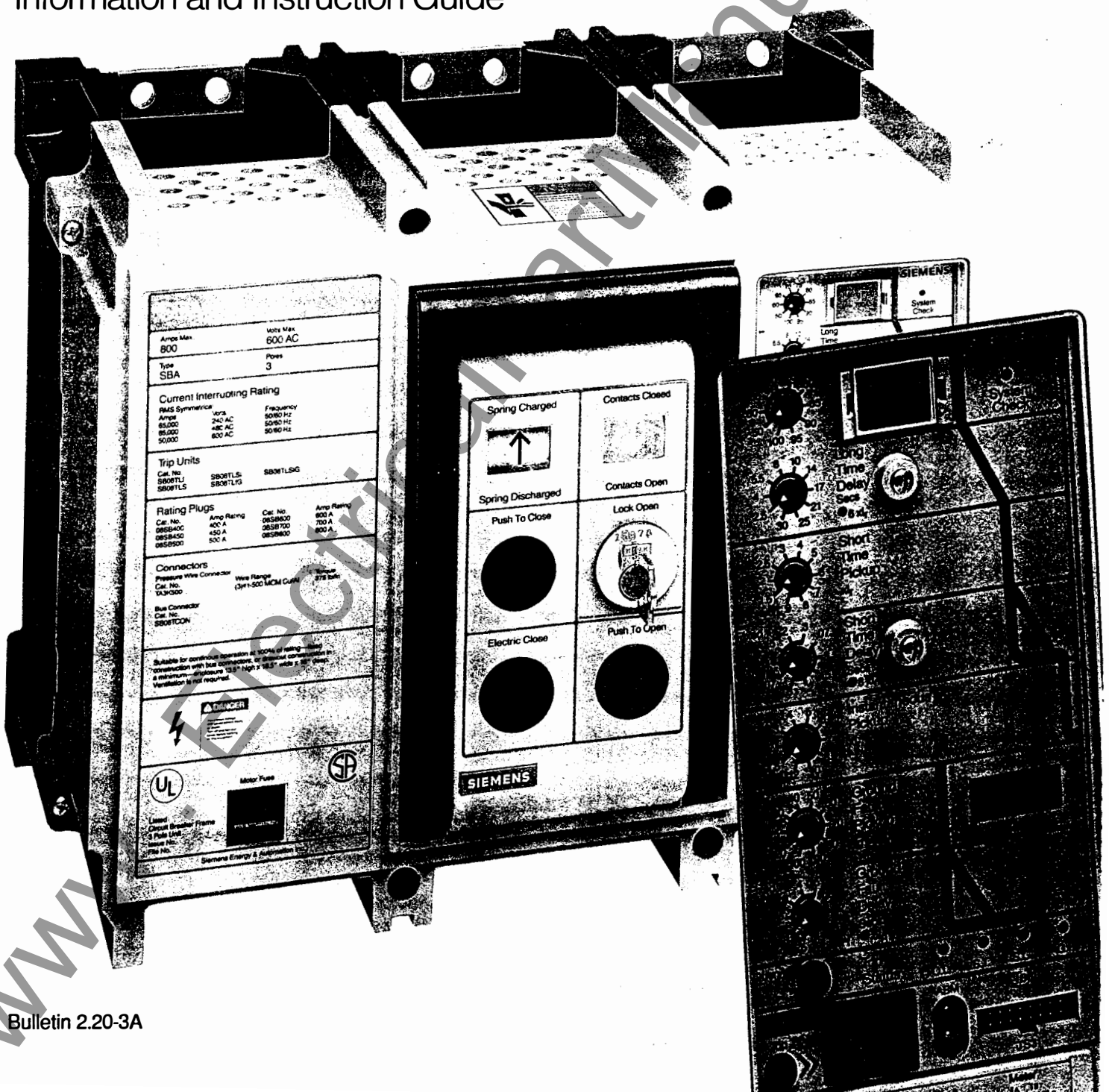
SIEMENS

Tony King's trip unit info

Electronic Trip Unit for SB Encased Systems Breakers

Information and Instruction Guide



Bulletin 2.20-3A

⚠ DANGER

Hazardous voltages are present inside the enclosures or panels in which the circuit breakers are installed. Serious injury, electrocution, and/or equipment damage **will** result if circuit breakers are improperly applied or precaution is not used.

De-energize all incoming power prior to installation of circuit breakers or associated accessories.

Only qualified personnel should work on or around this equipment.

Position of circuit breaker indicators shown in this booklet is for illustration purposes only. Circuit breakers are to be installed in Off or Tripped position only.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

NOTE

***Authorized and qualified personnel—**
For the purpose of this manual a qualified person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, he has the following qualifications:

(a) **is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
(b) **is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
(c) **is trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office, listed on back of this instruction guide.

The contents of this instruction manual should not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Energy & Automation, Inc. The warranty contained in the contract between the parties is the sole warranty of Siemens Energy & Automation, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

Electronic Trip Unit for Siemens Type SB Systems Breakers

Table of Contents

Electronic Trip Unit For Siemens Type SB Systems Breaker

Electronic Trip Unit
The Electronic Trip Unit is a microprocessor controlled multi-function overcurrent protective device for application with Siemens state-of-the-art family of Type SB Systems Breakers. The adjustment flexibility provided by the Electronic Trip Unit allows the user to easily accommodate load changes and other protective requirements while still assuring optimum coordination. In addition to the adjustment protection functions, the trip unit is designed to use field interchangeable rating plugs. These rating plugs allow the ampere rating of the circuit breaker to be changed to meet specific applications.

For ease of installation and interchangeability in the field, the trip unit has been designed as a plug-in unit to mount directly into a Type SB Breaker frame.

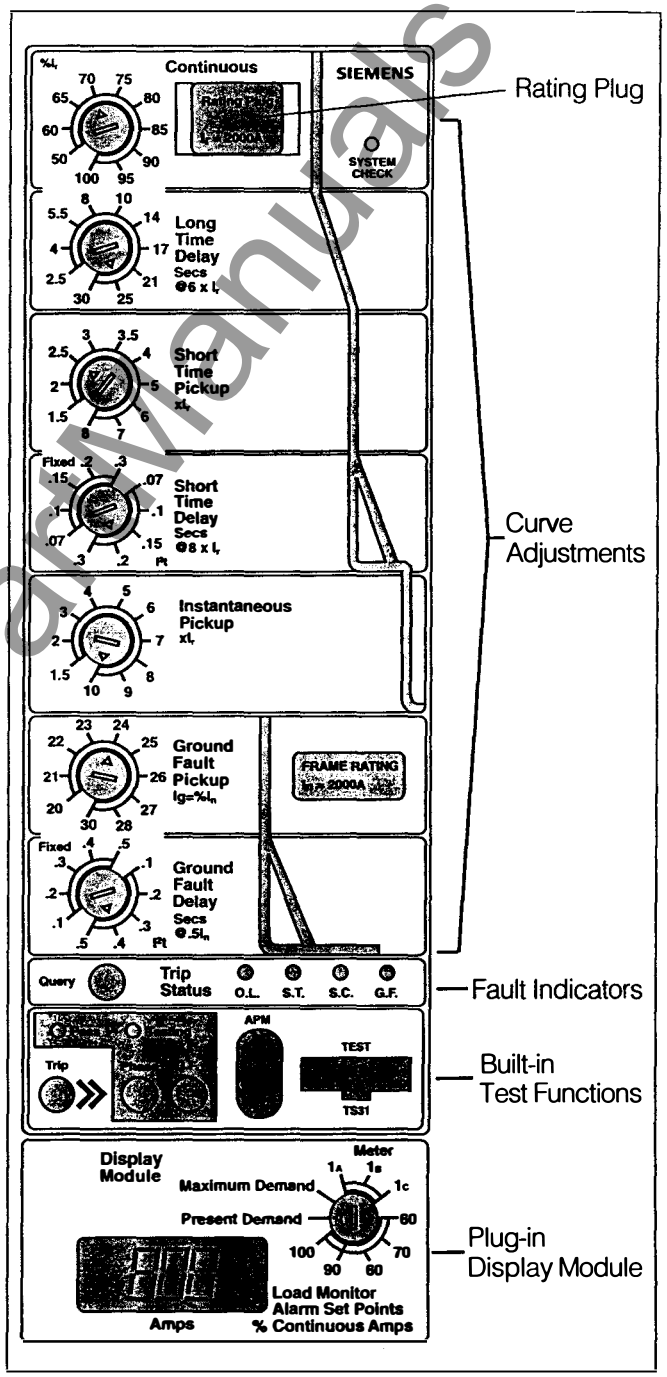
Current sensors within the Type SB Breaker provide signal currents and operating power for the trip unit. Therefore, when the circuit breaker is closed, the trip unit requires no external connections or control power to perform its protection functions.

Overcurrent Protection Configurations
Trip units are available in six basic overcurrent protection configurations to meet specific protection requirements. All trip units have Adjustable Continuous Current and Long Time Delay. Optional protection configurations are:

Protection Configuration	Identifier
Long Time/Short Time	(LS)
Long Time/Instantaneous	(LI)
Long Time/Short Time/Instantaneous	(LSI)
Long Time/Short Time/Ground Fault	(LSG)
Long Time/Instantaneous/Ground Fault	(LIG)
Long Time/Short Time/Instantaneous/ Ground Fault	(LSIG)

As standard features, the trip unit has two built-in-test functions and a fault identification function. System Check is a built-in-test function that continuously checks the status of the microprocessor and protective algorithms. A green LED on the front panel blinks approximately every 3 seconds when the microprocessor is properly cycling through its protection routines. Integral Test is a built-in-test that allows the user to exercise the trip unit electronics, breaker-magnetic latch, and breaker mechanism if desired. LED indicators display the testing status. Trip Status is a fault identification function that stores information when a current fault causes the trip unit to trip the circuit breaker. By pressing the Query button the user can display the cause of the breaker trip by illuminating one of four LED's: OL (overload), ST (short time), SC (short circuit), or GF (ground fault).

Additional optional features include:
Display Module for local current monitoring (field addable)
Zone Selective Interlocking
Communications for remote monitoring



Electronic Trip Unit Adjustment Panel (4000A illustrated)

General Information, Frame Sizes and Frame Ampere Ratings

RMS Current Sensing

The Siemens microprocessor controlled Electronic Trip Unit executes the overcurrent fault protection functions of the Type SB Systems Circuit Breakers. The adjustment flexibility provided by the Electronic Trip Unit allows the user to easily accommodate load changes and other protection requirements while still assuring optimum coordination. A standard feature of the Electronic Trip Unit is RMS current sensing. As opposed to peak-current sensing, RMS sensing measures the true heating potential of the current waveform. This allows for more accurate overcurrent protection and eliminates nuisance tripping due to harmonic distortion of the current waveform.

Siemens Type SB Systems Breaker

Three physical Type SB frame sizes are presently available. These are the 800A, 2000A, and 4000A. The interrupting ratings of these frames are given in the following table.

UL Symmetrical RMS Amperes Interrupting Rating (A.I.R.)

UL Listed Symmetrical Amperes	Frame Size 800A	2000A	4000A
Alternate A.I.R. Rating, kA			
@ 240V ac	65	85	NA
@ 480V ac	65	65	NA
@ 600V ac	42	50	NA
Standard A.I.R. Rating, kA			
@ 240V ac	100	100	150
@ 480V ac	100	100	100
@ 600V ac	50	65	85
High A.I.R. Rating, kA			
@ 240V ac	200	200	200
@ 480V ac	150	150	150
@ 600V ac	100	100	100

Within each frame size is a series of available frame ampere ratings (I_n). The frame ampere rating is determined by the current transformers within the frame. Properly rated Electronic Trip Units are available for all Type SB systems breakers. The trip units are fully field installable by authorized personnel. A special rejection scheme is built into the frames and trip units to prevent the installation of a trip unit into a frame for which it is not intended. This rejection scheme is illustrated on page 7. The combinations of frame sizes and frame ampere ratings are illustrated in the following table.

Frame Sizes/Ratings Combinations

Breaker Frame Size	Breaker Frame Ampere Ratings (I_n)
800A	400A 800A
2000A	1200A 1600A 2000A
4000A	2500A 3200A 4000A

Rating Plugs

Field interchangeable rating plugs are used to set the effective ampere rating of the circuit breaker. Available rating plugs, as a function of the frame ampere ratings, are given in the following table. Note that the maximum rating plug value for a particular Electronic Trip Unit is equal to the frame rating; the minimum is equal to 50% of the I_n. A rejection scheme is built into the rating plugs and trip units to prevent the insertion of a rating plug into a trip unit for which it is not intended.

Available Rating Plugs

Frame Ampere Rating (I_n)	Rating Plug Values (Amperes) (I_r)
400A	200, 225, 250, 300, 350, 400
800A	400, 450, 500, 600, 700, 800
1200A	600, 700, 800, 1000, 1200
1600A	800, 1000, 1200, 1600
2000A	1000, 1200, 1600, 2000
2500A	1600, 2000, 2500
3200A	1600, 2000, 2500, 3000, 3200
4000A	2000, 2500, 3000, 3200, 4000

See pages 38 and 39 for a complete listing of trip unit and rating plug catalog numbers.

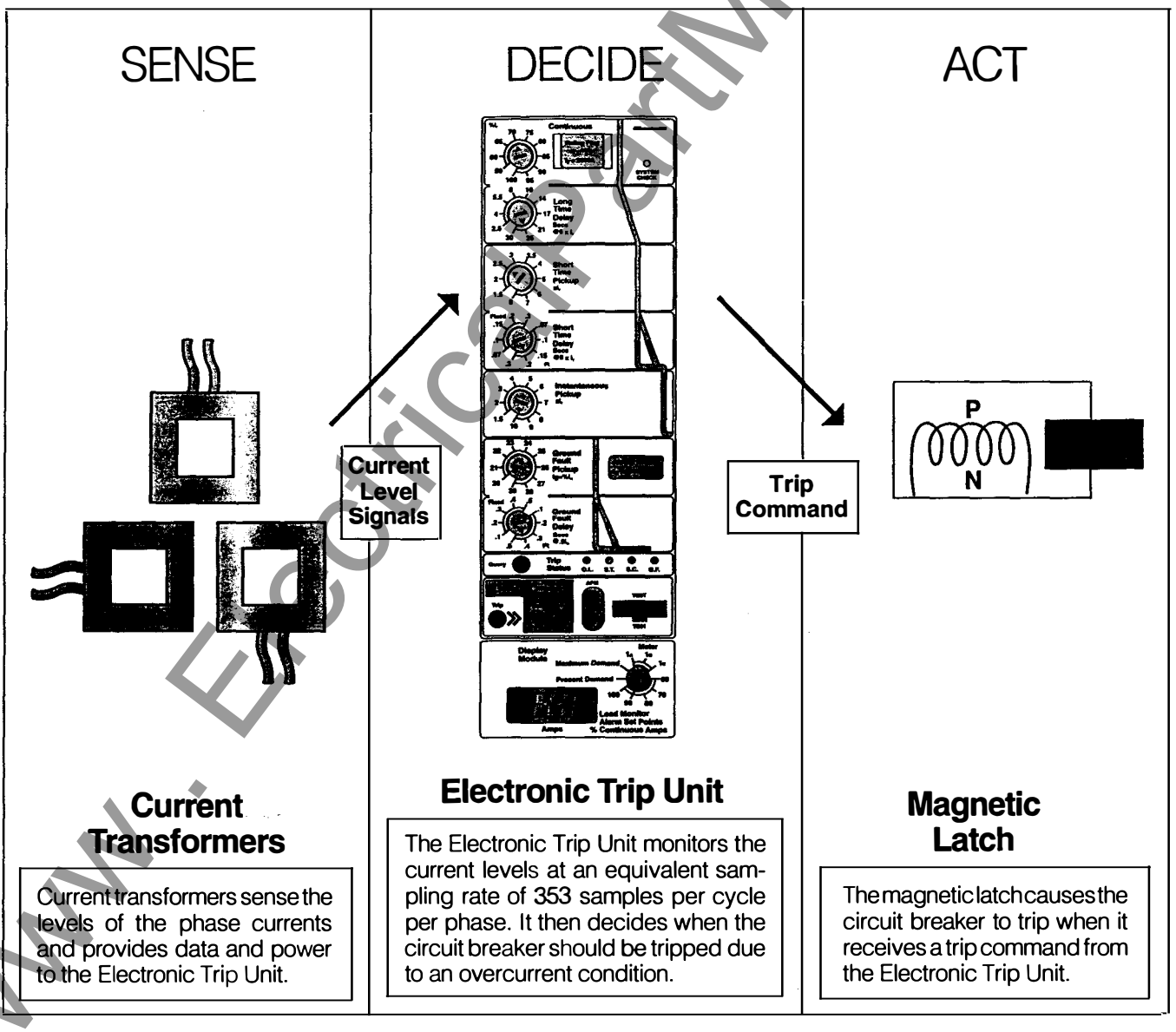
Principles of Operation

The Electronic Trip Unit uses a microprocessor to execute the numerous numeric and logic functions programmed in the unit. The adjustments on the trip unit face allow the user to select what numerical values are to be used by the microprocessor in performing its protection function. (The numerical values are stored in the processor's permanent memory.)

