 15-100 amps</td></tr>
<tr><td>23a</td><td>THJK, THKM, THJ4V, TJH</td></tr>
<tr><td>24a</td><td>TJL, TKL, TJH, TKH</td></tr>
<tr><td>26a</td><td>TB-1, TB-4, TB-6, TB-8</td></tr>
<tr><td rowspan="3">Not defined</td><td>TED 4, TED 6, 110-150 amps</td><td>3</td><td></td></tr>
<tr><td>THED 4, THED 6 110-150 amps</td><td>3</td><td></td></tr>
<tr><td>TEL, TFL, TLB, THLC</td><td></td><td></td></tr>
</table>

① *Single unit or duplex construction must be specified.*

② *This class may incorporate a current limiting device within the breaker case.*

③ *2-pole rated 480Vac maximum.*

④ *UL/CSA 347Vac maximum.*

Current Ratings

Molded case circuit breakers are designed to protect insulated cable, therefore the characteristics of breakers are closely tied to the Underwriters Laboratories specified size and type of wire for each rating as well as the load characteristics. The following items should be considered when applying and using molded case circuit breakers:

A. Cable size must be equal to or greater than that specified by Underwriters Laboratories Inc. Standard for Safety 489. All GE molded case circuit breakers described in this manual are to be used with 75°C ampacity conductors. The use of 90°C conductors is acceptable providing they are sized to the 75°C ampacities. Using a lug marked "Cu9A1" does NOT make the breaker suitable for use with 90°C conductors at 90°C ampacity. Thermal current measuring systems (bimetals and fuses) incorporate a resistance element which generates heat at a rate proportional to the square of the current. The cable is used as a heat sink to control the temperature of the bimetal; reducing the size of the conductor raises the temperature and the breaker will carry less current. In general the effect of cable size on breaker thermal calibration is illustrated in Figure 29.1.

B. Ambient temperatures have an even wider effect on the rating of the breaker-cable system. High ambient temperatures not only affect the calibration of the breaker but may cause internal temperatures to exceed the temperature limits of the insulating materials. Cable may be adapted through the use of higher rated materials such as glass or mineral, but this is not possible with switching devices due to mechanical requirements and fabrication techniques. Low temperatures, on the other hand, substantially increase the current carrying ability of the system until other limiting factors occur, such as lubricant failure or binding due to differential contraction of parts. In general the effect of ambient temperature on an ambient compensating breaker calibration looks like Figure 30.1.

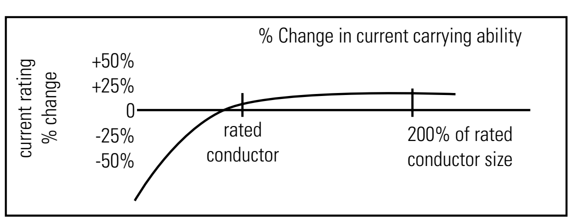
   Notice that the curve in Figure 30.1 specifies the ambient temperature of the air surrounding the breaker not room temperature. To convert this information to room ambient it is necessary to know the temperature rise of the equipment housing the circuit breaker. This must include factors for group mounting of devices, ventilation, solar insulation, other radiant heat sources, etc. The curve in Figure 30.1 also applies only to devices connected with the UL sized conductor.

C. System operating frequency also has a major effect on the rating and performance of molded case circuit breakers. Most circuit breakers may be directly applied at their published ratings on 50 or 60 Hertz systems, but molded case circuit breakers should not be applied at other frequencies without the concurrence of the General Electric Company except as described on page 36, "Factor C — Frequency Rating".

   Two separate effects occur at frequencies above 60 Hertz depending on the method of current sensing. In thermal magnetic devices, the bimetal, which provides overload protection, responds accurately to the applied current. However, the instantaneous element, which is a solenoid constructed of copper and steel, becomes hot. This raises the temperature of the breaker, thereby reducing the continuous current rating of the device. The instantaneous trip solenoid becomes hot because of the nature of its construction and materials. In addition to adding heat to the breaker, the instantaneous trip does not respond to current correctly; the higher the frequency, the less accurate the response.

   At nominal system frequencies less than 50 hertz but above direct current, solid-state trip devices become inoperative due to sensor saturation. Thermal trip devices remain accurate while instantaneous trip solenoids lose accuracy. On direct current systems, solid-state trip units are completely inoperative, thermal trip units calibrate accurately, and instantaneous trip solenoids may or may not be accurate depending on the specific construction technique used.

Figure 29.1
Breaker current rating and conductor size are a matched pair; any insulation type may be used but the cross section must remain constant.



D. Another factor to be considered is the altitude at which the breaker will be applied. The design altitude for molded case circuit breakers is 0 to 6000 feet. At altitudes above 6000 feet the thin atmosphere affects the heat transfer of the breaker as well as its ability to interrupt short circuits. An additional derating of 4 percent is applied at altitudes from 6000 to 10,000 feet.

E. Load type and duty cycle must also be considered in the application of molded case circuit breakers. Loads such as capacitors and electromagnets require a substantial continuous current derating factor if the breaker is normally used to switch the load. Group mounted devices require additional derating due to the lack of free air circulation around the devices.

With loads such as resistance welders, the breaker continuous current rating must be no less than 125 percent of the welder 100 percent duty-cycle rating.

In general, where load protection in addition to cable protection is desired, the load characteristics and protection requirements must be fully evaluated.

