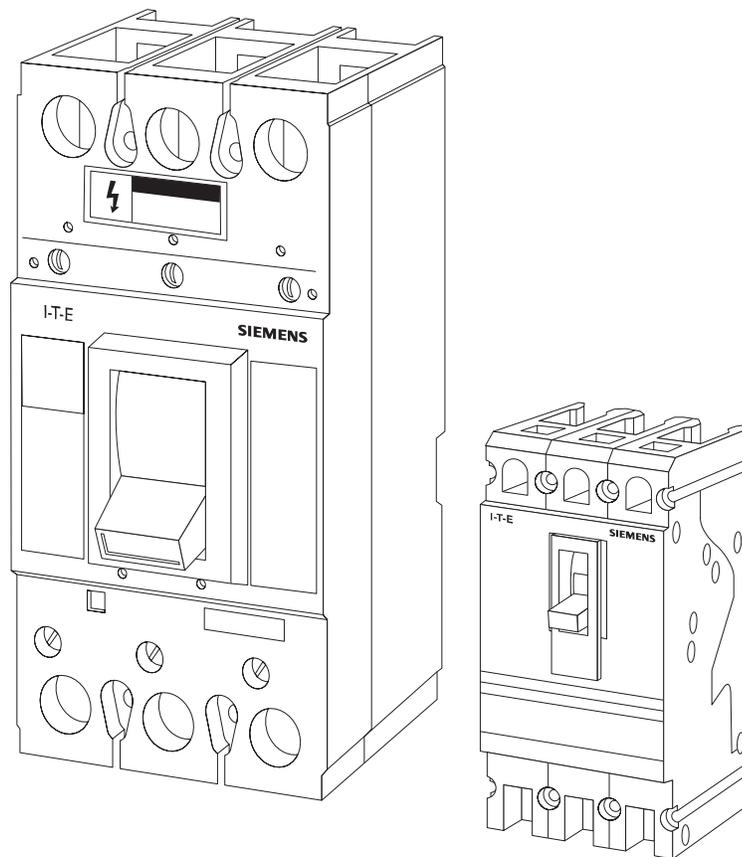


Sentron™ Series Circuit Breakers

Siemens Sentron™ Series circuit breakers are available in nine frame sizes: ED, FD, JD, LD, LMD, MD, ND, PD, and RD. Sentron Series circuit breakers have a wide range of uses in commercial and industrial applications, such as: combination motor starters, control centers, and distribution and power circuits in panelboards and switchboards, machine tools, resistance welder control panels, service entrance protection and main distribution feeder circuits in switchboards.



Ampere Rating

Sentron Series breakers are available with ampere ratings from 125 to 2000 amps. Each frame is divided into specific ampere ratings. For example, in the following table it can be seen that the ED frame has a maximum continuous current range of 15 to 125 amps. When selecting a circuit breaker, refer to the Siemens Speedfax® catalog for specific product ratings.

Frame	Ampere Rating	Maximum Continuous Ampere Rating
ED	125	15-125
FD	250	70-250
JD	400	200-400
LD	600	250-600
LMD	800	500-800
MD	800	500-800
ND	1200	800-1200
PD	1600	1200-1600
RD	2000	1800-2000

Voltage Rating

Breakers are rated according to the maximum voltage they can handle. Sentron breakers are available with the voltage ratings shown below. Breakers may be applied on systems with lower voltages than their maximum voltage rating, but never on systems above their maximum voltage ratings.

UL Voltage Ratings	IEC Voltage Ratings
120 VAC	220 VAC
240 VAC	240 VAC
277 VAC	380 VAC
480 VAC	415 VAC
600 VAC	500 VAC
125 VDC	
250 VDC	
500 VDC	

Interrupting Rating

The interrupting rating refers to the level of fault current that a breaker can safely interrupt. Sentron breakers are available with interrupting ratings from 10,000 to 200,000 amps. A color coded label system is used to identify the maximum interrupting rating.

Color Label	Interrupting Category	Voltage Range	Maximum Interrupting Current
Blue	Standard	240 - 600 VAC	65,000 Amps
Black	High Interrupting	240 - 600 VAC	100,000 Amps
Red	Current Limiting	240 - 600 VAC	200,000 Amps

The easiest way to determine the interrupting rating of a specific circuit breaker is with the interrupting selector in the Speedfax catalog. For example, if a customer required a 100 amp Sentron Series circuit breaker capable of interrupting 10,000 amps at 240 VAC, the ED2 could be selected. However, if the customer required a 100 amp Sentron circuit breaker capable of interrupting 200,000 amps at 480 VAC, either the CED6 or the CFD6 could be selected. Another column, not shown here, references a page number where more detail can be found concerning the selected circuit breaker.