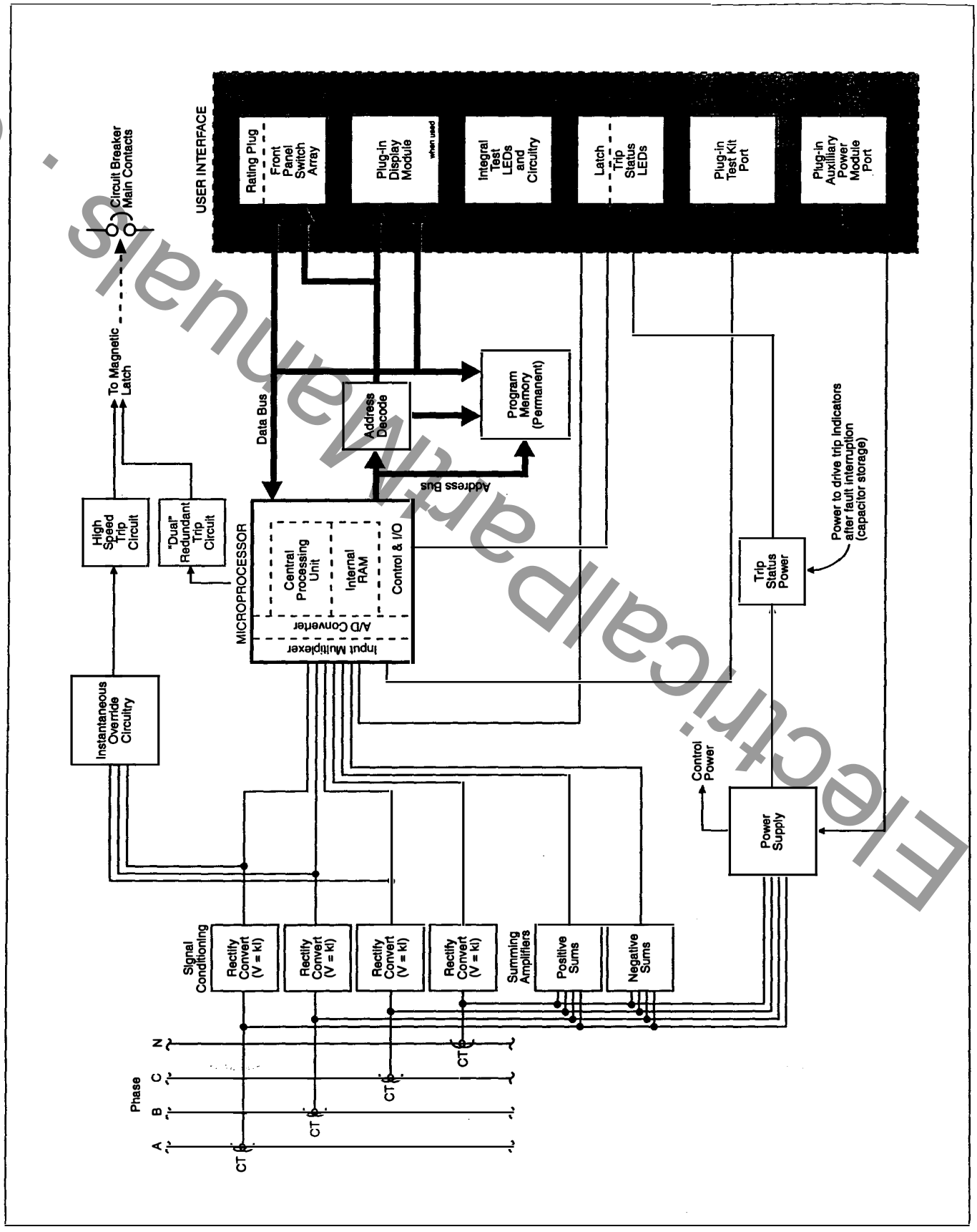
Current data is derived from current sensors mounted in the Siemens Type SB Breaker. These sensors are current transformers. As passive devices, they provide high reliability with minimum signal error while providing power for the trip unit. The current signals from the transformers are converted to digital voltages in the trip unit. These digital voltages are stored in temporary memory. The digital signals are used by the microprocessor in detecting and processing overcurrent conditions.

The microprocessor reads the temporarily stored digital voltages and compares their values with the set of permanently stored values that correspond to the user-selected adjustment settings. When an overcurrent condition is detected, the microprocessor's software begins to process the appropriate protection function. During the processing of the protection function, the microprocessor continues to monitor the incoming current level data. If the overcurrent condition continues until the processing is completed and the appropriate delay time has elapsed, a tripping command is issued by the microprocessor.

The tripping command from the microprocessor causes a signal to be sent from the Electronic Trip Unit to the low energy high speed magnetic latch in the circuit breaker. The signal in the trip unit counteracts the permanent magnet in the latch, allowing the latch to trip the breaker.



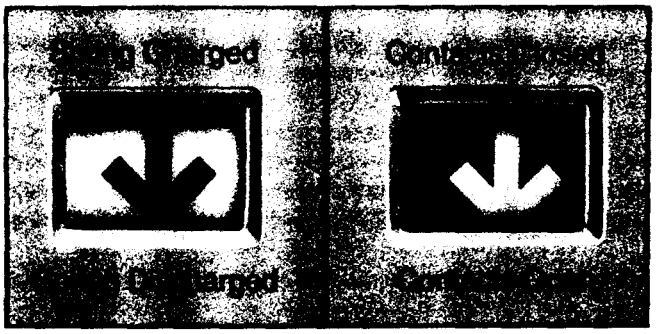
Principles of Operation – Functional Diagram



⚠ DANGER

Hazardous Voltage.
Will cause severe injury or death.

Turn power off and lock out supplying device before installing.

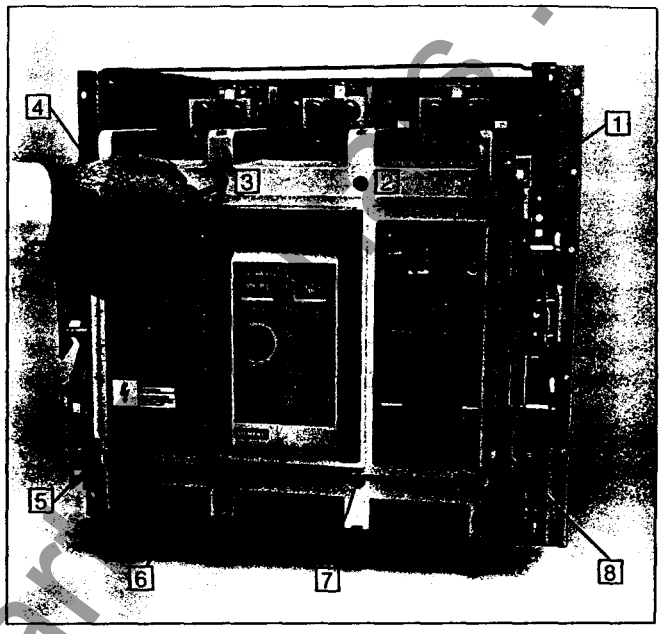


If trip unit is not already installed the breaker cannot be in a closed position.

CAUTION: To prevent possible personal injury or damage the SB Breaker should be in the "Discharged" mode prior to installing a trip unit.

Installation of Electronic Trip Unit
Siemens Type SB Breaker has a built-in interlock device that prevents the circuit breaker from being closed when there is not an installed trip unit. This same interlock device will trip the circuit breaker when the trip unit is removed.

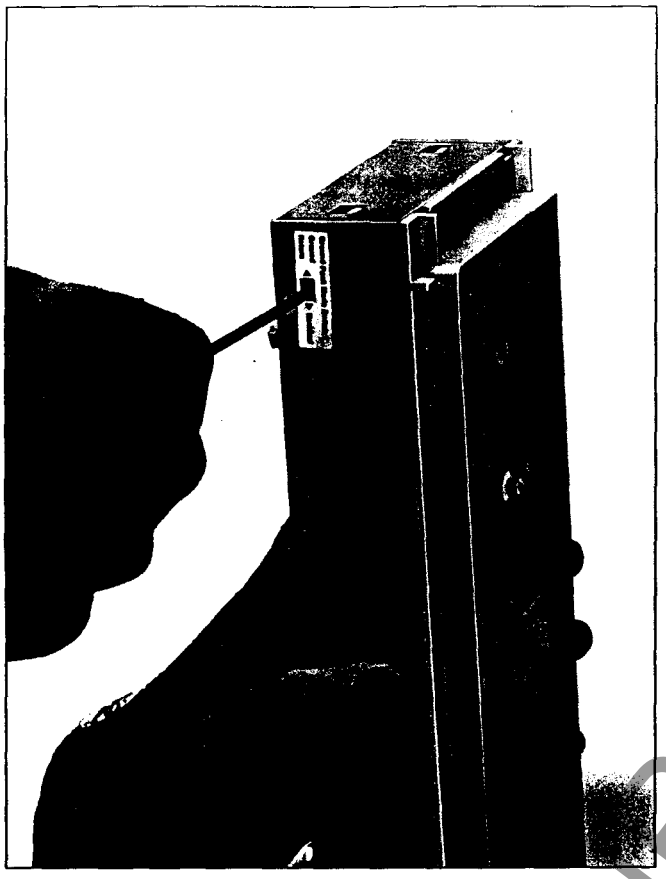
Installing the Electronic Trip Unit into the Circuit Breaker
Steps 1 through 9.



1.) Remove the 8 screws from breaker front cover.

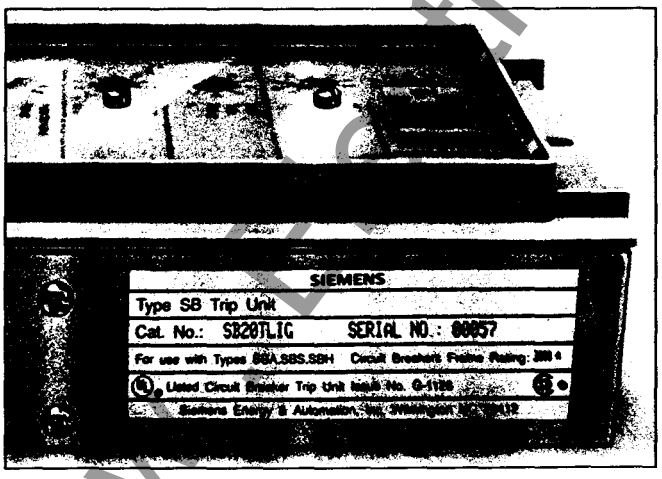
To install the trip unit, the front cover of the circuit breaker must first be removed. This is done by removing the eight (8) Phillips head screws that hold the front cover in place.

2.) Lift off front cover.



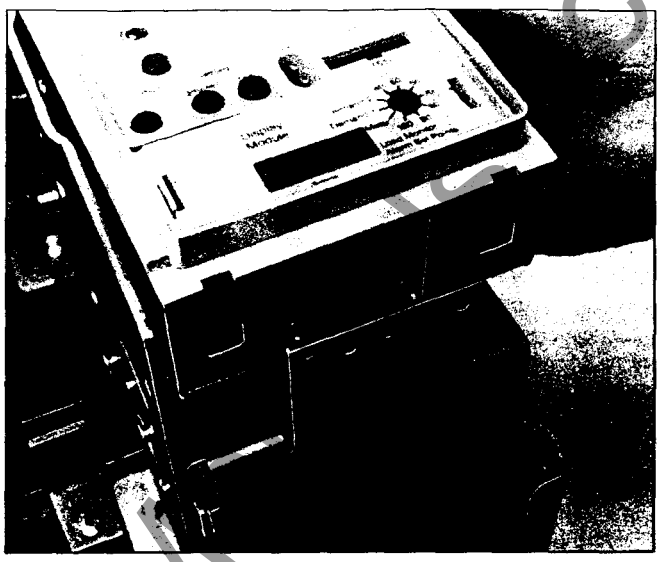
3.) Set Ground Fault Protection Switch.

On trip units with ground fault protection, the ground fault selection switch on the side of the trip unit must be set to the appropriate sensing scheme–Residual or Source Ground/ Zero Sequence–prior to installing the trip unit. These ground fault sensing schemes are discussed on page 18.



4.) Check label on side of Trip Unit.

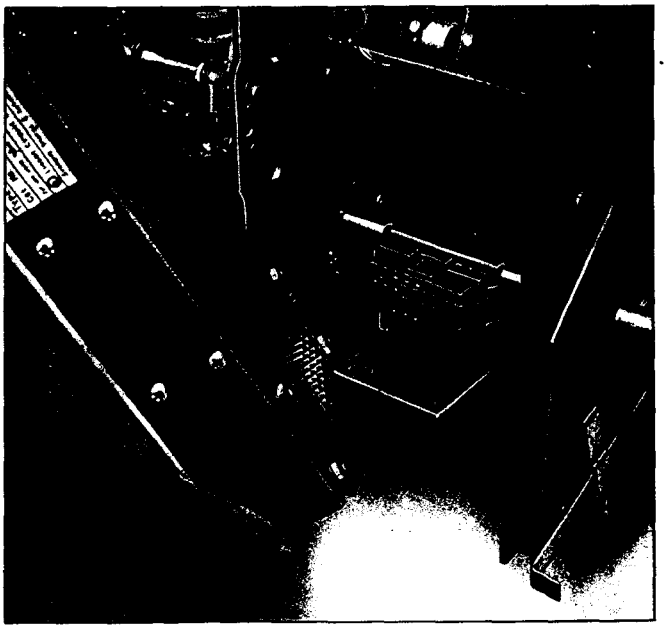
Before attempting to install the trip unit, check the label on the side of the unit to make sure that it is the proper unit for the Siemens Type SB Breaker. A built-in rejection scheme will prevent the installation of a trip unit into a



5.) Check alignment of pins and holes.