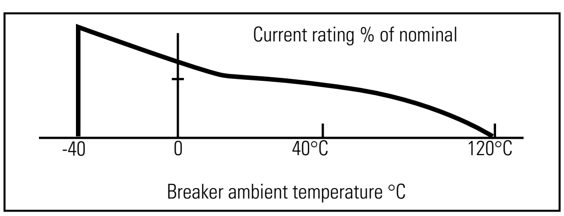
F. An additional factor which needs to be considered is a safety factor. If the circuit breaker is run at the current level derived from factors A-E continuously, it will be within its rating and the conductor ratings, but it will be on the verge of tripping, and any perturbation from nominal could cause the circuit breaker to trip. A safety factor of at least 10 percent should be applied to prevent possible nuisance tripping. Other conditions such as excessive load break operations, overload tripping, or severe load cycling can affect breaker life and should be factored into the rating.

The above information is summarized and tabulated on the following pages for your convenience.

The trip time characteristics of GE solid state trip systems which use rating plugs, like MicroVersaTrip® Plus, do not change over ambient temperature variations which are inside the operating temperature range of the trip unit. The operating temperature range for MVT Plus molded case circuit breakers is -20°C to +55°C. The operating range for the trip unit is -20°C to +85°C. Accordingly, for breakers with MVT Plus, the items above should be used only for the purposes of determining if a larger frame is required. Rating plugs should be selected based solely on the load current in order to provide the tightest overload protection.

Selecting the rating plug based solely on the actual RMS current also permits use of smaller conductors. Referring to Example #2 on page 35, it can be seen that if a non-interchangeable trip thermal magnetic breaker had been selected, it would have been rated 400 amperes and (2) 3/0 AWG conductors per phase would have been required (see Table 32.1). Using the solid state trip breaker with interchangeable rating plug, a 300 ampere rating plug would be appropriate for the load and the conductor size is reduced to (1) 350 kcmil.

Figure 30.1
The effect of ambient temperature on the continuous current carrying ability of the breaker and cable system is shown on page 35, "Factor B – Ambient Temperature."



Current Rating Selection

Circuit breaker ampere rating (I_p) = I_a x A x B x C x D x E x F x G
where:

I_a = Actual full-load current or RMS current	D = Altitude rating factor
A = Wire size factor	E = Load class rating factor
B = Ambient temperature rating factor	F = Safety factor
C = Frequency rating factor	G = 1.0 for intermittent load or 1.25 for continuous load

Table 31.1
Wire and Cable Size by Ampere Rating
Circuit breakers are calibrated and rated for use with the following wire sizes by ampere rating (based on 75°C insulation conductor ampacity).

Circuit Breaker Ampere Rating	Copper Conductor		Aluminum or Copper clad Aluminum Conductor	
	Paralleled	Size	Paralleled	Size
15 or less	—	14 AWG	—	12 AWG
20	—	12 AWG	—	10 AWG
25	—	10 AWG	—	10 AWG
30	—	10 AWG	—	8 AWG
35	—	8 AWG	—	8 AWG
40	—	8 AWG	—	8 AWG
45	—	8AWG	—	6 AWG
50	—	8 AWG	—	6 AWG
60	—	6 AWG	—	4 AWG
70	—	4 AWG	—	3 AWG
80	—	4 AWG	—	2 AWG
90	—	3 AWG	—	2 AWG②
100	—	3 AWG	—	1 AWG②
110	—	2 AWG	—	1/0 AWG
125	—	1 AWG①	—	2/0 AWG
150	—	1/0 AWG	—	3/0 AWG
175	—	2/0 AWG	—	40 AWG
200	—	3/0 AWG	—	250 kcmil
225	—	4/0 AWG	—	300 kcmil
250	—	250 kcmil	—	350 kcmil
275	—	300 kcmil	—	500 kcmil
300	—	350 kcmil	—	500 kcmil
325	—	400 kcmil	2	4/0 AWG
350	—	500 kcmil	2	4/0 AWG
400	2	3/0 AWG	2	250 kcmil
450	2	4/0 AWG	2	300 kcmil
500	2	250 kcmil	2	350 kcmil
550	2	300 kcmil	2	500 kcmil
600	2	350 kvmil	2	500 kcmil
700	2	500 kcmil	3	350 kcmil
800	3	300 kcmil	3	400 kcmil
1000	3	400 kcmil	4	350 kcmil
			3	600 kcmil
1200	4	350 kcmil	4	500 kcmil
	3	600 kcmil		
1400	4	500 kcmil	5	500 kcmil
1600	5	400 kcmil	6	600 kcmil
	4	600 kcmil		
2000	6	400 kcmil	6	600 kcmil
	5	600 kcmil		
2500	8	400 kcmil	9	500 kcmil
	7	500 kcmil	8	600 kcmil
	6	600 kcmil	7	750 kcmil
3000	9	400 kcmil	10	500 kcmil
	8	500 kcmil	9	600 kcmil
	7	600 kcmil	8	750 kcmil
4000	12	400 kcmil	13	500 kcmil
	11	500 kcmil	12	600 kcmil
	10	600 kcmil	11	750 kcmil

① *Number 1 Type RH, RHW, RUH, THW, THWN, or XHHW copper conductor may be used if the circuit breaker is so marked.*
② *Number 1 RH, RHH, RHW, THW, THWN, or XHHW aluminum conductor may be used if the circuit breaker is so marked.*

Table 32.1
Properties of Conductors Rated for Use With Molded Case Circuit Breakers