I-T-E® Molded Case Circuit Breakers

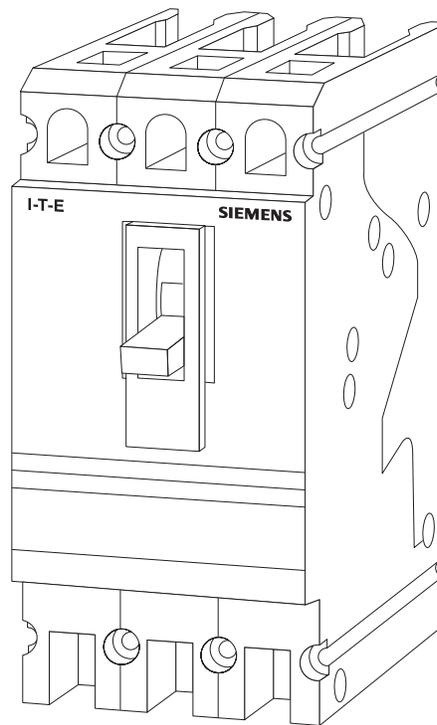
Selection/Application - Interrupting Selector

UL Interrupting Rating	Voltage Rating	Continuous Current	Breaker Type
10,000	120, 120/240	15-100	ED2
		15-125 125-225	QP, QT, BQ QPP
	240	15-100 15-125 60-225	ED2 QP, BQ, BL QJ2
	277	15-30	BQC
200,000	240	15-125 70-250 200-400 450-600 400-800 800-1200 1200-1600	CED6 CFD6 CJD6, SCJD6, HHJD6, HHJXD6 CLD6, SCLD6, HHLD6, HHLXD6 CMD6, SCMD6 CND6, SCND6 CPD6
		15-125 70-250	CED6 CFD6

ED Frame Sentron Circuit Breaker

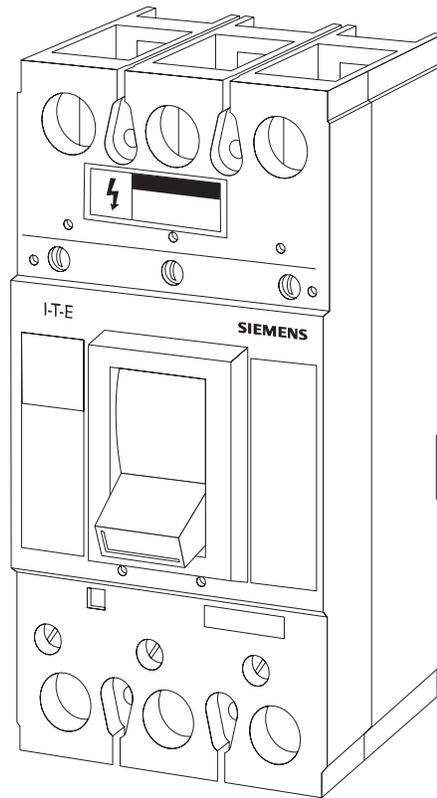
The ED frame circuit breaker is the smallest and least expensive circuit breaker in the Sentron Series family. Its frame ampere rating is 125 amps. ED frame circuit breakers are used in individual enclosures, switchboards, panelboards, and load centers. ED frame circuit breakers are available as a molded case switch, instantaneous magnetic trip circuit breaker (motor circuit protection), or thermal magnetic circuit breaker which provides complete overload and short circuit protection. The trip circuit is non-interchangeable. Fixed instantaneous trip values are shown in the following chart:

Ampere Rating	Fixed Instantaneous Band
15-25	400-700
30-125	600-1000



Other Sentron Series Circuit Breakers

The other Sentron Series circuit breakers (FD, JD, LD, LMD, MD, ND, PD, and RD) range in frame size from 250 to 2000 amperes.



Some Sentron Series circuit breakers, like the JXD6 breaker, are UL listed for reverse feed applications. This means that power can be applied to the load side of the circuit breaker. Depending on the specific circuit breaker, Sentron Series circuit breakers are available as a molded case switch, instantaneous magnetic trip circuit breaker (motor circuit protection), or thermal magnetic circuit breaker which provides complete overload and short circuit protection.

Some circuit breakers, like the FD6 breaker, have interchangeable trip units. Other circuit breakers, like the JXD6 have non-interchangeable trip units. The instantaneous trip values are externally adjustable. For example, a CFD6 circuit breaker with a 200 ampere trip unit as noted in the following table was used during the time-current curve discussion. It can be seen from the following table that the trip unit can be adjusted in eight steps from 900 to 2000 amps.

Breaker Ampere Rating	Nominal Instantaneous Band							
	Low	2	3	4	5	6	7	High
70-90	600	640	690	730	770	810	850	900
100-110	700	770	840	920	990	1060	1140	1200
125-150	800	900	1000	1100	1200	1300	1400	1500
175-200	900	1060	1210	1370	1520	1780	1930	2000
225-250	1100	1300	1500	1700	1900	2100	2300	2500

Selecting a Sentron Series Circuit Breaker

Selecting a circuit breaker requires the use of the Siemens Speedfax catalog. Suppose a customer requested a Sentron Series interchangeable trip, 2-pole circuit breaker with a continuous ampere rating of 300 amps, capable of interrupting an available fault current of 35,000 amps at 600 volts. The first place to look would be the Interrupting Selector of the Speedfax catalog. Note in the following example that there are four possible choices for breaker type: HJD6, HJXD6, HLD6, and HLXD6.

I-T-E® Molded Case Circuit Breakers

Selection/Application - Interrupting Selector

UL Interrupting Rating	Voltage Rating	Continuous Current	Breaker Type
35,000	480	70-250 200-400 250-600 450-600	FXD6, FD6 JXD6, JD6, SJD6 LD6, SLD6 LXD6
	600	200-400	HJD6, HJXD6 HLD6, HLXD6

The next step would be to go to the Discount Schedule. The JD frame is a 400 ampere frame and the LD frame is a 600 ampere frame. If the customer does not need the larger frame, the JD frame will be a good choice. The right catalog number is HJD62B300.