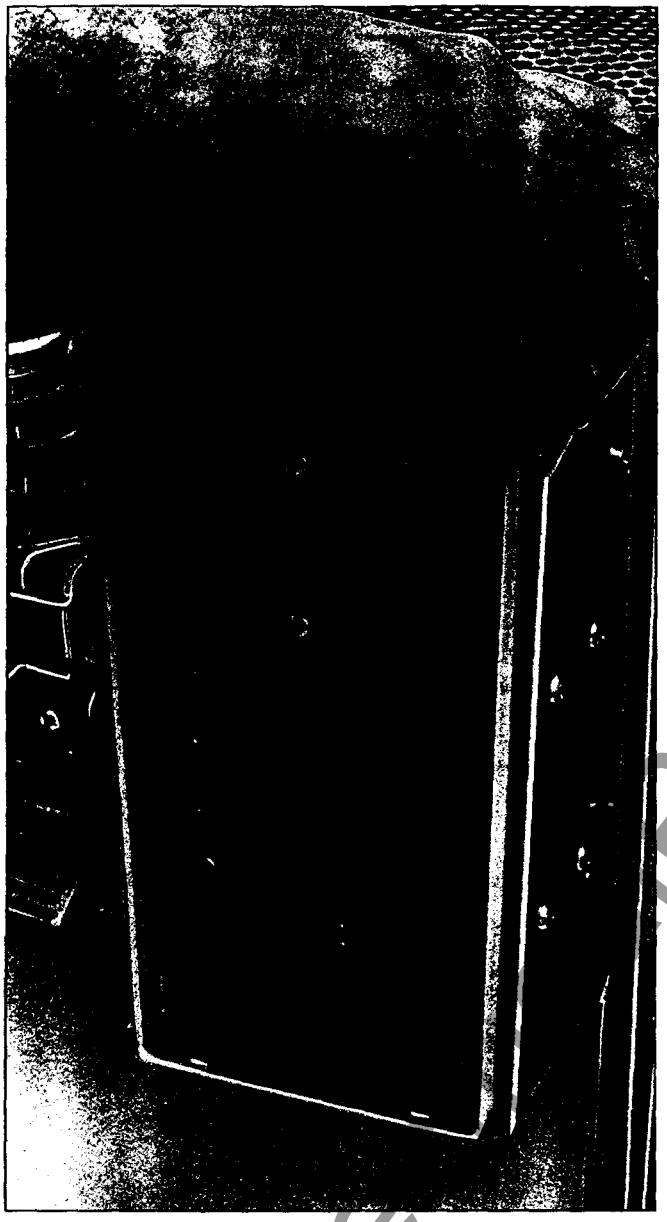
Siemens Type SB Breaker for which it is not intended. This scheme consists of two pins on the support plate on which the trip unit will set into two matching holes in the bottom of the trip unit. If the holes in the bottom of the trip unit cannot be aligned with the pins, the trip unit cannot be installed in the Siemens Type SB Breaker. If there is any doubt about a trip unit being the proper unit for a Siemens Type SB Breaker, hold the trip unit upside down and check the alignment of the pins and holes.

WARNING: Do not attempt to modify rejection features.



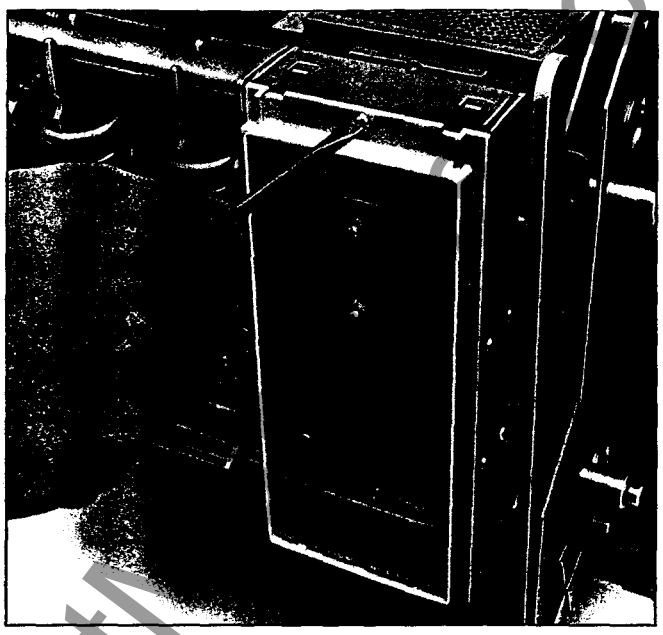
6.) Mate pin connectors.

Mate the connector half on the back of the trip unit with its corresponding connector half in the circuit breaker.



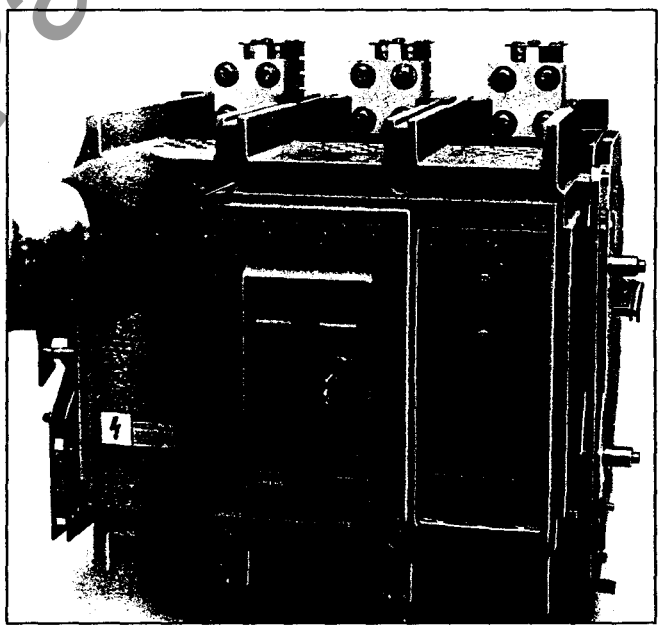
7.) Lower trip unit onto support plate.

After the connector has been mated, lower (push) the trip unit onto the support plate. The pins on the support plate will fit into the holes in the bottom of the trip unit.



8.) Secure trip unit.

Secure the trip unit in place with the retaining screw located at the top of the unit.



9.) Replace the front cover.

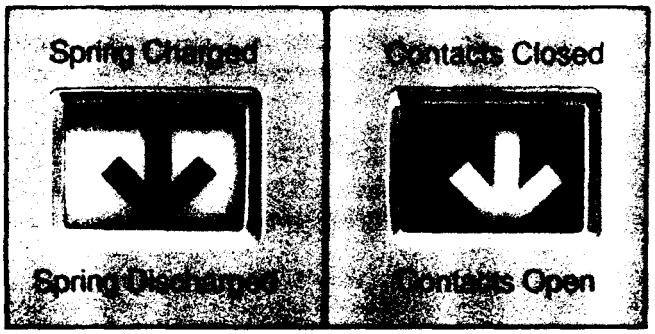
Replace the front cover. Then, replace the eight (8) front cover screws. If trip unit top is not secured properly, the interlock will prohibit closing of the breaker.

NOTE: Before energizing breaker be sure to install a proper rating plug. See pages 10 and 11.

⚠ DANGER

Hazardous Voltage.
Will cause severe injury or death.

Turn power off and lock out supplying device before installing.

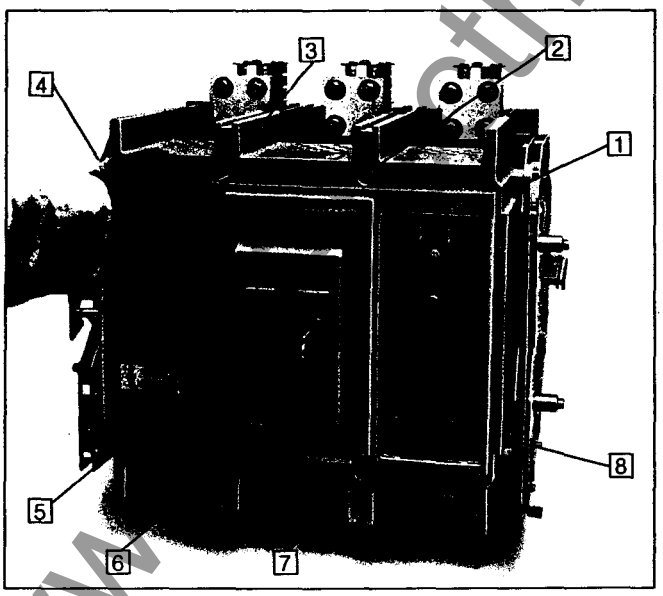


CAUTION: To prevent possible personal injury or breaker damage, the trip unit must not be removed when the circuit breaker is "Closed" or "Charged". Make certain the circuit breaker is "Open" and "Discharged" as illustrated above.

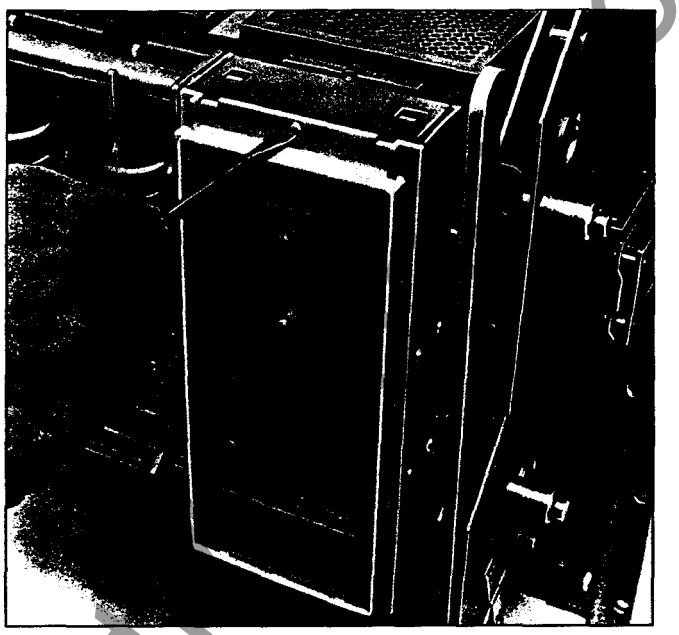
NOTE: When practical, the Electronic Trip Unit should be removed from the circuit breaker for rating plug removal or insertion.

Removing Electronic Trip Unit from Circuit Breaker
Steps 1 through 3.

Before starting to remove the trip unit, set the circuit breaker to the "Open" and "Discharged" positions. If the circuit breaker is in the "Closed" position, the breaker will trip when the trip unit is removed.

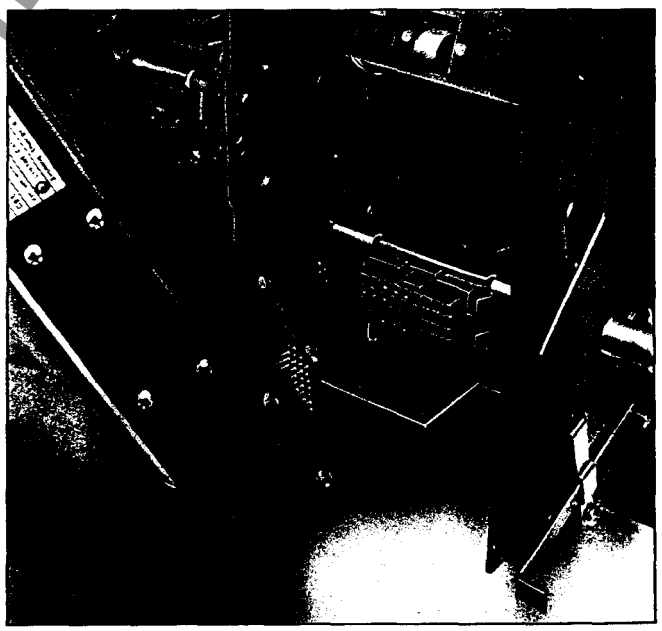


1.) Remove the 8 screws from breaker front cover. Lift off front cover.

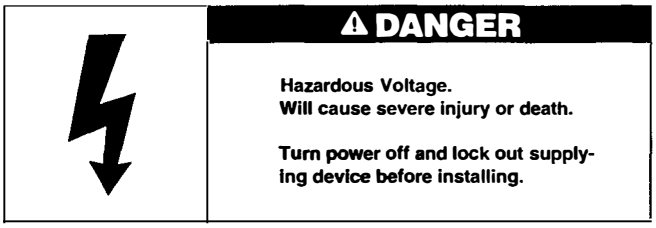


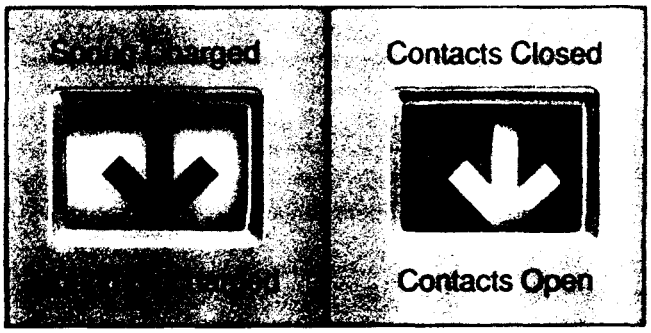
2.) Remove the trip unit retaining screw.

Remove the front cover of the breaker and trip unit retaining screw. Lift the trip unit from the support plate and unmate the connector. Note that the trip unit must be lifted from the support plate high enough for the pins on the support plate to clear the holes in the bottom of the trip unit; otherwise, the connector cannot be unmated. Remove the trip unit.



3.) Remove the trip unit.





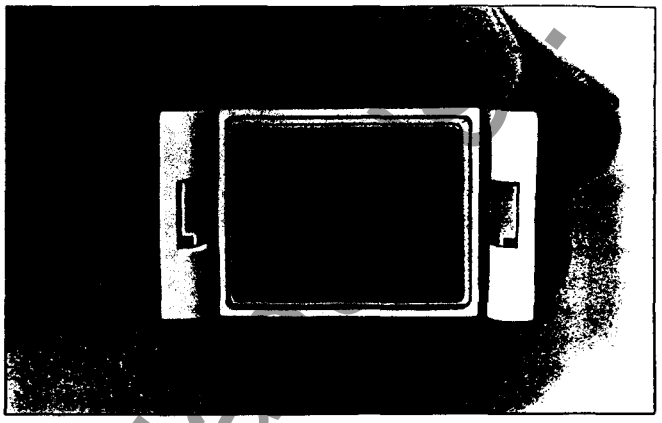
CAUTION: To prevent inadvertent service interruption, the rating plug must not be removed when the circuit breaker is "Closed". Make certain the cir-cuit breaker is "Open" as illustrated above.

Inserting and Removing Rating Plug from Trip Unit
Steps 1 through 7.

Prior to inserting or removing a rating plug, check to see that the circuit breaker is in the "Open" position. The circuit breaker should always be in the "Open" position when a rating plug is not in the trip unit. The trip unit will default to the lowest possible settings if a rating plug is not installed.

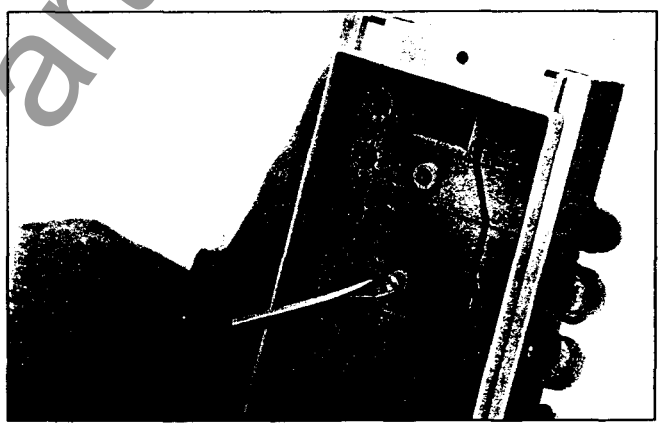
To prevent the insertion of a rating plug into a trip unit for which it is not intended, the rating plug connector in the trip unit has been keyed to reject improper plugs.

CAUTION: Do not attempt to force improper rating plug into trip unit.



1.) Check label on Rating Plug.