Size AWG, KCM	Area Cir. Mils	Concentric Lay Stranded Conductors		Bare Conductors		Dc Resistance Ohms/M Ft. at 25°C, 77°F		
						Copper		Aluminum
		No. Wires	Diam. Each Wire Inches	Diam. Inches	Area Square Inches①	Bare Conductor	Tin'd. Conductor	
18	1620	Solid	.0403	.0403	.0013	6.51	6.79	10.7
16	2580	Solid	.0508	.0508	.0020	4.10	4.26	6.72
14	4110	Solid	.0641	.0641	.0032	2.57	2.68	4.22
12	6530	Solid	.0808	.0808	.0051	1.62	1.68	2.66
10	10380	Solid	.1019	.1019	.0081	1.018	1.06	1.67
8	16510	Solid	.1285	.1285	.0130	.6404	.659	1.05
6	26240	7	.0612	.184	.027	.410	.427	.674
4	41740	7	.0772	.232	.042	.259	.269	.424
3	52620	7	.0867	.260	.053	.205	.213	.336
2	66360	7	.0974	.292	.067	.162	.169	.266
1	83690	19	.0664	.332	.087	.129	.134	.211
0	105600	19	.0745	.372	.109	.102	.106	.168
00	133100	19	.0837	.418	.137	.0811	.0843	.133
000	167800	19	.0940	.470	.173	.0642	.0668	.105
0000	211600	19	.1055	.528	.219	.0509	.0525	.0836
250	250000	37	.0822	.575	.260	.0431	.0449	.0708
300	300000	37	.0900	.630	.312	.0360	.0374	.0590
350	350000	37	.0973	.681	.364	.0308	.0320	.0505
400	400000	37	.1040	.728	.416	.0270	.0278	.0442
500	500000	37	.1162	.813	.519	.0216	.0222	.0354
600	600000	61	.0992	.893	.626	.0180	.0187	.0295
700	700000	61	.1071	.964	.730	.0154	.0159	.0253
750	750000	61	.1109	.998	.782	.0144	.0148	.0236
800	800000	61	.1145	1.030	.833	.0135	.0139	.0221
900	900000	61	.1215	1.090	.933	.0120	.0123	.0197
1000	1000000	61	.1280	1.150	1.039	.0108	.0111	.0177
1250	1250000	91	.1172	1.289	1.305	.00863	.00888	.0142
1500	1500000	91	.1284	1.410	1.561	.00719	.00740	.0118
1750	1750000	127	.1174	1.526	1.829	.00616	.00634	.0101
2000	2000000	127	.1255	1.630	2.087	.00539	.00555	.00885

① *Area given is that of a circle having a diameter equal to the over-all diameter of a stranded conductor.*

The values given in the table are those given in Handbook 100 of the National Bureau of Standards except that those shown in the 8th column are those given in Specification B33 of the American Society for Testing and Materials, and those shown in the 9th column are those given in Standard No. S-19-81 of the Insulated Power Cable Engineers Association and Standard No. WC3 of the National Electrical Manufacturers Association.

Table 32.2
Factor A — Wire Size

Applied Wire Cross-Sectional Area as a Percent of Rated Cross-sectional Area	Percent								
	50	60	70	80	90	100①	125	150	200
Factor A	1.4	1.25	1.15	1.07	1.03	1.0	.99	.97	.97

① *The correct size wire should be used with every circuit breaker. The values shown above can be useful in understanding the response of the breaker in some misapplications or in applications where cable ampacity is not required to match breaker ampacity.*

Table 33.1
Factor B — Circuit Breaker Ambient Temperature①

Circuit Breaker Type	Circuit Breaker Ambient Temperature											
	25°C		40°C		50°C		60°C		70°C		80°C	
	B=	Minimum Wire Insulation Rating	B=	Minimum Wire Insulation Rating②	B=	Minimum Wire Insulation Rating②	B=	Minimum Wire Insulation Rating②	B=	Minimum Wire Insulation Rating②	B=	Minimum Wire Insulation Rating②
Q-Line	1.0	60/75	1.0	90	1.16	105	1.19	105	1.27	125	1.38	125
TQD. TJQD	1.0	75	1.0	90	1.08	105	1.17	105	1.26	125	1.38	125
TEB, TED, TEY, TB-1 100A	1.0	60/75	1.0	90	1.05	105	1.05	105	1.14	125	1.25	125
TED 600V, THED, TEL-150A THLC-1	1.0	75	1.0	90	1.0	105	1.1	105	1.21	125	1.38	125
TFJ, TFK, THFK, TFL, TLB-2, THLC-2	1.0	75	1.0	90	1.0	105	1.08	105	1.14	125	1.38	125
TJJ, TJK-4, THJK4, TB4, TLB-4, THLC-4	1.0	75	1.0	90	1.0	105	1.05	105	1.14	125	1.25	125
TJK6, THJK6	1.0	75	1.0	90	1.0	105	1.08	105	1.21	125	1.33	125
TKMA8, THKMA8, TB-8, TB-6	1.0	75	1.0	90	1.0	105	1.05	105	1.18	125	1.25	125
TKMA12, THKMA12	1.0	75	1.0	105	1.0	105	1.1	105	1.15	125	1.25	125
TJ4V, THJ4V, TJL4V, TJH, TJL	1.0	75	1.0	90	1.0	105	—	—	—	—	—	—
TK4V, TKL4V, TKH, TKL	1.0	75	1.0	105	1.0	105	—	—	—	—	—	—

① *This is the air temperature around the outside of the breaker molded case, but inside the enclosure.*
② *Wire size, however, must be based on 75°C ampacity.*