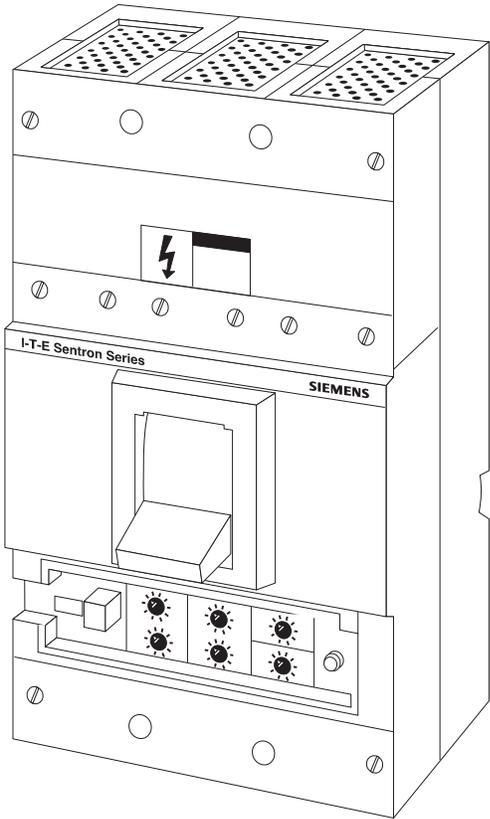
JD 400A Frame - Type HJD6

2-Pole 600 VAC, 250 VDC

Interchangeable Trip		
Continuous Current Rating @ 40° C	Complete Breaker Unassembled	
	Catalog Number	List Price
200	HJD62B200	
225	HJD62B225	
250	HJD62B250	
300	HJD62B300	

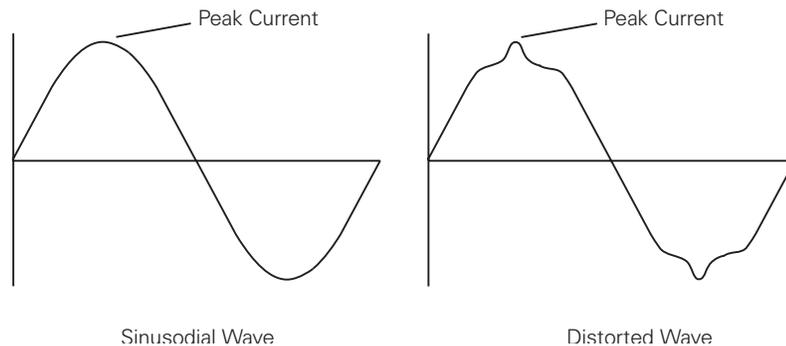
Sentron™ Series Digital Circuit Breakers

The Sentron™ Series circuit breakers are also available in a digital circuit breaker version, referred to as Sensitrip® III. Sensitrip III circuit breakers utilize a microcomputer which makes it possible to customize overcurrent protection that is matched exactly to the loads of an electrical system.

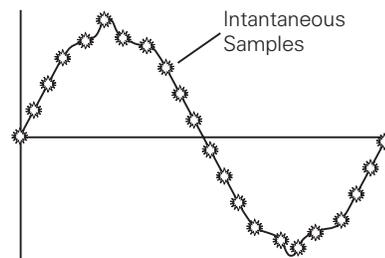


True RMS Sensing

Some solid state circuit breakers react to peak currents of a sine wave. This method accurately measures the heating effect of the current on sine waves that are perfectly sinusoidal. Frequently, however, sine waves are distorted due to harmonics on the line. When this happens, peak current measurement does not adequately evaluate the true heating effect of the current.



Sensitrip III digital circuit breakers use true RMS sensing to detect what is really happening with current. RMS (root-mean-square) current is the effective value of AC current. Sensitrip III RMS sensing capabilities take multiple, instantaneous "samples" of the actual current waveshape for a more accurate picture of its true heating value.



Being able to monitor true RMS current precisely is becoming more important in today's electrical distribution systems because of the increasing number of power electronic devices being used that can distort the waveform of the current. The microcomputer in Sensitrip III breakers samples the AC current waveform many times a second, converting each value into a digital representation. The microcomputer then uses the samples to calculate the true RMS value of the load current. This capability allows Sensitrip III breakers to perform faster, more efficiently and with repeatable accuracy.

Maximum Continuous Ampere Rating

Sensitrip III breakers are available in 400 through 1600 amp, 600 VAC and below, frames. A color label system is used to identify the interrupting category of the circuit breaker.