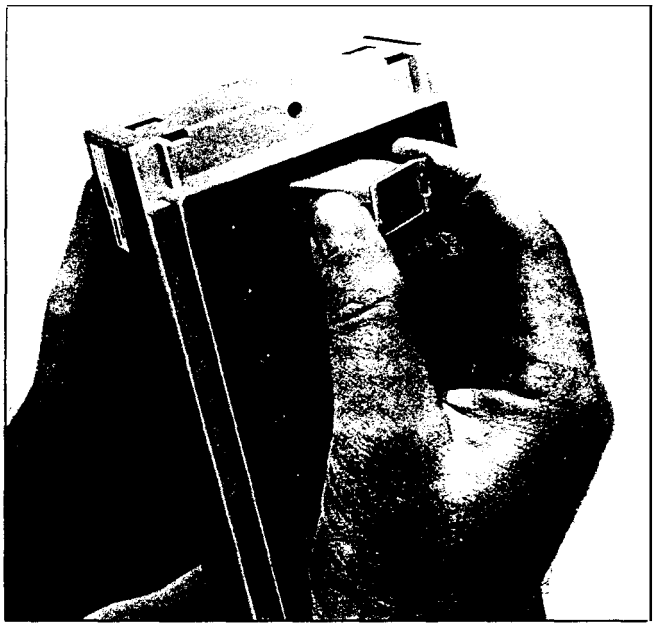
Before attempting to insert the rating plug, check the label on the rating plug to verify that it is a proper plug for the trip unit. If it is not a proper plug, the pins on the plug will not mate with the connector in the trip unit.



2.) Remove the two (2) plexiglass shield retaining screws.

Inserting and removing the rating plug requires the removal of the clear plexiglass shield. To remove the shield, unscrew the two screws that hold it in place, gently pry one end of the cover loose with a small screwdriver, and lift.

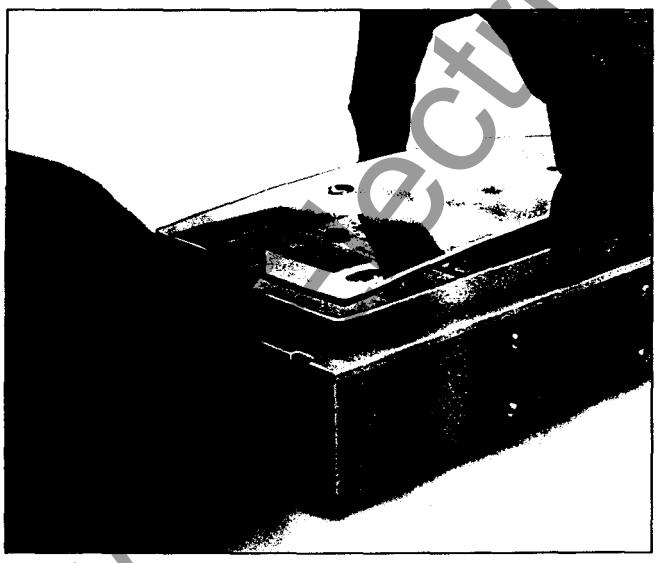
3.) Remove plexiglass shield.



4.) Press the plug into place (or remove).

To insert a rating plug in the trip unit, align the plug with the plug receptacle and press the plug into place. The clips on the rating plug and the compression fitting of the plug hold the plug in place, eliminating the need for screws or latches. The plug will "snap" into place without excessive force. Do not force the rating plug into place.

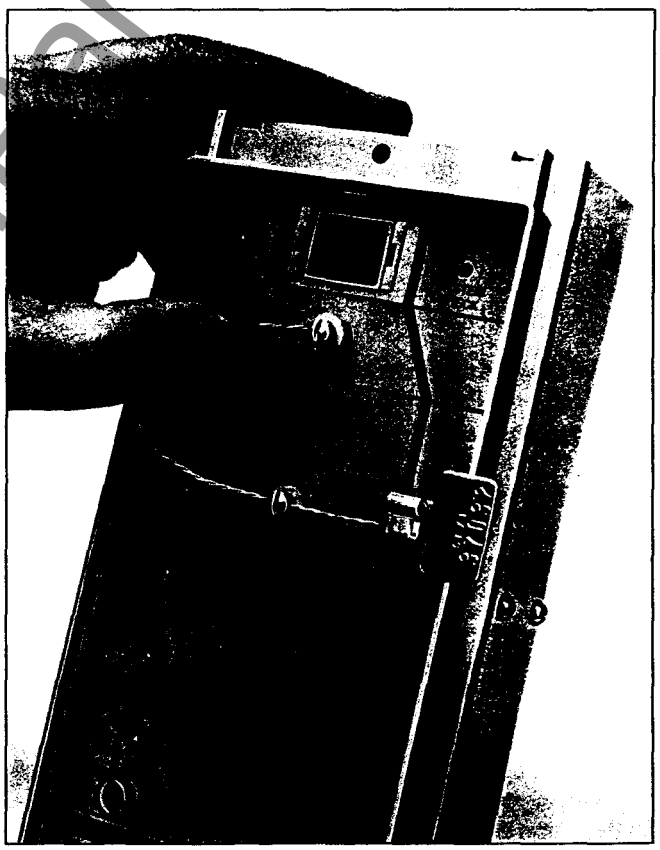
To remove a rating plug, squeeze the clips and pull the plug from the plug receptacle. Since the plug is held in place by compression, some force will be required to remove the plug. Do not close the circuit breaker with the rating plug removed from the trip unit.



5.) Replace the plexiglass shield.

Slide the protective shield into the top lip of the trip unit, bow slightly in middle, and press down with thumb on bottom to snap shield into place.

6.) Replace the two (2) plexiglass shield retaining screws.



7.) Seal the cover.

After the cover has been replaced a wire lock may be inserted through holes in the screws and sealed with a lead seal. This will help prevent tampering by unauthorized personnel.

⚠ DANGER

Hazardous Voltage.
Will cause severe injury or death.

Turn power off and lock out supplying device before installing.

Removing and Replacing the Plexiglass Cover

To remove the plexiglass cover unscrew the two screws that hold it in place, and gently pry one end of the cover loose with a small screwdriver. After the rating plug has been installed and any necessary adjustments have been made, the cover must be replaced to prevent unauthorized adjustments (see pages 10 and 11, steps 2, 3, 5, 6, and 7).

Electronic Trip Unit Functions

Displayed and accessible on the front panel of the trip unit are the adjustments, switches, and indicators that are available to the user for local control, test, and monitoring. These include:

- System Check Indicator
- Fault Protection Adjustments
- Trip Query Switch and Indicators
- Integral Test Switches and Indicators
- Current Demand Indicators (Optional Display Module).

Also accessible on the front panel is a receptacle for an external test set and power supply.

The trip unit has factory-installed capability for zone selective interlocking and communications for remote monitoring. These functions are accessible via the TS-31 Test Port.

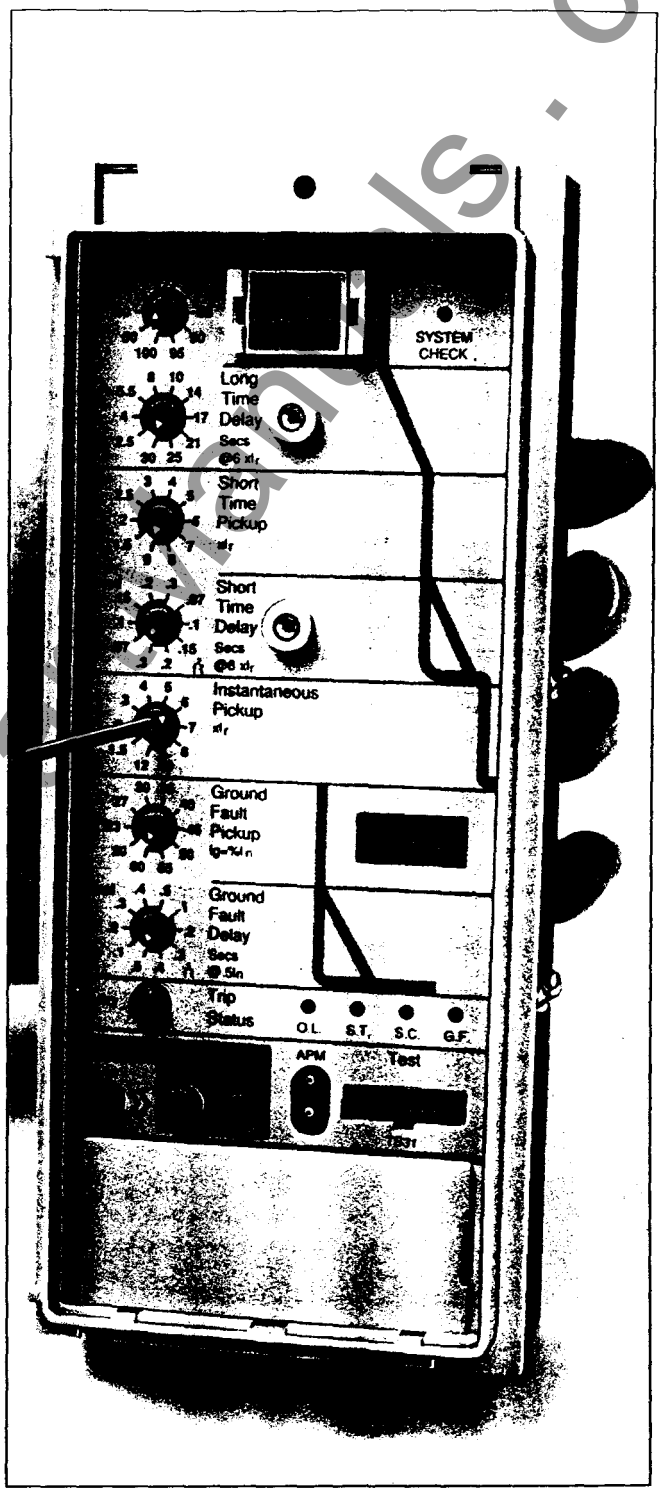
Setting the Fault Protection Adjustments

The Electronic Trip Unit executes its overcurrent protection functions based on the rating plug value and the setting of the current adjustments. Therefore, care should be taken by the user to make proper selections and settings.

To avoid potential nuisance tripping, while changing settings, Siemens recommends that all adjustments be made with the Siemens Type SB Breaker in the "Open" position.

To set an adjustment, place a slotted screw driver onto the point-to-point adjustment switch and rotate the switch to the desired setting. The following figures and text illustrate and describe the fault protection adjustments.

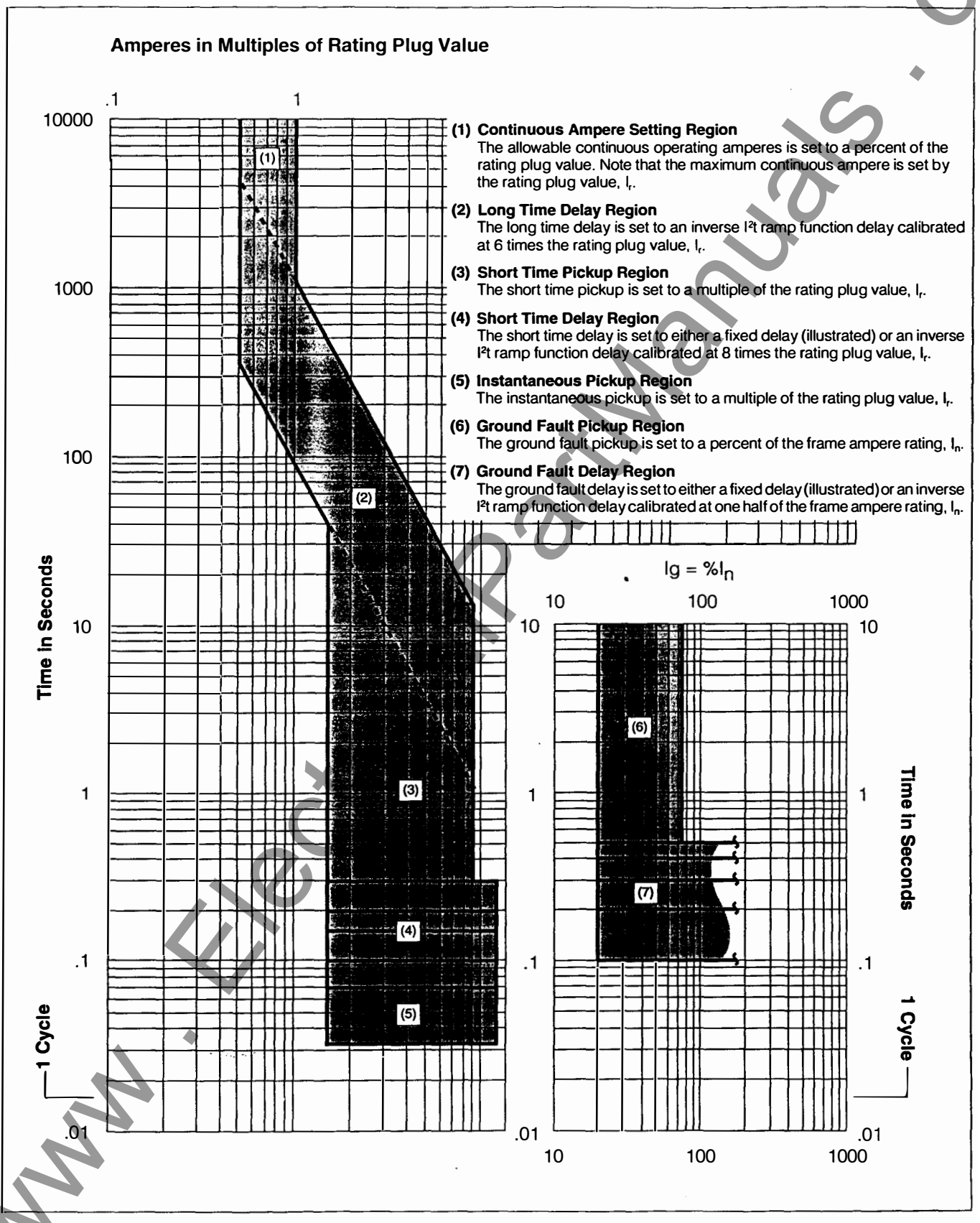
All pick-up adjustments, except ground fault, are multiples of the rating plug value, I_r. Ground fault pick-up is a multiple of the frame ampere rating, I_n. All pick-up settings are RMS amperes or values.



2000A Electronic Trip Unit Adjustment Panel shown with plexiglass cover removed and access adjustment switches shown.

Trip Unit Current Shaping Adjustments

(This curve is for illustration purposes only)



(1) Continuous Ampere Setting Region
The allowable continuous operating amperes is set to a percent of the rating plug value. Note that the maximum continuous ampere is set by the rating plug value, I_r.

(2) Long Time Delay Region
The long time delay is set to an inverse I^2t ramp function delay calibrated at 6 times the rating plug value, I_r.

(3) Short Time Pickup Region
The short time pickup is set to a multiple of the rating plug value, I_r.

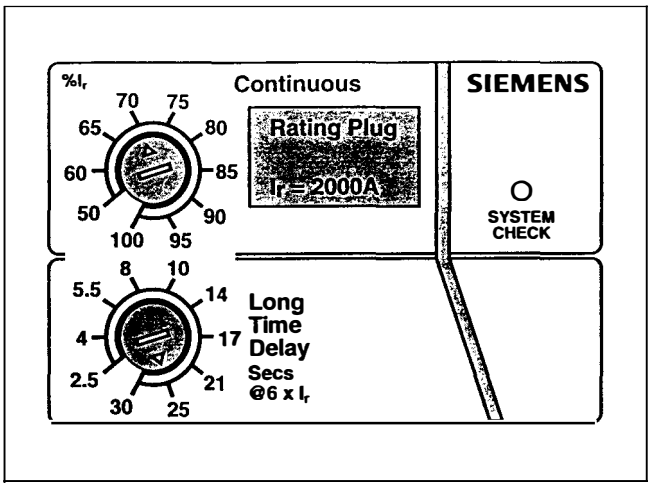
(4) Short Time Delay Region
The short time delay is set to either a fixed delay (illustrated) or an inverse I^2t ramp function delay calibrated at 8 times the rating plug value, I_r.