Table 33.2
Factor C — Frequency Rating

Circuit Breaker Type	C (Frequency) Rating Factor							
	Dc	25 Hz	50/60 Hz	100/120 Hz	150/180 Hz	200/240 Hz	300/360 Hz	400/415 Hz
Q-Line	1.0①		1.0	1.01	1.02	1.03	1.04	1.05
TEB, TED, THED, TEY, TEL, THLC-1	1.0		1.0	1.00	1.00	1.00	1.00	1.00
TFJ, TFK, THFK, TFL, TLB-2, THLC-2	1.0		1.0	1.02	1.05	1.09	1.18	1.18
TFC	1.0		1.0	1.02	—	—	—	—
TJJ, TJK, THJK, TLB-4, THLC-4	1.0		1.0	1.02	1.04	1.06	1.15	1.15
TJC	1.0		1.0	1.02	—	—	—	—
TKM8, THKMA8	1.0		1.0	1.02	1.04	1.15	1.35	1.35
TKMA12, THKMA12	—		1.0	1.02	—	—	—	—
TKC	1.0		1.0	1.02	—	—	—	—
TJ4V, THJ4V, TJL4V, TJH, TJL	—		1.0	1.02	1.04	1.06	1.15	1.15
TK4V, TKL4V, TKH, TKL	—		1.0	1.02	1.04	1.15	1.35	1.35

① *Q-Line rated 48 Vdc, 5KA, not UL listed.*

Factor D — Altitude Rating

1.00 for -100 to +6000 feet   1.04 for 6001 to 10000 feet   1.08 for 100001 to 15000 feet

Table 33.3
Factor E — Load Class Rating Total①

Group Mounted (12 or more breakers)	Switching Capacitors	Switching Electromagnets	Single Motor Branch Circuit Protection (Normal Duty)	Single Motor Branch Circuit Protection (Heavy Duty)	All other (Normal) Load Types	Transformer Primary Protection with Secondary Protection ≤600V		Transformer Primary Protection Only – No Secondary Protection ≤600V
						Primary Breaker	Secondary Breaker	
1.1	1.35	1.5	1.25	②	1.0	2.5	1.25	1.25

① *Equals the product of the load class rating factors which apply to the circuit in question.*
② *Refer to the NEC Article 430, Part B, for conductor and circuit breaker sizing.*

Factor F — Safety Factor ≥ 1.1

Table 33.4
Factor G — Duty Factor

Continuous duty (operation at essentially constant load for three hours or more)	Intermittent or short-time duty (constant load for less than three hours or intermittent load)
1.25	1.00

Selection of Circuit Breaker Current Rating

Circuit breakers are primarily used to provide overload and short circuit protection for insulated conductors. In this regard, the National Electrical Code Article 240-3 (1999 NEC) requires that conductors be protected in accordance with their ampacities, as given in NEC Tables 310-16 or 310-17. Exceptions are listed in the article for certain specific applications or conditions including protection for conductors in motor circuits.

The size and type of conductors required for a given circuit is usually calculated by the consulting engineer or other specifying authority, and specified on the job plans. It is in these instances, relatively simple to select a standard circuit breaker rating that matches the ampacity of the conductor. Where standard circuit breaker ratings do not correspond to the ampacity of the conductor, the NEC allows the next higher rating to be used where rating is 800 amperes or less.

For applications where only load currents are known, and motor circuits, ambient temperature, special duty cycles, frequency and altitude are involved, the following formula for selection of standard circuit breaker ratings is used:

Circuit Breaker Ampere Rating = Actual Load Current x A x B x C x D x E x F x G.

The procedure for using this formula is explained in the following steps.

Step 1.

Determine the ACTUAL CURRENT of the circuit by adding the continuous load amperes for each load on the circuit. If the load is intermittent, the actual load current is equal to the RMS current over a time period equal to one-tenth of the frame ampere rating in minutes – 100 ampere frame = 10 minutes, 225 ampere frame – 22.5 minutes, etc.

Example #1:
An air-conditioning compressor cycles on and off at a maximum rate of four per hour and has the following characteristics:

- 62 full load amperes
- 248 locked rotor amperes
- 6 second starting time
- 5 minute off-time between starts

If we use an E frame breaker (150 ampere maximum) we must calculate the RMS current during the worst 10 minute period, which is START and RUN in this example.

$$I_{RMS} = \sqrt{\frac{(I\ start)^2\ (T\ start) + (I\ run)^2\ (T\ run)}{T\ total}} =$$

$$\sqrt{\frac{(248)^2\ (0.1\ minute) + (69)^2\ (9.9\ minutes)}{10\ minutes}}$$

I_{RMS} = 66.5 amperes

If we use an F frame (225 amperes) we must calculate the RMS current during the worst 22.5 minute period which is 0.1 minute START, 9.9 minute RUN, 5 minute OFF, 0.1 minute START, 7.4 minute RUN.

$$I_{RMS} = \sqrt{\frac{(248)^2\ (.1) + (62)^2\ (9.9) + (248)^2\ (.1) + (62)^2\ (7.4)}{22.5}}$$

$$= 59.2\ amps$$

Step 2.

Using the ACTUAL CURRENT, or RMS current determined in Step 1, estimate the breaker frame size required by your application. Retain this “estimated” frame size to complete STEP 3.

Step 3.

Select the appropriate multiplying factors A to F for the application conditions involved, and substitute in the formula. For applications under the jurisdiction of the National Electrical Code the product of B through G must be equal to or greater than 1.25 for continuous loads on standard rated devices and equal to or greater than 1.0 for 100 percent rated devices.

Step 4.