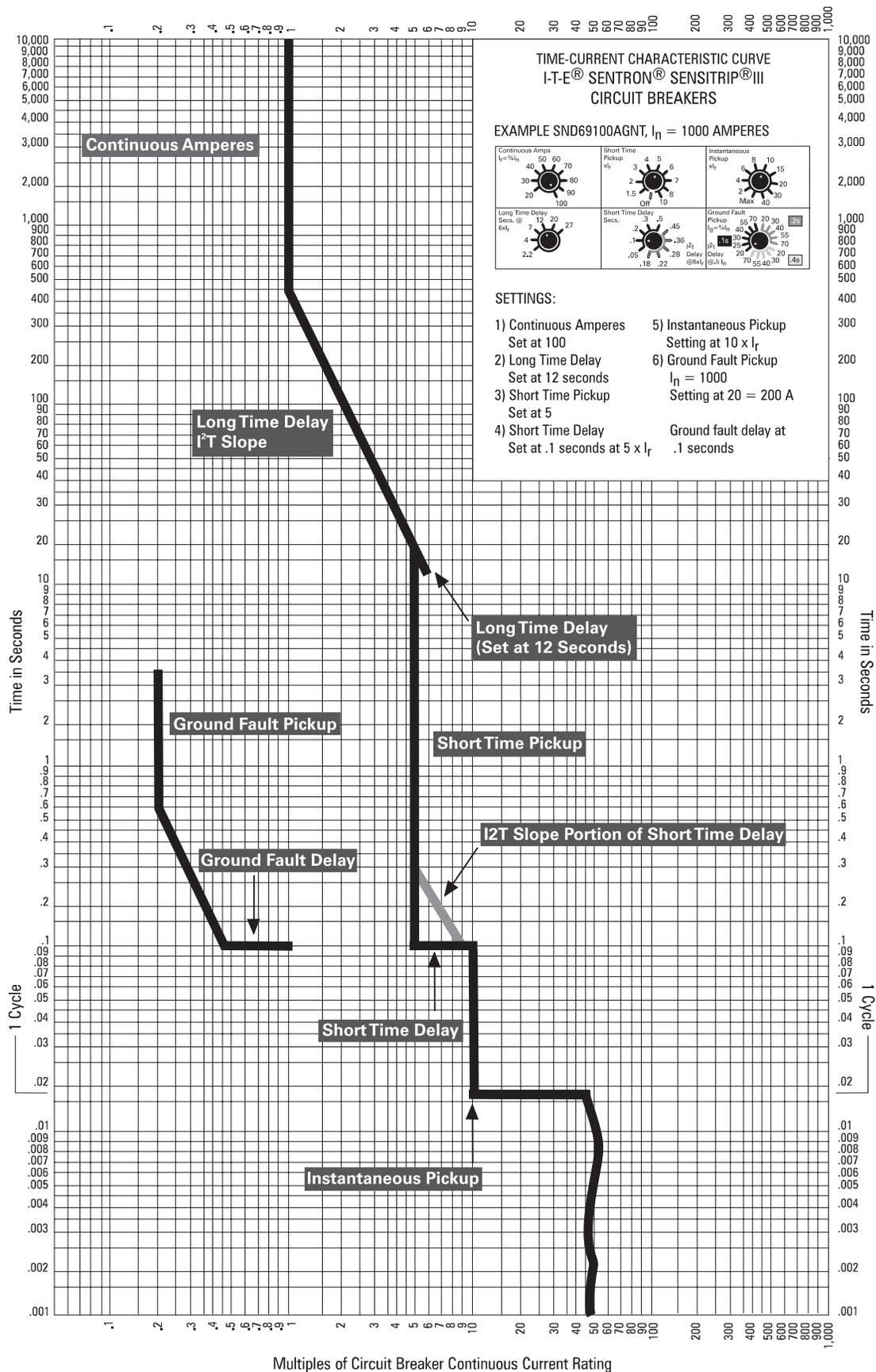
Blue = standard interrupting rating

Black = high interrupting rating

Red = current limiting

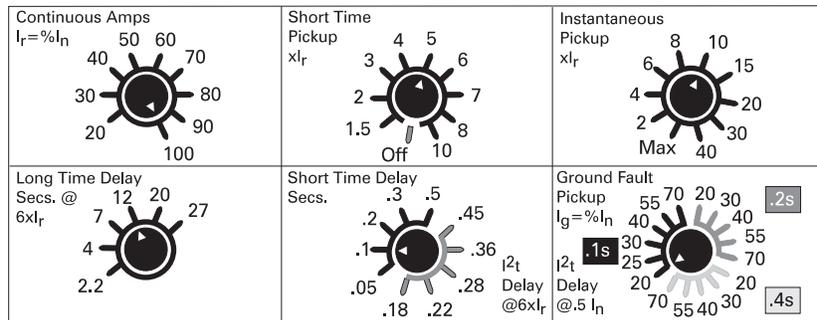
Frames are grouped according to maximum current. For example, it can be seen from the following table that a 1200 ampere frame Sensitrip III is available with 800, 1000, or 1200 maximum continuous amperes. Maximum continuous amperes is also referred to as nominal ampere rating (I_n).

Frame Size	Maximum Continuous Amperes (I_n)	Continuous Ampere Range ($I_r = \% \text{ of } I_n$)
400 A	200	40-200
	300	60-300
	400	80-400
600 A	300	60-300
	400	80-400
	500	100-500
	600	120-600
800 A	600	120-600
	700	140-700
	800	160-800
1200 A	800	160-800
	1000	200-1000
	1200	240-1200
1600A	1200	240-1200
	1400	280-1400
	1600	320-1600



Adjustable Functions

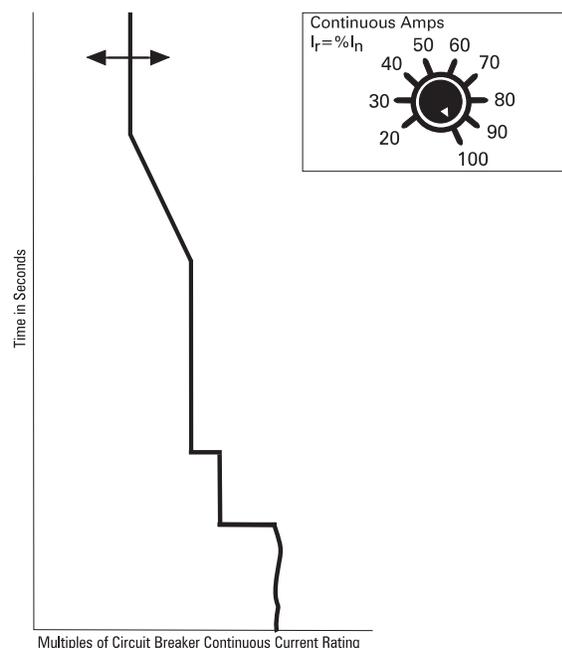
Curve shaping allows adjustment of individual circuit breakers for proper coordination between upstream and downstream devices. The basic adjustable functions are shown in the following illustration.