(5) Instantaneous Pickup Region
The instantaneous pickup is set to a multiple of the rating plug value, I_r.

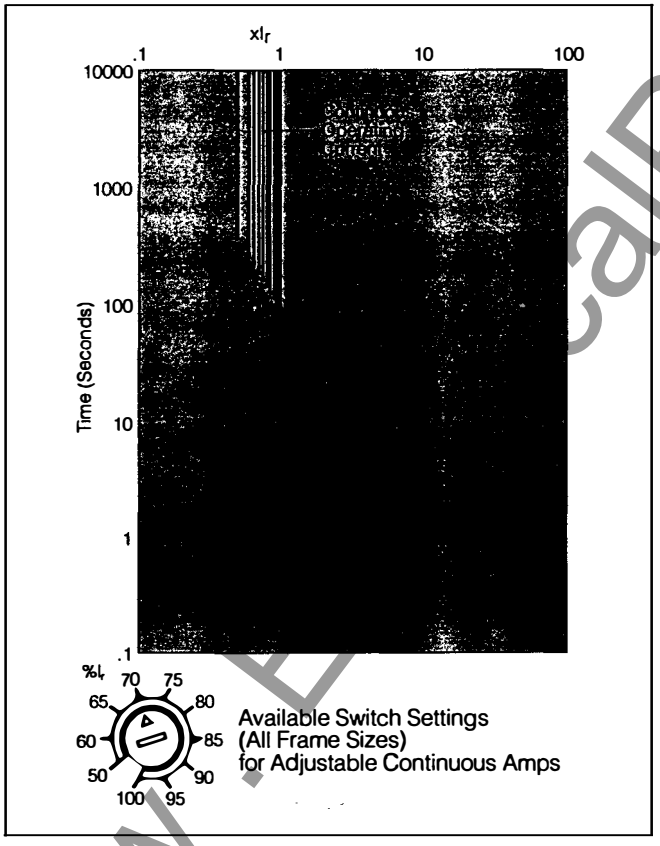
(6) Ground Fault Pickup Region
The ground fault pickup is set to a percent of the frame ampere rating, I_n.

(7) Ground Fault Delay Region
The ground fault delay is set to either a fixed delay (illustrated) or an inverse I^2t ramp function delay calibrated at one half of the frame ampere rating, I_n.

Adjustable Continuous Amps and Adjustable Long Time Delay

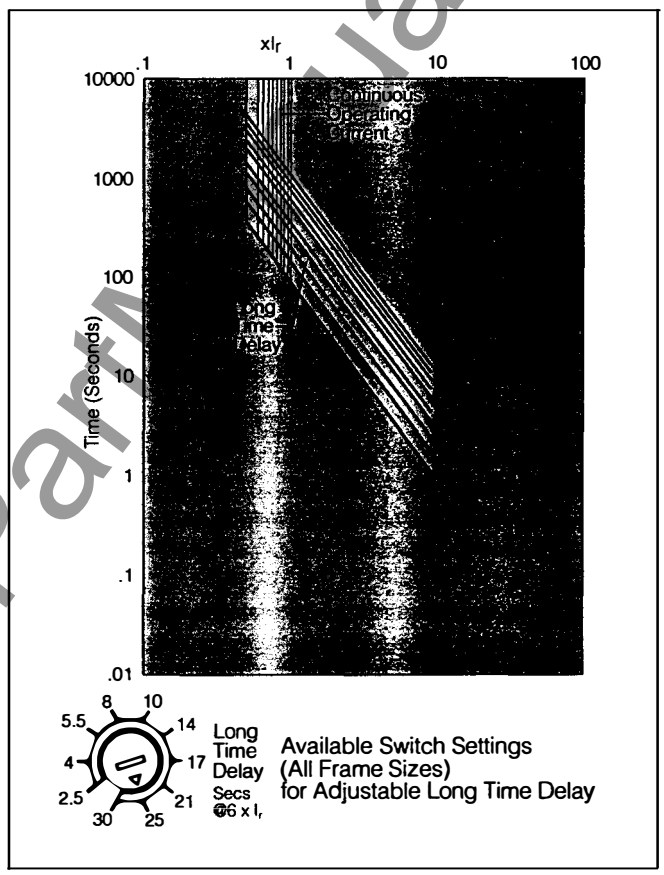


Adjustable Continuous Amps
The Continuous ampere adjustment sets the current level at which the breaker will continuously operate without initiating a tripping sequence. On Siemens Type SB Trip Units, the continuous operating current may be set to 50, 60, 65, 70, 75, 80, 85, 90, 95, and 100% of the rating plug value I_r.



Continuous Operating Current

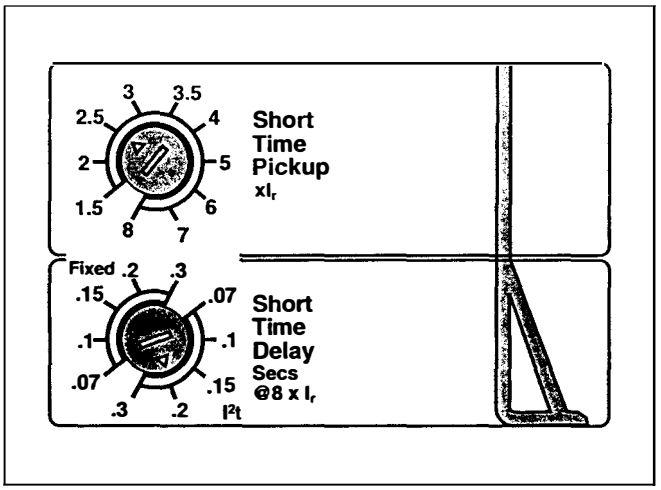
Adjustable Long Time Delay
The Long Time Pickup is nominally set at 115 percent of the continuous amps setting. The Long Time Delay adjustment is used to set the tripping delay of the Type SB based on the magnitude of the overcurrent condition. On Siemens Type SB trip units, the long time delay, which is an inverse I^2t ramp function, may be set to a calibrated value of 2.5, 4, 5.5, 8, 10, 14, 17, 21, 25, or 30 seconds at a current equal to 6 times I_r.



Long Time Delay

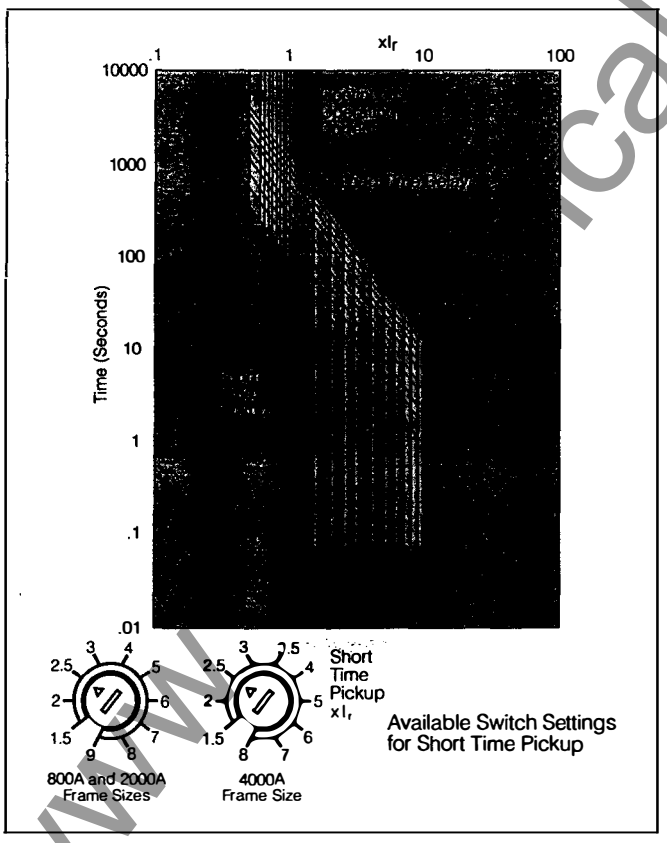
Operations – Short Time Fault Protection

Adjustable Short Time Pickup and Adjustable Short Time Delay



Adjustable Short Time Pickup

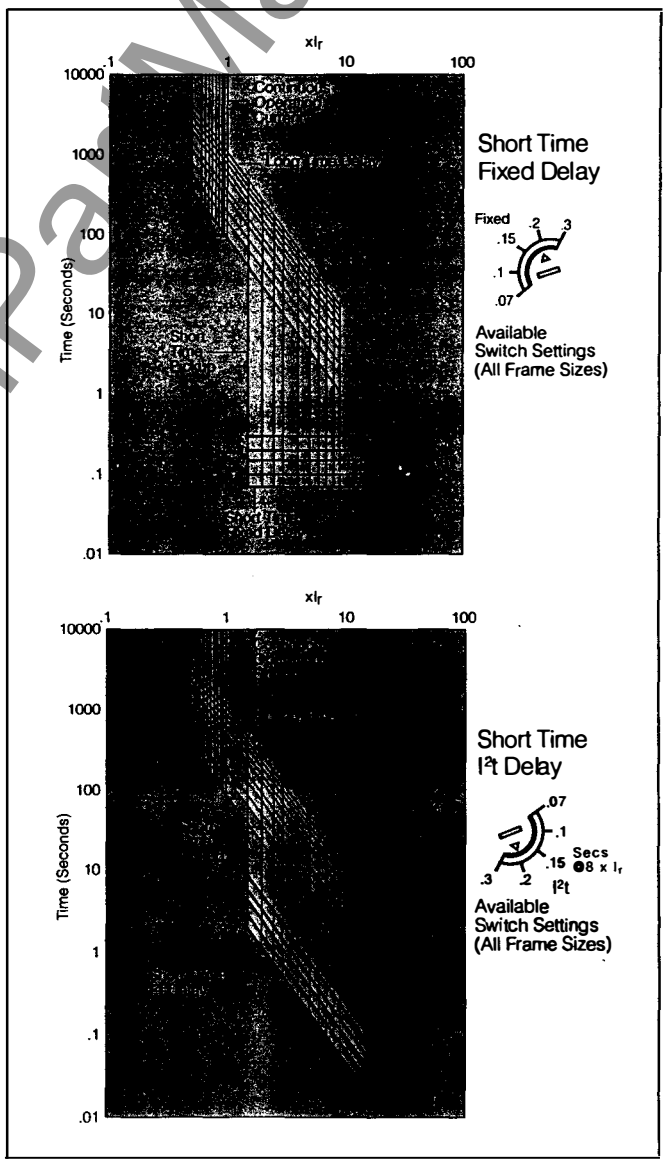
The Short Time Pickup adjustment is used to set the level of high current the breaker will carry for a short period of time without tripping. This adjustment, together with the Short Time Delay, allows downstream breakers time to clear short circuit faults without tripping the upstream breakers. On trip units for the 800A and 2000A Type SB frame sizes, the Short Time Pickup may be set to 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, or 9 times I_r. On trip units for the 4000A Type SB frame size, the short time pickup may be set to 1.5, 2, 2.5, 3, 3.5, 4, 5, 6, 7, or 8 times I_r.



Short Time Pickup

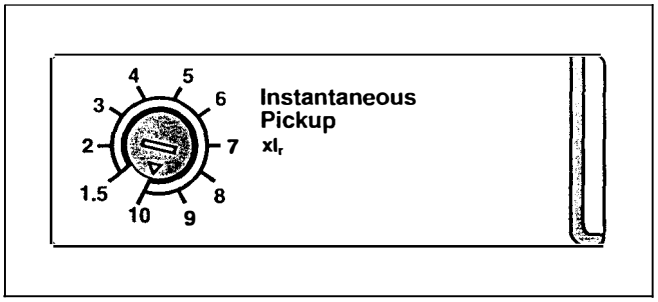
Adjustable Short Time Delay

The Short Time Delay adjustment is used to set the time interval the breaker will wait before responding to the current value selected on the Short Time Pickup adjustment. There are two modes of operation of this adjustment on all Type SB Trip Units; one is a fixed delay, the other is an inverse I^2t ramp delay. The I^2t Delay has the characteristic of being inversely proportional to the square of the magnitude of the overcurrent condition. This means that higher overcurrent conditions have shorter delays and conversely lower overcurrent conditions have longer delays. This characteristic allows for better coordination with downstream circuit breakers and fuses. In the fixed delay mode, the Short Time Delay may be set to .07, .1, .15, .2, or .3 seconds. In the inverse I^2t ramp Short Time Delay mode, the delay may be set to a calibrated value of .07, .1, .15, .2, or .3 seconds at a current equal to 8 times I_r.

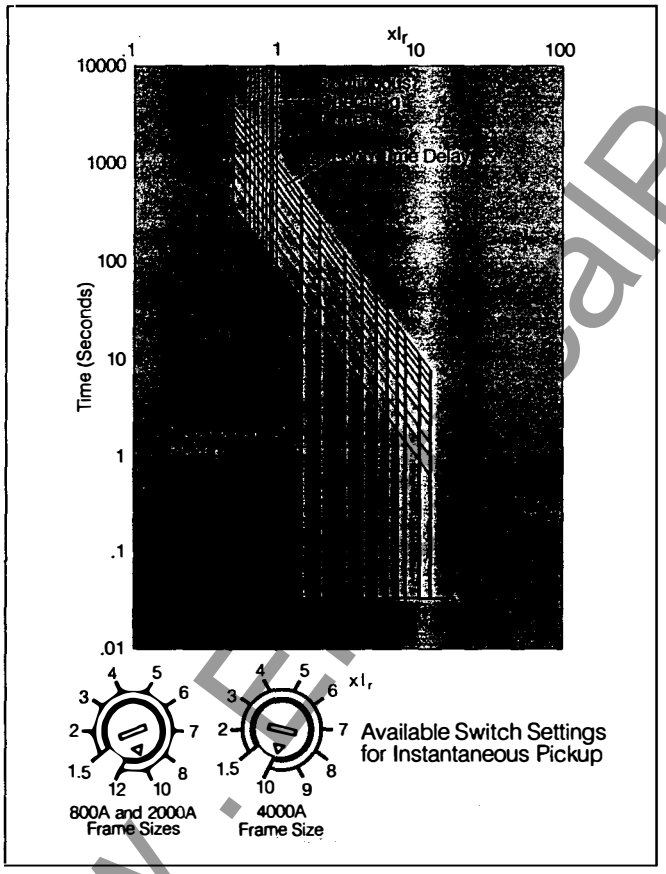


Short Time Delay

Adjustable Instantaneous Pickup



Adjustable Instantaneous Pickup
The Instantaneous Pickup adjustment is used to set the current level at which the breaker will trip without an intentional time delay. Non-delayed tripping, as a result of a severe overcurrent condition, minimizes potential damage to electrical systems and equipment. On trip units for the 800A and 2000A Type SB frame sizes, the Instantaneous Pickup adjustment may be set to 1.5, 2, 3, 4, 5, 6, 7, 8, 10, or 12 times I_r. On trip units for the 4000A frame size, the adjustment may be set to 1.5, 2, 3, 4, 5, 6, 7, 8, 9, or 10 times I_r.