Now compute the proper ampere rating and the proper General Electric circuit breaker for the application by multiplying the ACTUAL CURRENT by each of the four factors determined under STEP 3.

Ampere Rating = Actual Current x A x B x C x D x E x F x G = amperes

Select a breaker having a rating equal to or next above your answer.

Example #2:
To illustrate: Assume a 480 v three phase load of 260 amperes continuous such as an air-handling fan motor. The available short circuit current is 57 kA. The protective device is individually mounted in a switchboard.

The conductors supplying the load will be selected to be equal to 1.25 times the load current.

Ambient temperatures inside the box will not exceed 40°C.

A solid state breaker with a rating plug and long time, short time, ground fault and instantaneous protection is required.

There are no appreciable harmonics associated with the load and the instantaneous inrush is 7.8 times motor full load amperes.

The mounting location will be at 7200 ft.

Circuit Breaker Ampere Rating = I continuous x A x B x C x D x E x F x G.

Rating = 260 x 1.0 x 1.0 x 1.0 x 1.04 x 1.0 x 1.1 x 1.25 = 371.8 amperes.

Select a 400A frame MicroVersaTrip® Plus, TJL4S with a C204LSIG programmer. Since the rating plug is not affected by load characteristics other than the actual RMS current value, select a 300A rating plug rather than a 400A plug.

Interrupting Ratings

Circuit breakers must not only carry the circuit current at all times under normal conditions and trip open under overload conditions, but must have sufficient interrupting capacity to successfully interrupt short circuit current that will flow under the worst fault conditions that can occur.

Basis of Interrupting Ratings

Short-Circuit Current

Interrupting ratings depend upon knowing the magnitude of the short-circuit current that may flow through the circuit breaker or molded case switch. Devices rated in accordance with UL Standard 489 list their interrupting rating in terms of rms symmetrical amps.

The procedures for calculating short-circuit current and the X/R ratios are described in detail in GE Publication GET-3550.

Generally, electrical power system engineers calculate the X/R ratios rather than the power factors of protected circuits during their short-circuit studies. The magnitude of the momentary peak current to be interrupted — or withstood — is a function of the maximum peak current displacement from the zero current axis. That displacement is a function of the X/R ratio (or power factor) of the faulted circuit. The higher the X/R ratio, the lower the power factor, and the greater the magnitude of peak current displacement.

Listed interrupting ratings (Table 38.1) are subject to derating where circuit power factors are below listed values. Table 39.2 lists rating factors versus X/R ratios and power factors to allow the user to compensate the interrupting rating of a circuit breaker for circuit power factor, where necessary.

Frequency

Frequency has an effect upon the interrupting capability of a molded case circuit breaker. Exhaustive testing has been conducted at the two worldwide standard frequencies, 50 Hz and 60 Hz. Less testing has been conducted on industrial circuit breakers at 25 Hz and 400 Hz. Table 40.1 lists suggested application guidelines for circuit breakers in 400 Hz circuits.

The data shown takes into account the lack of world test facilities to verify 400 Hz performance, but does represent the existing best engineering judgment of General Electric.

Power Factor or X/R Ratio

Interrupting ratings of molded case circuit breakers are based upon a specific ratio of reactance-to-resistance, or a specific power factor. Since practical ac circuits contain some reactance, there is some displacement between current and voltage waveforms. Because a short-circuit can literally occur during any point of the voltage wave, an actual trace of short-circuit current may display considerable initial displacement from zero axis.

Figure 36.1
Symmetrical Ac Waveform

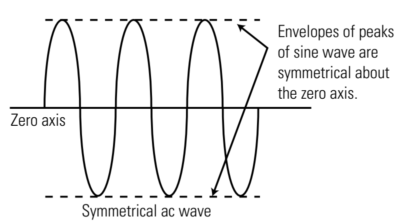
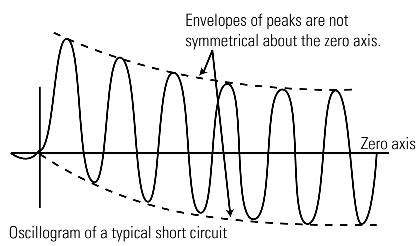


Figure 36.1 shows a symmetrical ac current waveform that would occur if a purely resistive circuit was short-circuited (or even a circuit containing reactance if the short circuit occurred at precisely the right point in the voltage waveform — which is unlikely).

Figure 37.1 shows the current trace of a short circuited ac circuit where displacement about the zero axis exists as a consequence of when the short circuit is applied and the amount of reactance in the short-circuited circuit, compared to its resistance.

Figure 37.1
Asymmetrical Ac Waveform



Interrupting Ratings

There is a simple relationship between the power factor of a short-circuited circuit and its X/R ratio. It is:

$$\text{Power Factor (in Percent)} = \frac{R}{Z} \times 100$$

$$\text{and: } Z = \sqrt{R^2 + X^2}$$

$$\text{therefore PF} = \frac{R}{\sqrt{R^2 + X^2}} \times 100$$

R = Circuit Resistance
X = Circuit Reactance
Z = Circuit Impedance

Interrupting ratings not UL listed are based on tests per NEMA Standard AB-1 "Molded Case Circuit Breakers." The basic rating is given in RMS symmetrical amperes, the preferred basis for selection and application.

In dc applications, values of UL listed interrupting ratings are maximum amperes.