The time-current curve on the preceding page reflects one possible setup for a 1200 ampere Sensitrip III circuit breaker with a nominal (maximum continuous ampere) rating of 1000 amps. This time-current curve will be the basis for discussing adjustable features of the Sensitrip III circuit breakers.

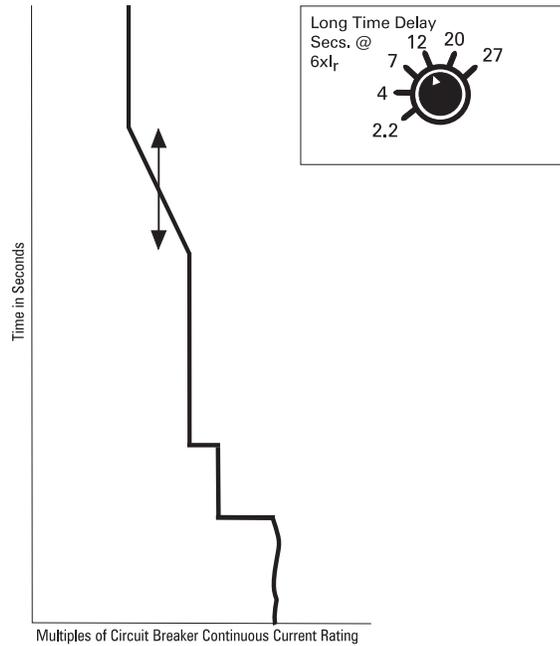
Continuous Amps (I_r)

Continuous Amps (I_r) varies the level of current the circuit breaker will carry without tripping. I_r is a percentage of the circuit breaker's nominal rating (I_n). Continuous amps can be adjusted from 20 to 100 percent of the circuit breaker's nominal rating. For example, a 1000 amp Sensitrip III breaker can be changed from 1000 amps to 800 amps by adjusting the breaker continuous amps setting to 80%.



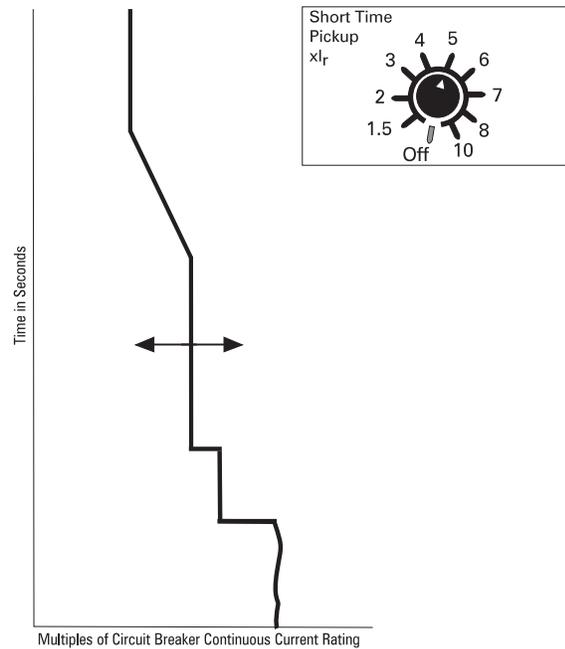
Long-Time Delay

Long-time delay causes the breaker to wait a certain amount of time to allow temporary inrush currents, such as those encountered when starting a motor, to pass without tripping. The adjustment is from 2.2 to 27 seconds at six times the continuous amps (I_r) setting. As shown below, the long-time delay effects the position of an I^2T slope. This means that lower levels of current will allow the breaker to remain online for longer periods of time.



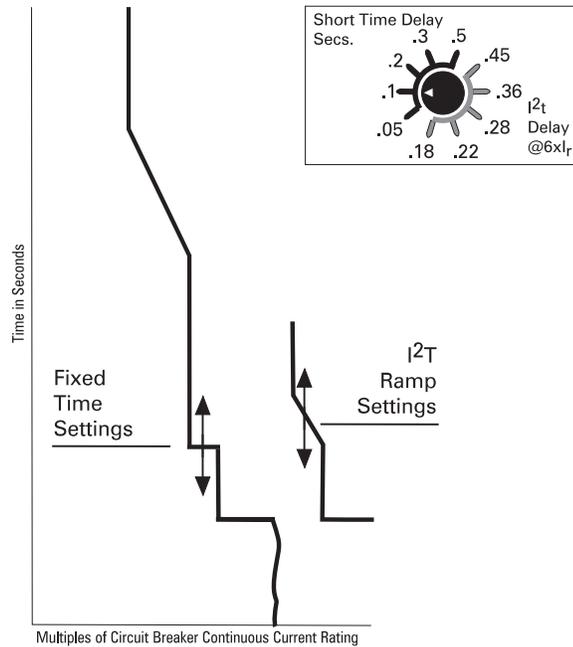
Short-Time Pickup

Short-time pickup is used for selective tripping. The short-time pickup function determines the amount of current the breaker will carry for a short period of time, allowing downstream protective devices to clear short-circuits without tripping the upstream device. Short-time pickup is adjustable from 1.5 to 10 times the trip unit ampere setting (I_r). For example, a 1000 ampere frame can be adjusted to trip anywhere from 1500 to 10,000 amps. The switch also has an "OFF" position to eliminate short-time pickup and short-time delay.