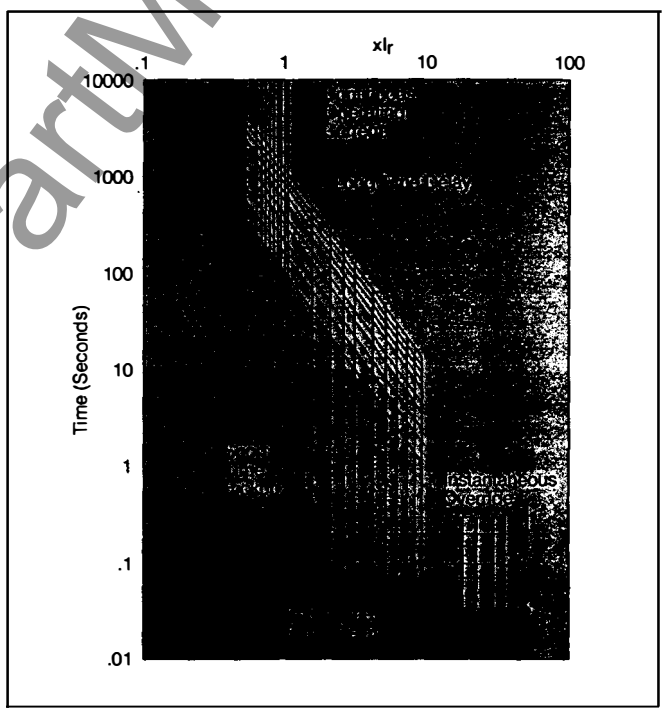


Instantaneous Pickup

Instantaneous Override
On all trip units, an instantaneous override function has been provided. It is set nominally at the short time rating of the respective breaker frame size. This allows the breaker to ride through high faults up to its short time capability; however, it is self-protecting above these values.

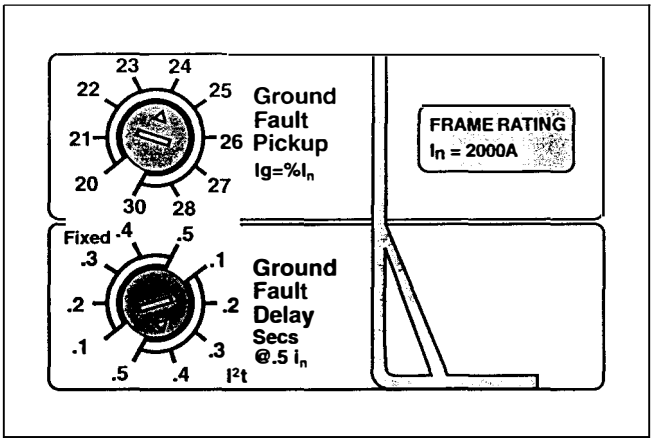
Breaker Frame Size	Short Time kA Rating (.500 seconds max.)
800A	25
2000A	35
4000A	65

Discriminator Circuit (Making Current Release)
This circuit overrides the short time delay function should the breaker attempt to close into a faulted system, tripping the breaker instantaneously. The discriminator function is enabled for the 6 cycles of current flow, after which normal short time characteristics operate.



Instantaneous Override (Illustrated with Short Time Fixed Delay)

Adjustable Ground Fault Pickup and Adjustable Ground Fault Delay



Adjustable Ground Fault Pickup

The Ground Fault Pickup adjustment is used to set the level of ground current at which circuit interruption will be initiated. Together with the Ground Fault Delay, this adjustment allows selective tripping between main and feeder or other downstream breakers. The available ground fault pickup settings, as a percent of the Type SB frame ampere rating I_n are given in the table below. In compliance with the National Electric Code (NEC 230-95), no trip point setting exceeds 1200 amperes.

Frame Ampere Rating I_n	Available Setting % I_n									
400A	20	25	30	40	50	60	70	80	90	100
800A	20	25	30	40	50	60	70	80	90	100
1200A	20	25	30	40	50	60	70	80	90	100
1600A	20	26	32	38	44	50	56	62	68	75
2000A	20	23	27	30	35	40	45	50	55	60
2500A	20	23	26	29	32	35	38	41	44	48
3200A	20	21	23	25	27	29	31	33	35	37
4000A	20	21	22	23	24	25	26	27	28	30

Adjustable Ground Fault Delay

The Ground Fault Delay adjustment is used to set the time interval the breaker will wait before responding once the ground fault pickup level has been reached. There are two modes of operation of this adjustment on all Electronic trip units; one is a fixed delay and the other is an inverse I^2t ramp delay. In the fixed delay mode, the Ground Fault Delay may be set to .1, .2, .3, .4, or .5 seconds. In the inverse I^2t ramp delay mode, the delay may be set to a calibrated value of .1, .2, .3, .4, or .5 seconds at a current equal to 0.5 times the frame ampere rating I_n. The inverse I^2t ramp delay reverts to a fixed delay of the same value when the ground current (I_g) exceeds 50 percent of the frame rating (I_n).

Ground Fault Memory Circuit

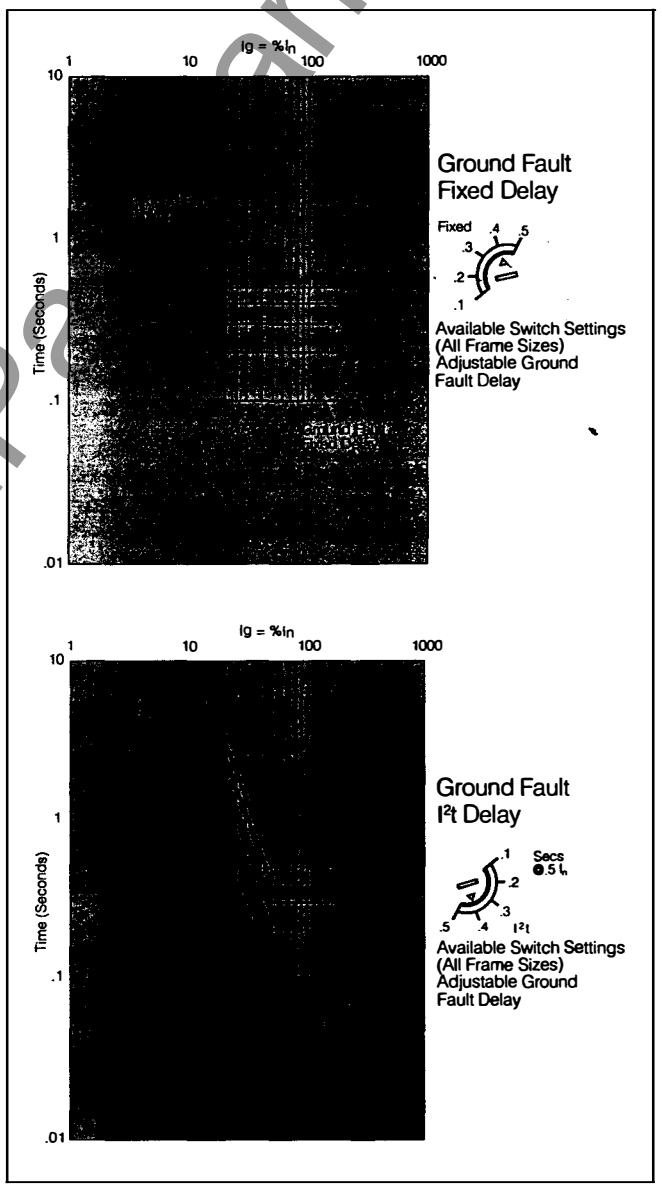
All Siemens Type SB Trip Units with ground fault protection come equipped with a ground fault memory circuit. This circuit effectively integrates ground fault currents with time. This provides an added protection by preventing the ground fault delay circuits from being reset to zero when the ground fault currents are intermittent and erratic. The time constants for the current integration are preset within the trip unit as a function of the Ground Fault Delay.

Ground Fault Sensing Schemes

The trip unit can be configured to accommodate the following ground fault sensing schemes.

- 3-Phase, 3-Wire Residual
- 3-Phase, 4-Wire Residual
- Source Ground
- Zero Sequence

All that is required by the user to configure the trip unit to support these protection schemes is to set the ground fault selection switch to the desired configuration. The selection switch is on the left side of the trip unit and must be set prior to the trip unit being installed in the Type SB Breaker, see Installation Instructions on pages 6 through 8.



Ground Fault Delay

Ground Fault Sensing Scheme

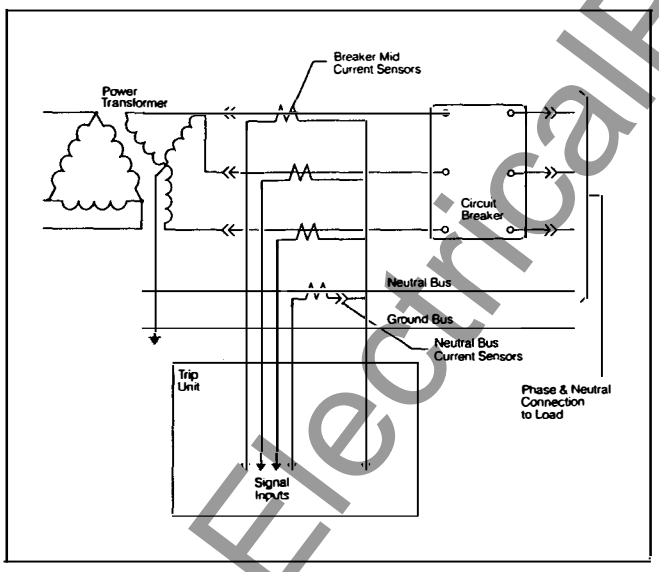
The following are brief descriptions of the ground fault sensing schemes as they relate to the Siemens Type SB Trip Unit. Detailed technical and application information of the ground fault sensing schemes is contained in NEMA Standard No. PB 2.2 "Application Guide for Ground Fault Protective Devices for Equipment". For information on Ground Fault Selection Slide Switch, refer to page 7.

Residual (3-Phase, 3-Wire). Under normal system conditions (without ground fault), the vector sum of the phase currents being monitored by the trip unit is zero. This is also true under the condition of an overcurrent phase-to-phase fault and phase-unbalance condition. When a phase-to-ground fault occurs, the vector sum of the phase currents is directly proportional to the magnitude of the fault. The trip unit's microprocessor uses this vector sum data in the execution of the ground fault protection function. The trip unit utilizes the internal breaker current transformers. No external current transformers are required.

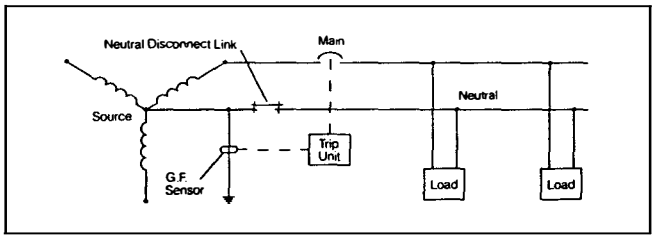
Residual (3-Phase, 4-Wire). In the 3-Phase, 4-Wire Residual scheme a fourth current transformer is connected in the neutral conductor to "Sense" normal neutral currents. Under normal system conditions the vector sum of the currents in all phases equals the neutral current. This is also true under the condition of an overcurrent phase-to-phase fault and phase-unbalance condition. When a phase-to-ground fault occurs, the fault current returns via a path other than the neutral. Therefore, the vector sum of the phase currents no longer equals the neutral current. This current differential is detected by the trip unit and used in the execution of the ground fault protection function.

Source Ground. In this scheme, the phase currents are not used in detecting and processing ground faults. The trip unit executes the ground fault protection function based on data from a ground current sensor. This sensor is located on the neutral connection to ground at the service entrance, and is connected to the neutral transformer input terminals on the trip unit.

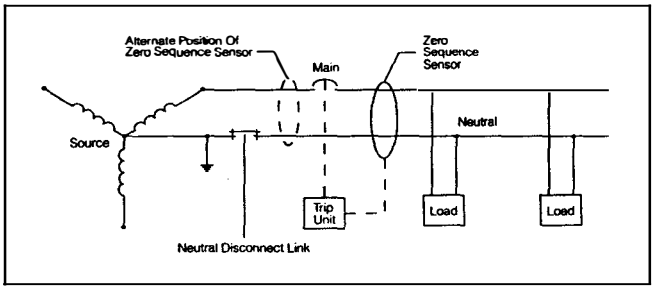
Zero Sequence. This scheme is very similar to the Residual Schemes. A core balance type current sensor encircles all phase conductors and neutral on a 4-wire system. Under normal system conditions or a phase-to-phase fault condition, there is no output from the sensor to the trip unit because the vector sum of the currents through the sensor window is zero. If a ground fault occurs, the ground current is not seen by the sensor, which returns to the source by a path other than through the sensor window. The sensor detects this current unbalance and provides the data required by the trip unit to execute the ground fault protection function. The zero sequence sensor is connected to the neutral transformer input on the trip unit.



Residual Sensing. Circuit Breaker Wiring for Ground Protection (3-Phase, 4-Wire System Shown).



Source Ground Current.

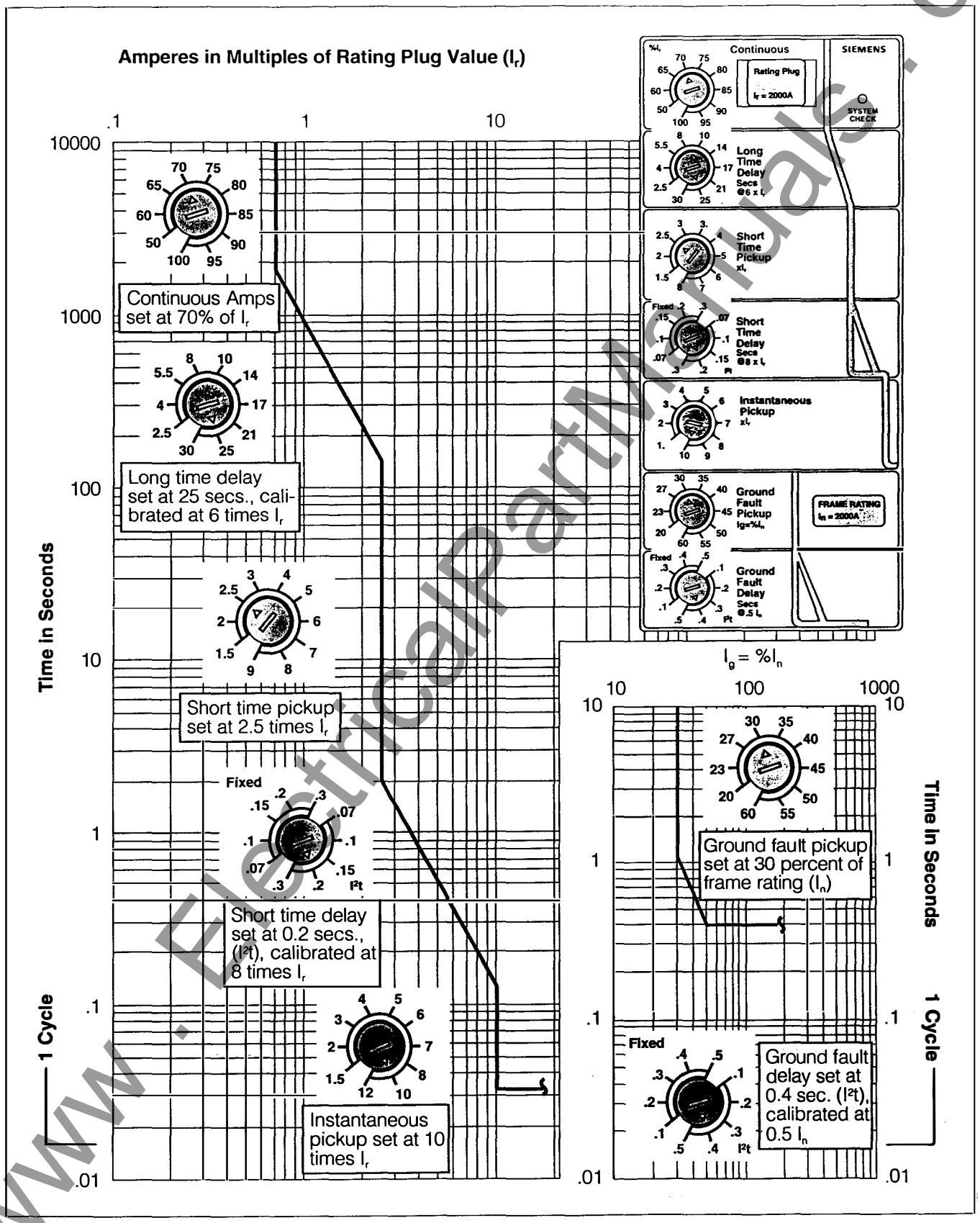


Zero Sequence Ground Fault Protection.