Table 38.1
AC Interrupting Ratings — UL Listed Except as Noted

Circuit Breaker Type	Max. Ampere Rating	Max. ac Voltage	Voltage 120/240 Multi-Pole (2P)	120/240 1 Pole	240 Multi-Pole (3P)	240 1 Pole	277 277/480 Multi-Pole	277 1 Pole	480 Multi-Pole	480 1 Pole	600 Multi-Pole	600 1 Pole
THQB, C, L	100⑦,70⑤	120/240	10000	5000	10000	8660						
THHQB, C, L	100, 70⑤	120/240	22000	5000	22000	8660						
TXQB, C, L	30		65000	5000	65000	8600						
TQD	225		10000	5000	10000	8660						
TQDL	200		10000	5000								
THQD	225		22000	5000	22000	8660						
THQDL	200	120/240	22000	5000								
TEB	100	120		10000								
TEB	100	240			10000	8660						
TEY	100	277/480	65000	65000	65000	8660②	14000	14000				
TED	100	480								10000		
TED	100	277						14000				
TED	100	480			18000	8660			18000	8660		
TB-1	100	600			200000	8660			200000	8660	200000	8660
TEC	150	600			10000	8660			10000	8660	10000	8660
TEC and TECL	150	600			100000	8660			100000	8660	100000	8660
TED	150	600			18000	8660			18000	8660	14000	8660
THED	30	277						65000				
THED	150	600			42000	8660			25000	8660	18000	8660
TEL	150	600			100000	8660			65000	8660	25000	8660
TEML	150	600			100000	8660			65000	8660	25000	8660
THLC-1⑥	150	480			200000	8660			150000	8660	50000	8660
TFJ, TFK④, TFC	225	600			25000	8660			22000	8660	18000	8660
THFK④	225	600			65000	8660			25000	8660	18000	8660
TFL	225				100000	8660			65000	8660	25000	8600
TLB-2	225	480			85000	8660			50000	8660		
THLC-2⑥	225	480			200000	8660			150000	8660	50000	8660
TJD	400	240	22000	10000	22000	8660						
TJ①④	600	600			42000	8660			30000	8660	22000	8660
THJ①④	600	600			65000	8660			35000	8660	25000	8660
TLB-4	400	480			85000	8660			50000	8660		
TJH	600	600			65000	8660			35000	8660	25000	8660
TJL	600	600			100000	8660			65000	8660	30000	8660
THLC-4⑥	400	480			200000	8660			150000	8660	50000	8660
TB-4	400	600			200000	8660			200000	8660	200000	8660
TB-6	600	600			200000	8660			200000	8660	200000	8660
TK④	1200	600			42000	12120			30000	12120	22000	12120
THKMA④	1200	600			65000	12120			35000	12120	25000	12120
TKH	1200	600			65000	12120			50000	12120	25000	12120
TKL③	1200	600			100000	12120			65000	12120	42000	12120
TB-8	800	600			200000	8660			200000	8660	200000	8660

① *Includes J, K, C, and 4V suffixes.*
② *Includes C, MA and 4V suffixes.*
③ *Includes 4V suffixes.*
④ *Interchangeable thermal-magnetic trip circuit breakers are not UL listed for reverse feed.*
⑤ *Single pole limit.*
⑥ *If model is rated for 600 volts.*
⑦ *110A for THQC.*

Note: *The single pole interrupting ratings shown are the UL listed values for three pole devices and are not necessarily the maximum capability of the device. Single pole interrupting capability must be considered when molded case circuit breakers are used on ungrounded or resistance grounded distribution systems.*

Note: *For series-connected ratings with main circuit breakers or fuses, refer to publication DET-008.*

Table 39.1
DC Interrupting Ratings — UL Listed Except as Noted by (*)

Circuit Breaker Type	125 Volts	250 Volts		300 Volts		400 Volts		500 Volts			600 Volts	
	1 Pole	1 Pole	2 Pole	1 Pole	2 Pole	1 Pole	2 Pole	1 Pole	2 Pole	3 Pole①	1 Pole	2 Pole
TEB	5000	—	5000									
TED4, TEC, TED6	10000	—	14000*							10000		
THED	20000*	—	20000*		20000*		20000*					
TFJ, TFK, TFC	10000	—	10000							10000		
THFK	20000*	—	20000*		20000*		20000*					
TJJ, TJK4, TJC, TJD	10000	10000	10000		20000*					20000		
THJK4, THJK6	20000*	10000	40000		20000*		20000*		20000*			
TKMA8, TKC800	10000	10000	10000	10000*						22000		
TKC361200L	22000*	22000*	23000*	10000*	23000*	10000*	23000*		23000*			23000*
THKMA8	20000*	20000*	20000*	10000*	20000*	10000*	20000*	10000*	20000*			

* *Not UL listed.*

① *UL listed for 500 volts 3 poles in series ungrounded battery applications.*

Notes:

1. Direct current interrupting ratings are based on a system fault time constant of 8 ms (milliseconds) or less.

2. Multi-pole ratings (2 or 3) are based on midpoint grounded systems with one pole in positive leg and one pole in negative leg, or end grounded systems with two or three poles wired in series in the ungrounded leg.