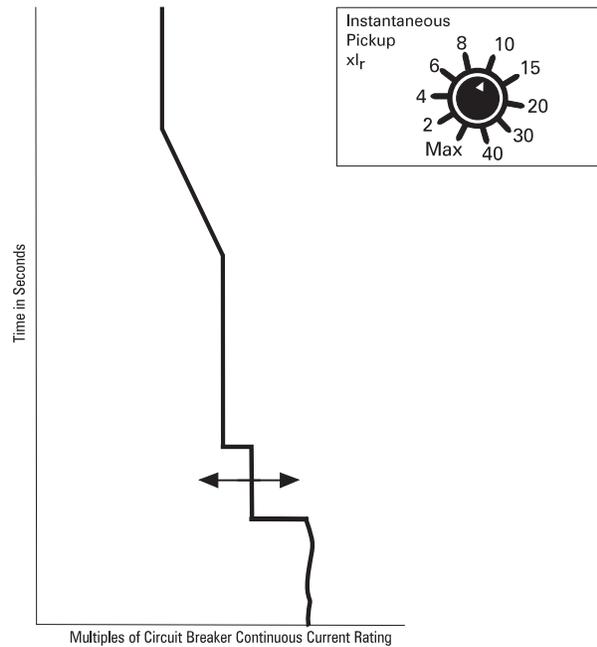
Short-Time Delay

Short-time delay, used in conjunction with short-time pickup, controls the time involved in postponing a short-time pickup trip. There are two modes: fixed time, or I^2T ramp. Fixed time is adjustable from .05 to .5 seconds. The I^2T ramp mode is adjustable from .18 seconds to .45 seconds, providing a short inverse time ramp. This allows better coordination with downstream thermal-magnetic circuit breakers and fuses. A fixed instantaneous trip point of 10,000 amps trips the breaker automatically and overrides any pre-programmed instructions.



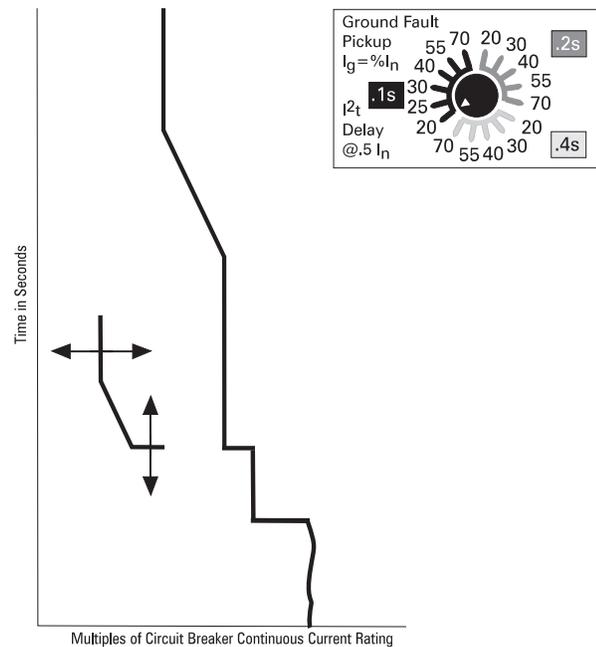
Instantaneous Pickup

Instantaneous pickup is used to trip the circuit breaker with no intentional delay at any current between 2 and 40 times the breaker's continuous ampere setting (I_r). In this example instantaneous pickup has been set to 10 times the continuous amp setting, or 10,000 amps (10×1000) with a continuous amp setting of 1000 amps. In this case a higher setting would still trip at 10,000 amps due to a fixed instantaneous override of 10,000 amps which automatically trips the breaker regardless of the instantaneous pickup setting. If the continuous amp setting had been 300 amps, setting the instantaneous pickup at 10 would make the instantaneous setting equal to 3000 amps, well below the fixed instantaneous override.

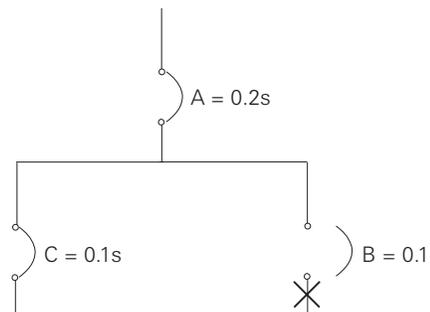


Ground Fault Pickup

Ground fault pickup controls the amount of ground fault current that will cause the breaker to interrupt the circuit. The adjustment can be set from 20 to 70% of the maximum breaker rating. In compliance with *NEC*® 230.95 (A), no trip point setting exceeds 1200 amps. The ground fault pickup is divided into three sections; 0.1s, 0.2s, and 0.4s. This feature adds a time delay of 0.1, 0.2, or 0.4 seconds to the breaker's trip when a ground fault occurs.



The ground fault pickup time delay feature is useful for circuit breaker coordination. In the following illustration, upstream breaker "A" has been set to 0.2s and downstream breakers "B" and "C" have been set to 0.1s. A ground fault occurring in the circuit supplied by "B" will trip the "B" breaker without disturbing "A" or "C."