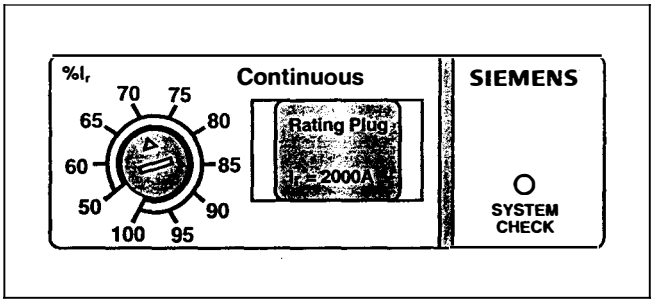
Operations – Example Time Current Curve

Type SB Breaker Frame Time Current Curve

Example: 2000A



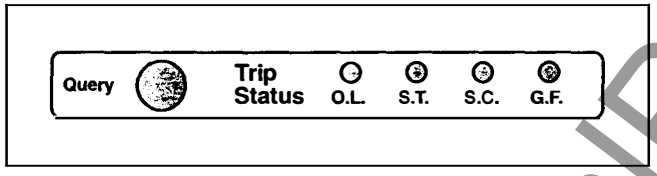
System Check Indicator



The System Check Indicator is a green LED that blinks approximately once every 3 seconds when the microprocessor is properly cycling through its protection routines.

The trip unit derives its operating power from the phase currents in the Type SB Breaker. The phase current required to operate the unit is approximately 20 percent of the frame ampere rating I_n. If the microprocessor is not properly cycling through its protection routines or the phase current is below 20% I_n, the LED will not light.

Trip Status



The Query button switch and Trip Status indicator lights provide the user the means for determining what type of fault caused the trip unit to trip the circuit breaker. Fault indicators are provided for:

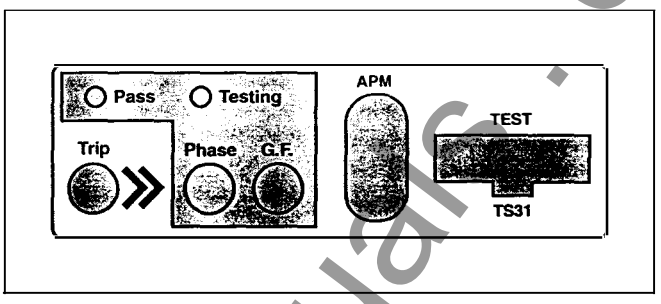
O.L. - Overload or Long Time Fault
S.T. - Short Time Fault
S.C. - Short Circuit or Instantaneous Fault
G.F. - Ground Fault

When a fault occurs, the fault information is stored in the trip unit by latching the appropriate red LED fault indicator to the "On" position. When the Query button is depressed, the latched fault indicator will light. The electrical power to the indicators is automatically stored in the trip unit, eliminating the need for a battery pack.

A hole is provided in the transparent cover to allow the user access to the Query button.

NOTE: During trip unit power up, the S.C. fault indicator will latch, providing a means to check that the circuitry is properly operating. In the case of a fault, the proper indicator will be latched to the fault position. The indicator circuitry always latches the most recent fault event.

Integral Test Modes



The integral test function enables the user to "exercise" the trip unit electronics, the magnetic latch, and the breaker mechanism. The purpose of the integral test function is to provide the user an easy means to conduct a "go/no go" type test before bringing the circuit breaker on-line. After the circuit breaker has been brought on-line, it may be used during routine inspection and maintenance.

Both phase fault current protection and ground fault current protection may be tested. The integral ground fault test function tests the circuit breakers' ground fault protection system in accordance with NEC Article 230-95(c).

Electrical power to operate the integral test function is provided internally if the circuit breaker is closed and the phase currents are greater than 20% of the frame ampere rating I_n, or by a plug-in power source (see Accessories).

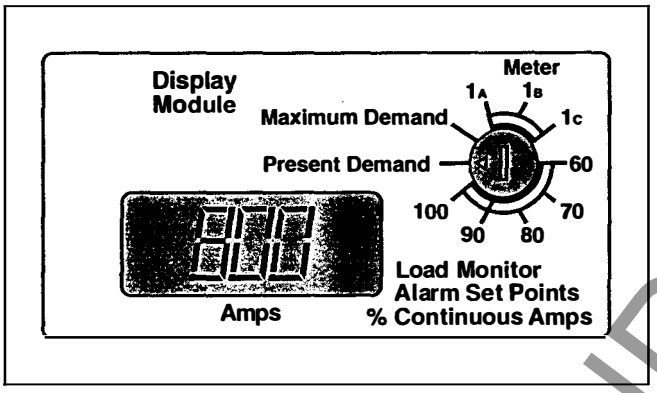
The user may execute the test function in either a "no trip" mode, which will test only the trip unit electronics, or a "trip" mode, which will also test the magnetic latch and breaker mechanism. The execution of the integral test function in both the "no trip" and "trip" modes is based on the settings of the long time delay and ground fault delay adjustments. Therefore, the Phase Test will take several seconds (depending upon long time delay setting) to execute and the Ground Fault Test will appear to be nearly instantaneous. To execute a test function in the "no trip" mode, depress the appropriate pushbutton test switch: Phase or GF. As the trip unit is performing the test, the Testing indicator will light. If the trip unit successfully passes the test, the Pass indicator will light. If the Pass indicator does not light after the Testing indicator signifies that the test is complete, a more extensive test should be run with Siemens TS-31 Universal Test Kit (see Accessories).

CAUTION: Before conducting a "Trip" test on a circuit breaker which is "Closed" and in service, caution should be taken to evaluate effects on downstream loads. The breaker *will* open during testing, resulting in a disruption of service.

To properly execute a test function in the "trip" mode, the circuit breaker must be in the "Closed" position. Hold the pushbutton Trip switch in the depressed position and depress the appropriate test switch, Phase or GF. In addition to lighting the test indicators, the trip unit will send a trip signal to the circuit breaker to test the magnetic latch and breaker mechanism. If the test is successfully passed, the circuit breaker will "Open". The proper LED fault indicator will also be latched.

NOTE: After conducting a "Trip" test with the Auxiliary Power Module (APM), the trip unit is kept in a "Trip Free" condition and the system check LED will be turned off. Remove the APM before returning (Closing) the breaker to service.

Display Module



The optional Display Module provides the features for allowing the user to locally monitor the phase currents. The Display Module plugs into the front of the trip unit. The plexiglass cover must be removed to install the display module (see pages 10-11). The switch to set and select the displays is accessible to the user through a hole in the transparent cover.

Load Monitor Alarm. This feature provides a local alarm display (display flashes) and an output signal for an external alarm when the average of the phase currents exceeds the alarm set point. The display and the external alarm signal automatically resets when the alarm condition ceases. The output alarm signal is a 5-volt DC level. This signal may be used to display an alarm on the Remote Relay Indication Panel. The alarm set point may be set to 60, 70, 80, 90 or 100 percent of the continuous ampere setting.

Current Demand. This feature provides two ampere demand functions. The Present Demand setting displays the present ampere demand calculated on 15 minute intervals. The Maximum Demand setting displays maximum ampere demand since last reset. To reset the Maximum Demand memory, the operator should simultaneously press the "Phase" and "G.F." buttons on the integral test function.

NOTE: If the breaker sees an overload at any time, the display will flash "OL" until the breaker trips.

Ammeter. This feature provides a local display of the present phase currents. The user may display the current value in "A" phase, "B" phase, or "C" phase by setting the switch to the appropriate Meter position.

Zone Selective Interlocking

Zone Selective Interlocking is a feature that is provided for both Short Time and Ground Fault protection functions. With this feature, a trip unit (breaker) in the protected zone will respond to its preset delay settings if it receives an "arming" signal from a downstream breaker. If no "arming" signal is received, the trip unit will trip the breaker with minimum delay, thus minimizing fault damage in the protected zone. The Type SB Trip Unit Zone Selective Interlocking is compatible with Siemens Sensitrip® III and LVPCB product offerings.

Communications

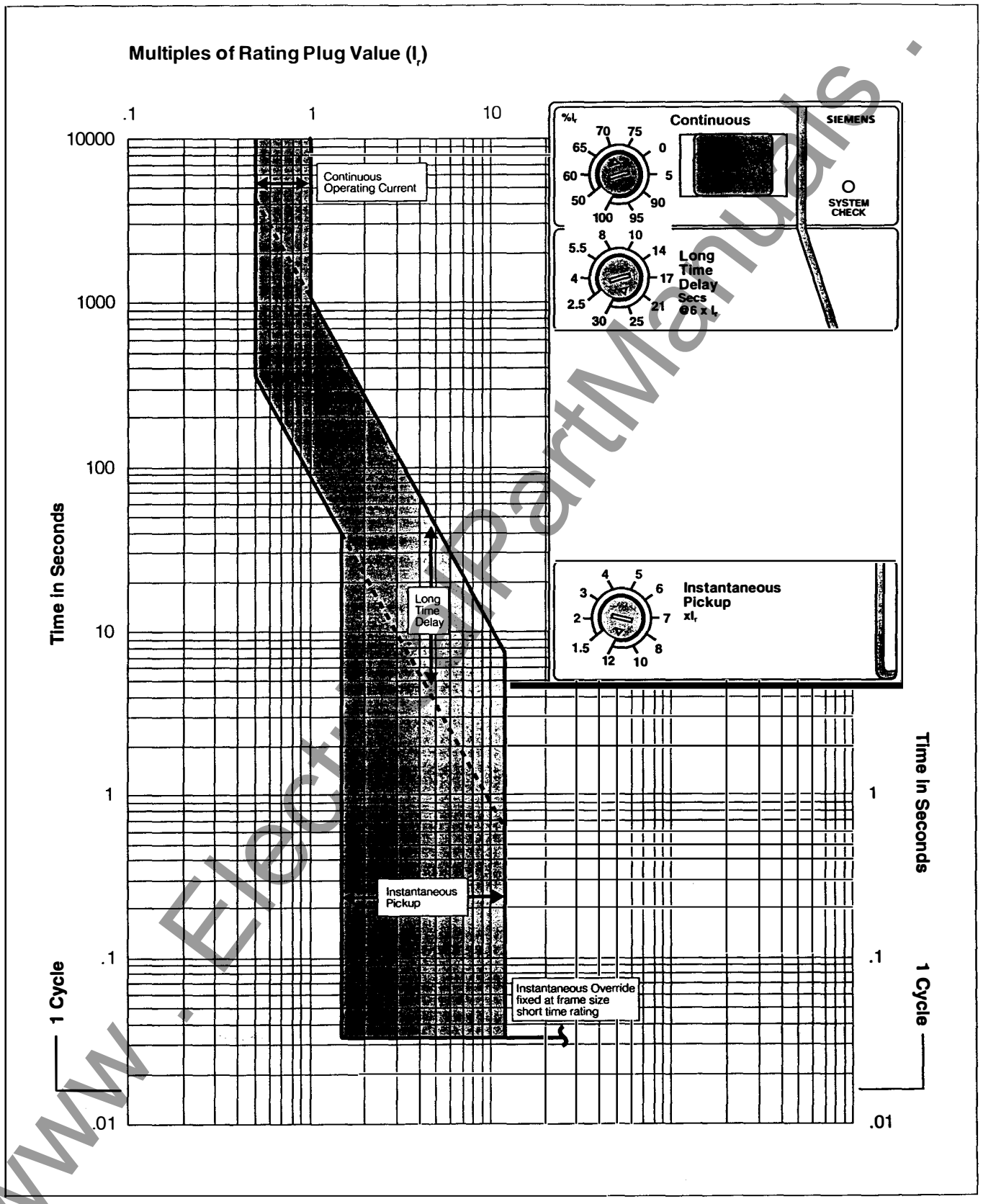
Communications to a remote display, printer or computer is a feature for monitoring the status of the circuit breaker. Data that may be remotely monitored include:

- Circuit Breaker Status
- RMS Phase Currents
- Tripping Events
- Fault Indicator Status

For information on remote monitoring see Siemens ACCESS™ bulletin number SG3099.

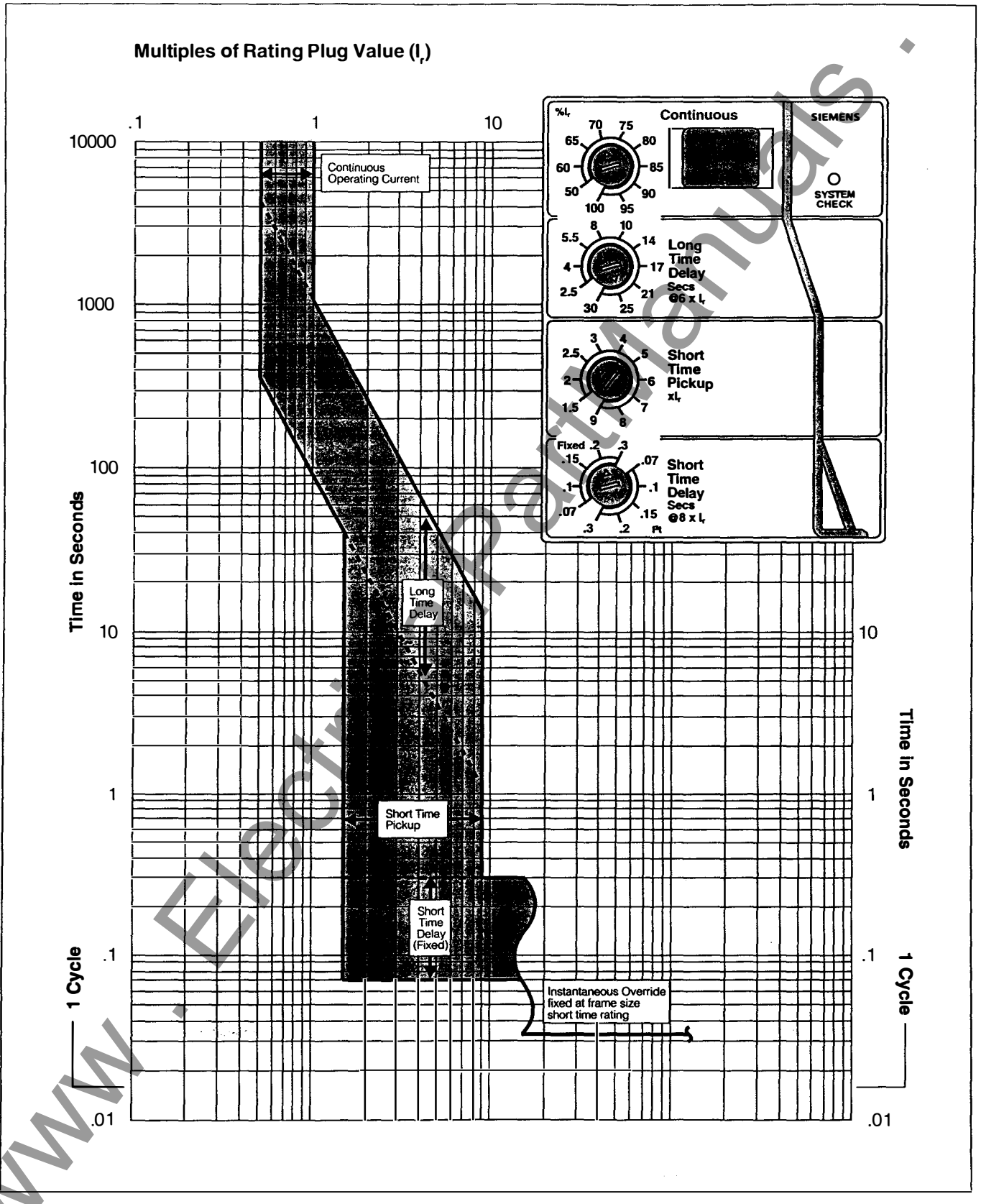
Time Current Characteristic Curves

Time Current Curve - 800A and 2000A Frame Sizes
Long Time/Instantaneous Protection Configuration