3. Single-pole ratings are for application in ungrounded systems.

Table 39.2
Interrupting Rating Multiplying Factors for Power Factors Lower Than (or X/R Ratios Higher Than) Test Values

Power Factor (Percent)	X/R Ratio	Rated Maximum Interrupting Rating		
		1 to 10 kA① Multiplier	11 to 20 kA Multiplier	21 kA and Higher Multiplier
4	24.980	.61	.72	.81
5	19.974	.62	.74	.82
6	16.637	.63	.75	.83
7	14.251	.64	.76	.84
8	12.460	.65	.77	.85
9	11.066	.66	.78	.87
10	9.950	.67	.79	.88
11	9.036	.68	.80	.89
12	8.273	.69	.81	.90
13	7.627	.69	.82	.91
14	7.072	.70	.83	.93
15	6.591	.71	.84	.94
16	6.169	.72	.85	.95
17	5.797	.73	.86	.96
18	5.465	.74	.87	.97
19	5.167	.75	.88	.98
20	4.899	.76	.89	1.000
21	4.656	.77	.90	1.000
22	4.434	.77	.91	1.000
23	4.231	.78	.92	1.000
24	4.045	.79	.94	1.000
25	3.873	.80	.95	1.000
26	3.714	.81	.96	1.000
27	3.566	.82	.97	1.000

Power Factor (Percent)	X/R Ratio	Rated Maximum Interrupting Rating		
		1 to 10 kA① Multiplier	11 to 20 kA Multiplier	21 kA and Higher Multiplier
28	3.429	.83	.98	1.000
29	3.300	.83	.99	1.000
30	3.180	.84	1.000	1.000
31	3.067	.85	1.000	1.000
32	2.961	.86	1.000	1.000
33	2.861	.87	1.000	1.000
34	2.766	.88	1.000	1.000
35	2.676	.88	1.000	1.000
36	2.592	.89	1.000	1.000
37	2.511	.90	1.000	1.000
38	2.434	.91	1.000	1.000
39	2.361	.91	1.000	1.000
40	2.291	.92	1.000	1.000
41	2.225	.93	1.000	1.000
42	2.161	.94	1.000	1.000
43	2.100	.95	1.000	1.000
44	2.041	.95	1.000	1.000
45	1.984	.96	1.000	1.000
46	1.930	.97	1.000	1.000
47	1.878	.97	1.000	1.000
48	1.828	0.98	1.000	1.000
49	1.779	0.99	1.000	1.000
50	1.732	1.000	1.000	1.000

① *kA = Kiloamps (1 kA is 1,000 amps) rms, symmetrical.*

Table 40.1
Estimated 400-415 Hz Interrupting Ratings in Amperes — Not UL Listed

Circuit Breaker Type	Volts			
	120	120/208 and 120/240	277/480	346/600
THQL, B, C		1000		
THHQL, B, C		2200		
TXQL, B, C		6500		
TQD, TQDL		1000		
THQD, THQDL		2200		
TEY	6500	6500	1400	
TEB	1000	1000	—	—
TED 4	1800	1800	1400	—
TED 6	1800	1800	1400	1400
THED	6500	6500	2500	1800
TFL, TEL	10000	10000	6500	2500
TFJ, TFK	2500	2500	2200	2200
THFK	6500	6500	2500	2200
THLC-1	20000	20000	15000	5000
TJD		2200	2200	
TJJ, TJK	4200	4200	3000	2200
TJ①	4200	4200	3000	2200
THJ①	6500	6500	3500	2500
TJH	6500	6500	3500	2500
TJL	10000	10000	6500	3000
TK①	4200	4200	3000	2200
THK①	6500	6500	5000	2500
TKH	6500	6500	5000	2500
TKL	10000	10000	6500	4200

① *Includes soild state trips.*

Note: *400-Hertz interrupting ratings are based on engineering judgement, taking into consideration the operating characteristics of molded case circuit breakers and the worldwide lack of test facilities to verify performance.*

Table 40.2
Q-Line and TEB Molded Case Switch Short Circuit Withstand Rating①

Molded Case Switch Catalog Number	Maximum Rating Protective Device②		Short Circuit Withstand Rating
	Voltage	Amps	Amps rms Sym
TQL, TQB, TQC21Y690	120/240	60	10,000
TQL, TQB, TQC21Y100	120/240	100	10,000
TQL, TQB, TQC22Y60	240	60	10,000
TQL, TQB, TQC22Y100	240	100	10,000
TQL, TQB, TQC32Y60	240	60	10,000
TQL, TQB, TQC32Y100	240	100	10,000
TEB111Y100	240	100	10,000
TEB122Y100	240	100	10,000
TEB132Y100	240	100	10,000

① *Q-Line and TEB molded case switches have a 10,000 amp symmetrical short circuit withstand rating when protected by a fuse or circuit breaker rated 10,000 amps IC or greater and whose ampere rating does not exceed the ampere rating of the switch.*
② *Protective device must be on line side of molded case switch.*

Note: *Circuit breakers, Mag-Break® instantaneous only breakers and molded case switches are inherently horsepower rated by the testing performance requirements in UL489. They are therefore not marked with horsepower ratings. See NEC Article 430-109.*