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Review 5

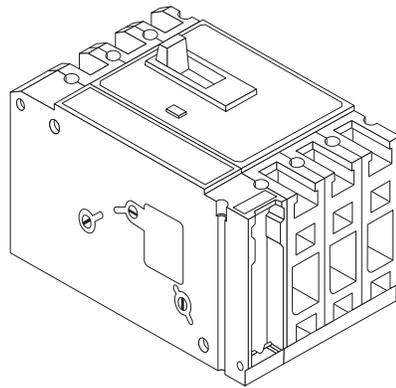
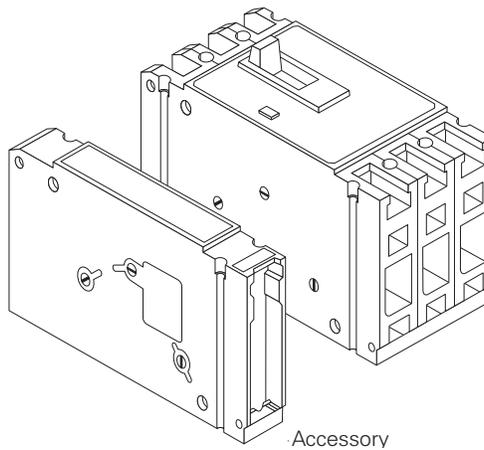
1. Sentron Series breakers are available in frame sizes from 125 to _____ amps.
2. A _____ color label is used to identify a current limiting Sentron Series breaker.
3. True _____ sensing is an advantage of the Sentron Sensitrip III circuit breakers over thermal-magnetic breakers.
4. Setting the continuous amps setting of a Sensitrip III 1200 amp breaker to 50% changes the breaker's continuous current trip point to _____ amps.
5. Long-time delay on a Sensitrip III is adjustable from _____ to _____ seconds.
6. If a 1000 amp Sensitrip III breaker's continuous amps is set to 100% and instantaneous pickup is set to "8," the breaker will trip instantaneously (without intentional delay) at _____ amps.

Internal Accessories

An accessory is an addition that adds to the performance of a circuit breaker or adapts the circuit breaker for specific application requirements. Various accessories are available for Siemens molded case circuit breakers. Internal accessories are used to modify a breaker's performance. The four internal accessories are shunt trip, undervoltage trip, auxiliary switches, and bell alarm.

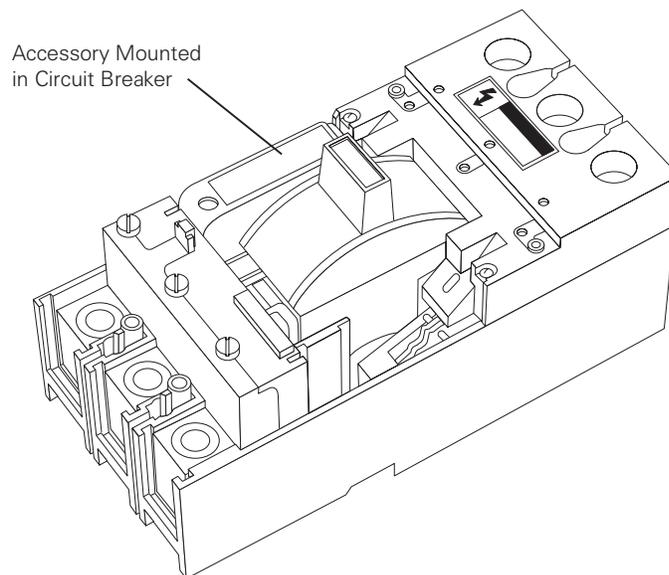
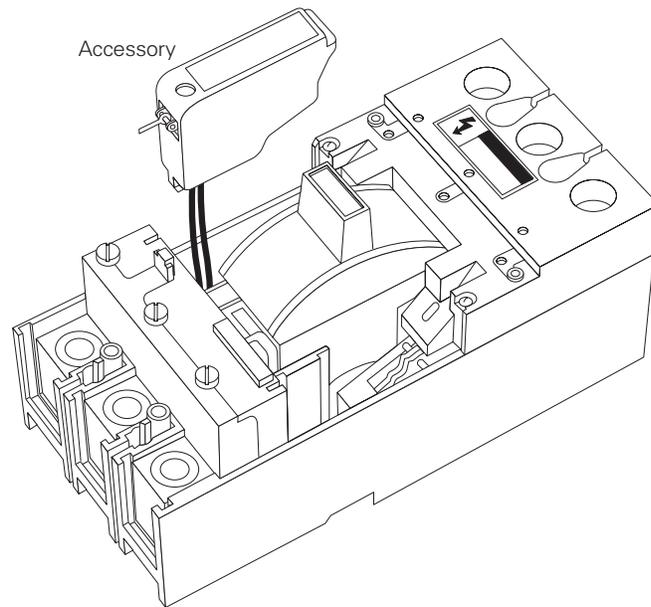
ED Frame Accessories

Mounting of internal accessories is handled differently for ED frame circuit breakers than for the other Sentron™ Series type circuit breakers. ED frame circuit breaker internal accessories are mounted on the side of the circuit breaker as shown in the following illustration.



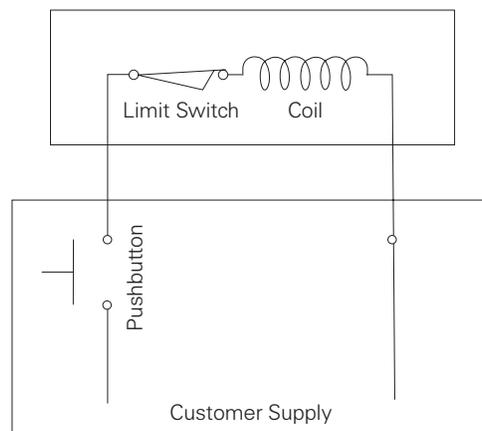
Other Sentron Series Accessories

To mount internal accessories in all other Sentron Series circuit breakers, remove the cover and install the accessories as shown in the following illustrations.