Table 41.1
Molded Case Switch Short Circuit Withstand Rating

Molded Case Switch		Protective Device①		Short Circuit Withstand Ratings	
Ampere Rating	**Catalog Number**	**Type**	**Max. Amp Rating**	**Amps rms Sym.**	**Max. Voltage**
100	TED113Y100	Any fuse or circuit breaker rated 10,000A 240V	100	10,000	240
100	TED134Y100	TED134100	100	14,000	480
150	TED136Y150	TED126150	150	14,000	600
		TED134150	150	14,000	480
225	TFJ236Y225	TED, THED	150	14,000	600
		TFJ, TFK, THFK	225	14,000	600
		Class J Fuse	400	14,000	600
225	TQD32Y225	TQD	225	14,000	240
400	TJD432Y400	TJD	400	22,000	240
		Class T Fuse	400	50,000	240
400	TJJ436Y400	TFJ, TFK, THFK	225	18,000	600
				22,000	480
		TJJ, THJK, TJ4V, THJ4V, TJL4S, TJL4SS, TJH4S, TJH4SS	400	30,000	480
		Class J Fuse	400	50,000	600
600	TJK636Y600	TJJ, THJK,	400	22,000	600
		TJ4V, THJ4V,		30,000	480
		TJL4S, TJL4SS, TJH4S, TJH4SS			
		Class J Fuse	600	50,000	600
		TJK, THJK,	600	22,000	600
		TJ4V, THJ4V,		30,000	480
		TJL6S, TJL6SS, TJH6S, TJH6SS			
800	TKMA836Y800	TJK, THJK,	600	22,000	600
		TJ4V, THJ4V,		30,000	480
		TJL6S, TJL6SS, TJH6S, TJH6SS			
		TKM, THKM,	800	22,000	600
		TK4V, THK4V,		30,000	480
		TKL8S, TKL8SS, TKH8S, TKH8SS			
		Class L Fuse	800	50,000	600
1200	TKMA3Y1200	TJK, THJK,	600	22,000	600
		TJ4V, THJ4V,		30,000	480
		TJL6S, TJL6SS, TJH6S, TJH6SS			
		TKM, THKM,	1200	22,000	600
		TK4V, THK4V		30,000	480
		TKL12S, TKL12SS, TKH12S, TKH12SS			
		Class L Fuse	1200	50,000	600

① *Three-pole, 600 volt switches cover 2-pole, 600 volt and 2- and 3-pole, 480 volt switches.*

Table 41.2
Electrical Formula — For Obtaining kW, kVA, Horsepower and Amperes

Wanted	Single-phase	Alternating Current Two-phase, Four-wire	Three-phase	Direct Current
Kilowatts	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times 2 \times PF}{1000}$	$\frac{I \times E \times 1.73 \times PF}{1000}$	$\frac{I \times E}{1000}$
kVA	$\frac{I \times E}{1000}$	$\frac{I \times E \times 2}{1000}$	$\frac{I \times E \times 1.73}{1000}$	$\frac{I \times E}{1000}$
Horsepower	$\frac{I \times E \times \%\ Eff. \times PF}{746}$	$\frac{I \times E \times 2 \times \%\ Eff. \times PF}{746}$	$\frac{I \times E \times 1.73 \times \%\ Eff. \times PF}{746}$	$\frac{I \times E \times \%\ Eff.}{746}$
Amperes from kVA	$\frac{kVA \times 1000}{E}$	$\frac{kVA \times 1000}{2 \times E}$	$\frac{kVA \times 1000}{1.73 \times E}$	$\frac{kVA \times 1000}{E}$
Amperes from kW	$\frac{kW \times 1000}{E \times PF}$	$\frac{kW \times 1000}{2 \times E \times PF}$	$\frac{kW \times 1000}{1.73 \times E \times PF}$	$\frac{kW \times 1000}{E}$
Amperes from Hp	$\frac{Hp \times 746}{E \times \%\ Eff. \times PF}$	$\frac{Hp \times 746}{2 \times E \times \%\ Eff. \times PF}$	$\frac{Hp \times 746}{1.73 \times E \times \%\ Eff. \times PF}$	$\frac{Hp \times 746}{E \times \%\ Eff.}$

E = *Volts*
I = *Amperes*
% Eff. = *Percent Efficiency*
PF = *Power Factor*

A.C. Short Circuit Determination —

For methods of calculating short-circuit currents for industrial and commercial power systems, request a copy of GET-3550.

Application Data

Table 42.1
Molded Case Switch Horsepower Ratings

Catalog Number	No. of Poles	Amperes	Volts	Horsepower Ratings					
				240 Volt		480 Volt		600 Volt	
				Single-phase	Three-phase	Single-phase	Three-phase	Single-phase	Three-phase
TEB122Y100	2	100	240 Vac	20	—	—	—	—	—
TEB132Y100	3	100	240 Vac	20	30	—	—	—	—
TED124Y100	2	100	480 Vac	20	—	40	—	—	—
TED134YT100	3	100	480 Vac	20	30	40	75	—	—
TED126Y100	2	100	600 Vac	20	—	40	—	50	—
TED136YT100	3	100	600 Vac	20	30	40	75	50	100
TED136YT150	3	150	600 Vac	30	50	50	100	50	150
TFJ226Y225	2	225	600	50	—	50	—	50	—
TFK226Y225	2	225	600	50	—	50	—	50	—
TFJ236Y225	3	225	600	50	75	50	150	50	200
TFK236Y225	3	225	600	50	75	50	150	50	200
TJJ426Y225	2	225	600	50	—	50	—	50	—
TJJ426Y400	2	400	600	50	—	50	—	50	—
TJK426Y400	2	400	600	50	—	50	—	50	—
TJJ436Y225	3	225	600	50	75	50	150	50	200
TJJ436Y400	3	400	600	50	150	50	300	50	400
TJK436Y400	3	400	600	50	150	50	300	50	400
TJD522Y400	2	400	240	—	—	—	—	—	—
TJD432Y400	3	400	240	—	—	—	—	—	—
TJK626Y600	2	600	600 Vac	50	—	50	—	50	—
TJK636Y600	3	600	600 Vac	50	200	50	500	50	500
TKMA2Y1000	2	1000	600	50	—	50	—	50	—
TKMA3Y1000	3	1000	600	50	250	50	500	50	500
TKMA2Y1200	2	1200	600	50	—	50	—	50	—
TKMA3Y1200	3	1200	600	50	250	50	500	50	500