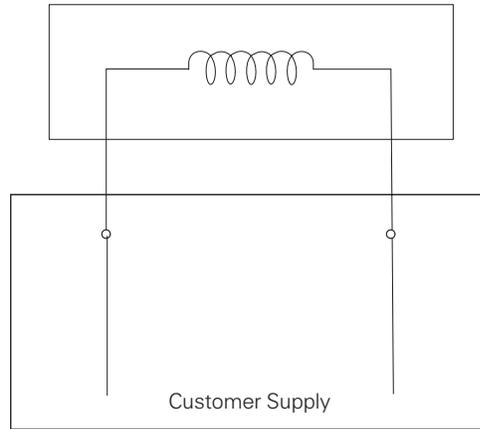
Shunt Trip

Because circuit breakers are often in a panel remote from operating equipment, it is sometimes necessary to trip a breaker remotely so that equipment can be stopped rapidly. For this reason, a circuit breaker shunt trip device is sometimes wired to a push button located on or near an operator panel. The shunt trip device consists of a coil in series with a limit switch. When the circuit breaker contacts are closed the limit switch is closed. Pressing a customer-supplied pushbutton energizes the shunt trip coil, causing the breaker's mechanical latch to disengage the trip mechanism and opening the circuit breaker's contacts. When the circuit breaker's contacts open the limit switch also opens, removing power from the shunt trip coil. As with any trip, the breaker must be reset manually.



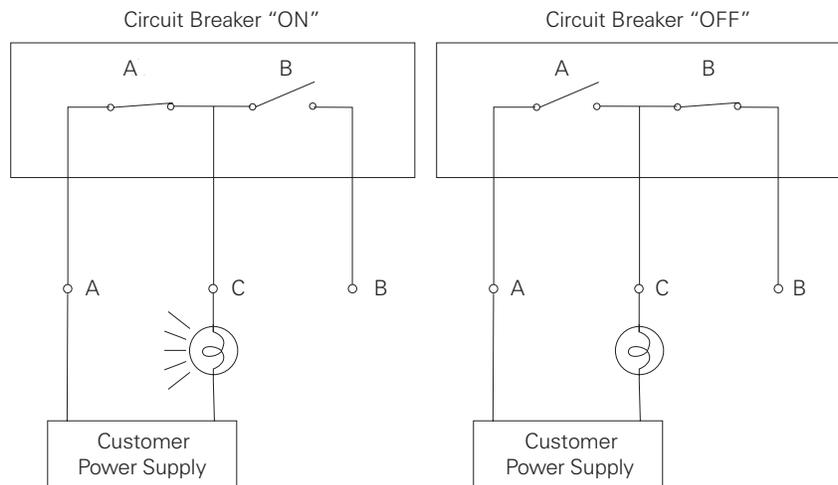
Undervoltage Trip

The undervoltage trip device is designed to automatically trip the circuit breaker when the supply voltage drops to a low value (35-70% of nominal line voltage). The device also prevents the circuit breaker from being reclosed until the supply voltage returns to at least 85% of its normal level.



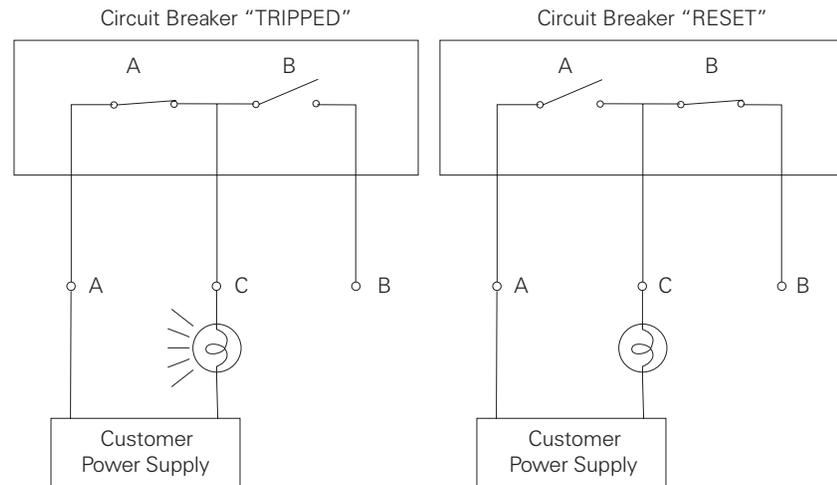
Auxiliary Switch

An auxiliary switch is an accessory that can be wired to a circuit that indicates the state of the circuit breaker. For example, in the circuits shown below, contact "A" is closed and the indicator light is on when the circuit breaker is on. At the same time, contact B, a normally closed contact, is open. If the circuit breaker is tripped or turned off, the states of the auxiliary switch contacts change and the light goes out.



Bell Alarm Switch

The bell alarm switch differs from the auxiliary switch in that it only functions when the circuit breaker trips. Opening and closing the circuit breaker by means of the operating handle does not affect the position of the alarm contacts. The "A" contact closes and the "B" contact opens when the circuit breaker trips. A horn or indicator light can be used to indicate the circuit breaker has tripped.



Accessory Combinations

The maximum number of internal accessory combinations available for each breaker type is shown in the Speedfax catalog.