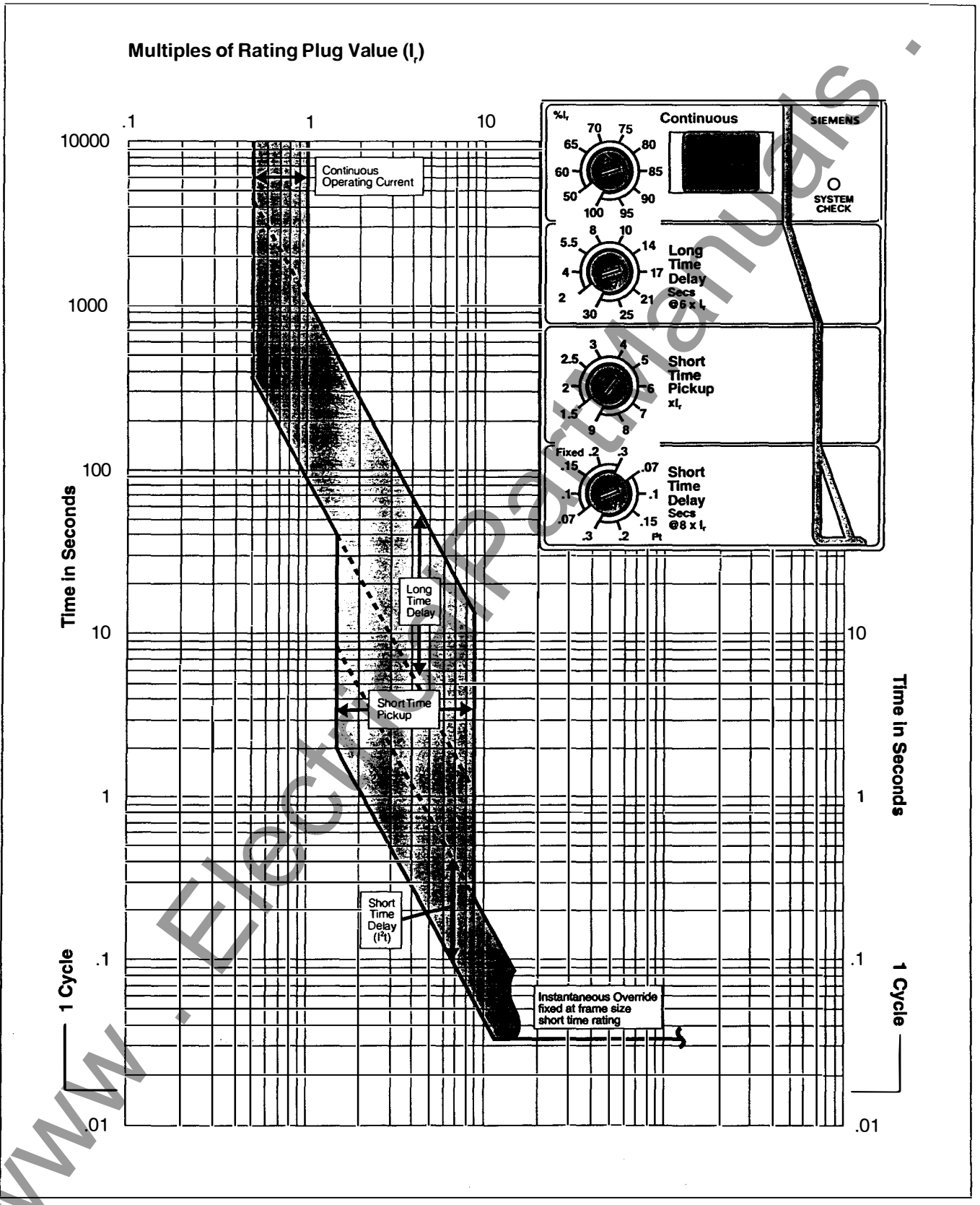
Time Current Characteristic Curves

Time Current Curve - 800A and 2000A Frame Sizes
Long Time/Short Time (Fixed Delay) Protection Configuration



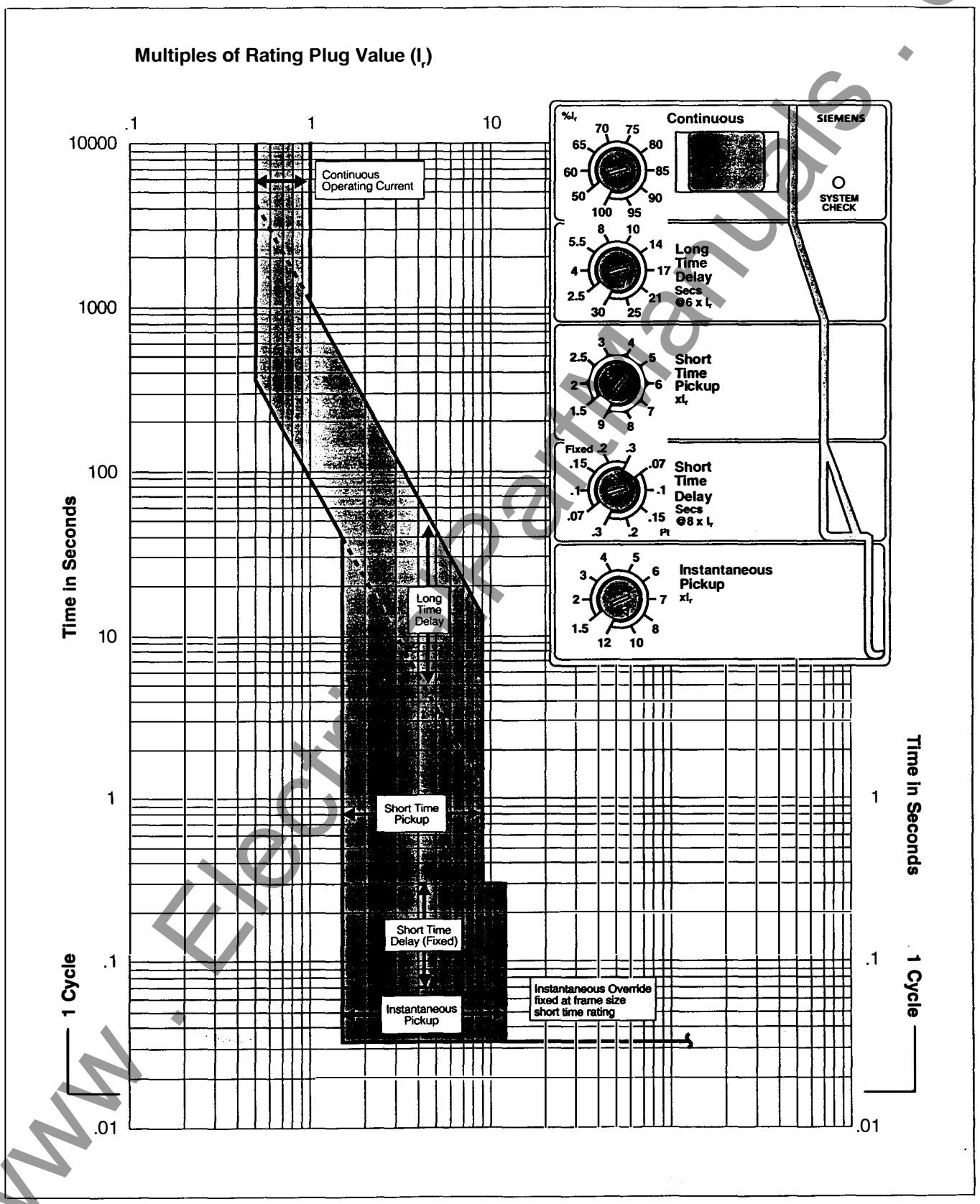
Time Current Characteristic Curve

Time Current Curve - 800A and 2000A Frame Sizes
Long Time/Short Time (I^2t Delay) Protection Configuration



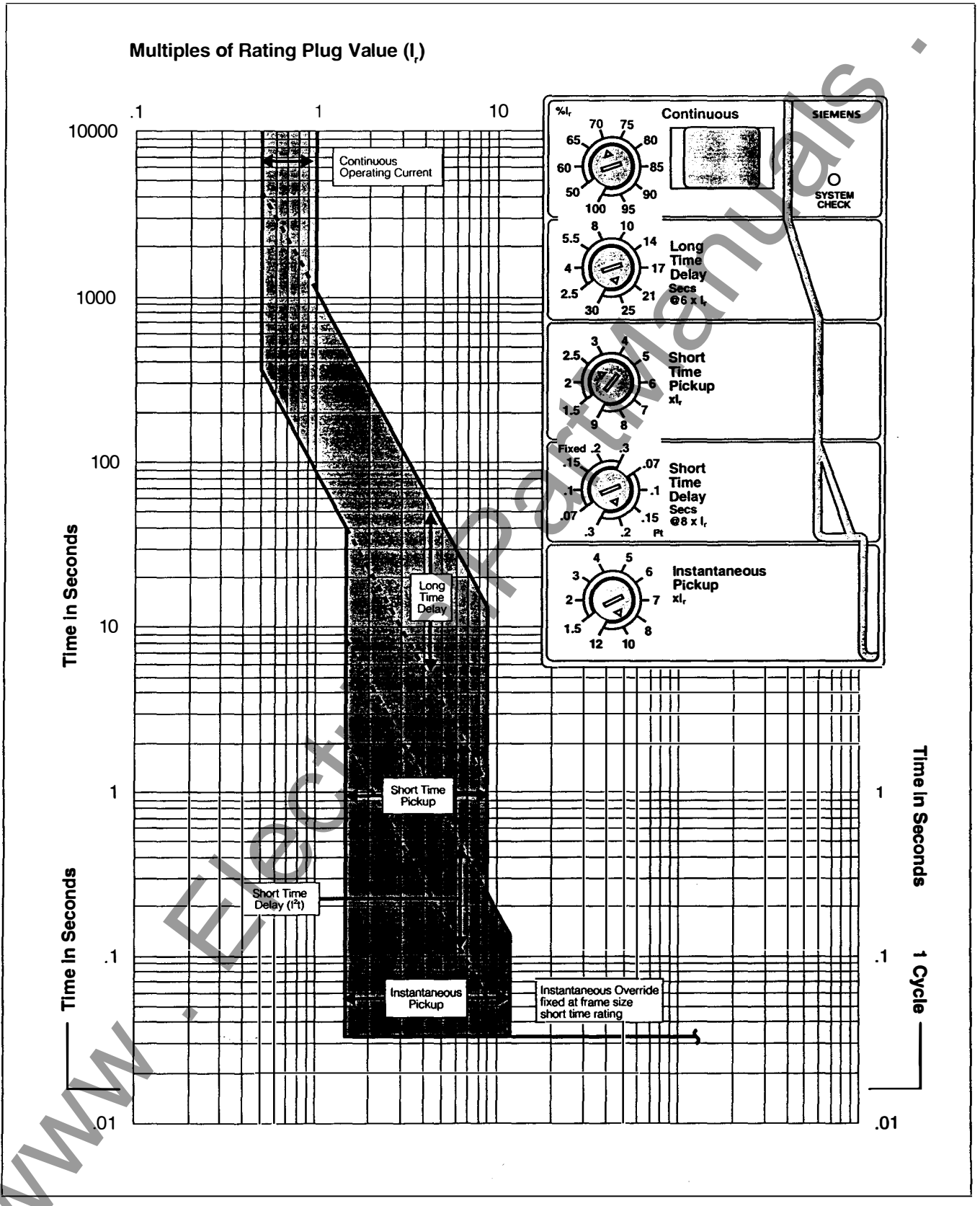
Time Current Characteristic Curve

Time Current Curve - 800A and 2000A Frame Sizes
Long Time/Short Time (Fixed Delay)/Instantaneous Protection Configuration



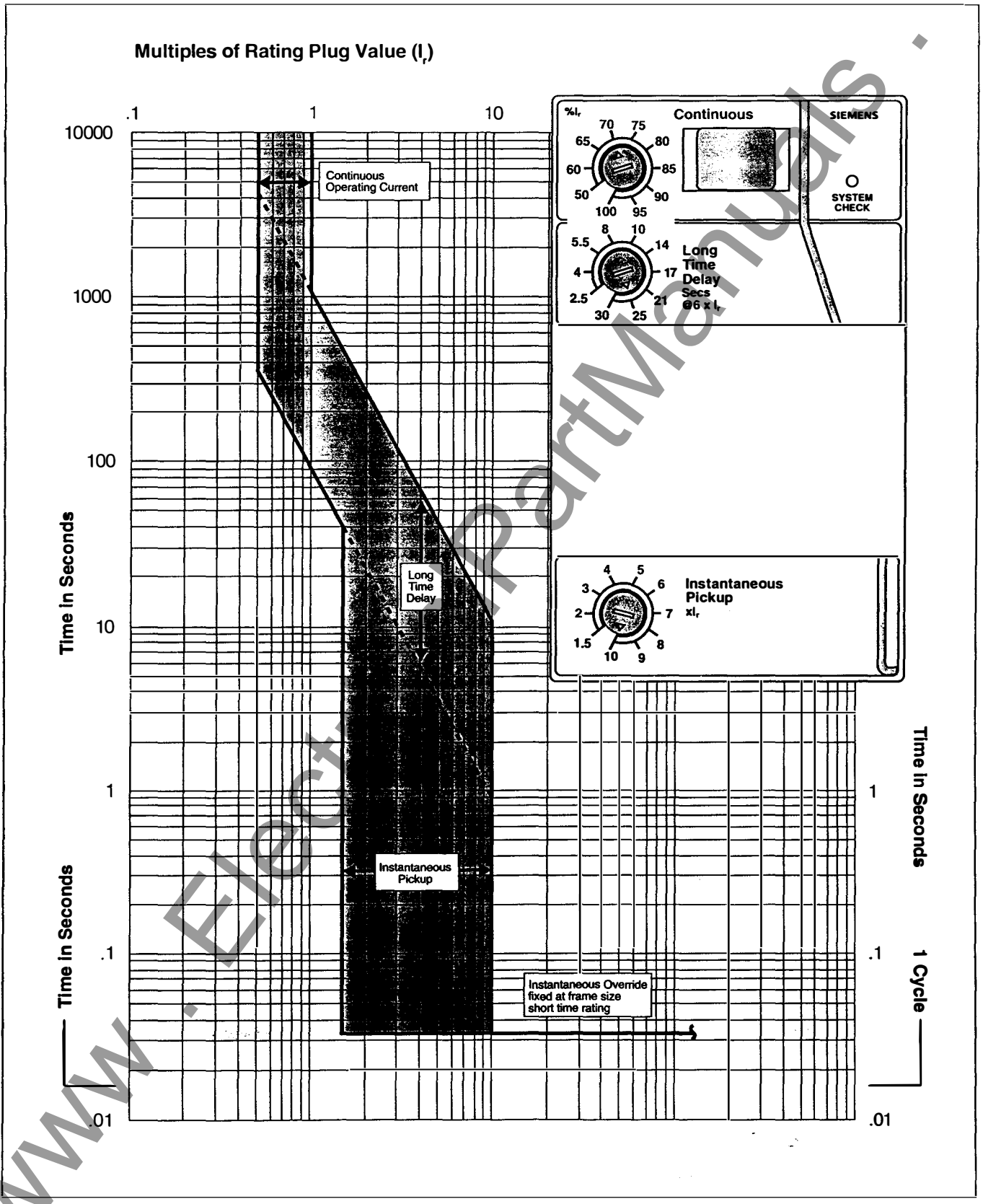
Time Current Characteristic Curve

Time Current Curve - 800A and 2000A Frame Sizes
Long Time/Short Time (I^2t Delay)/Instantaneous Protection Configuration



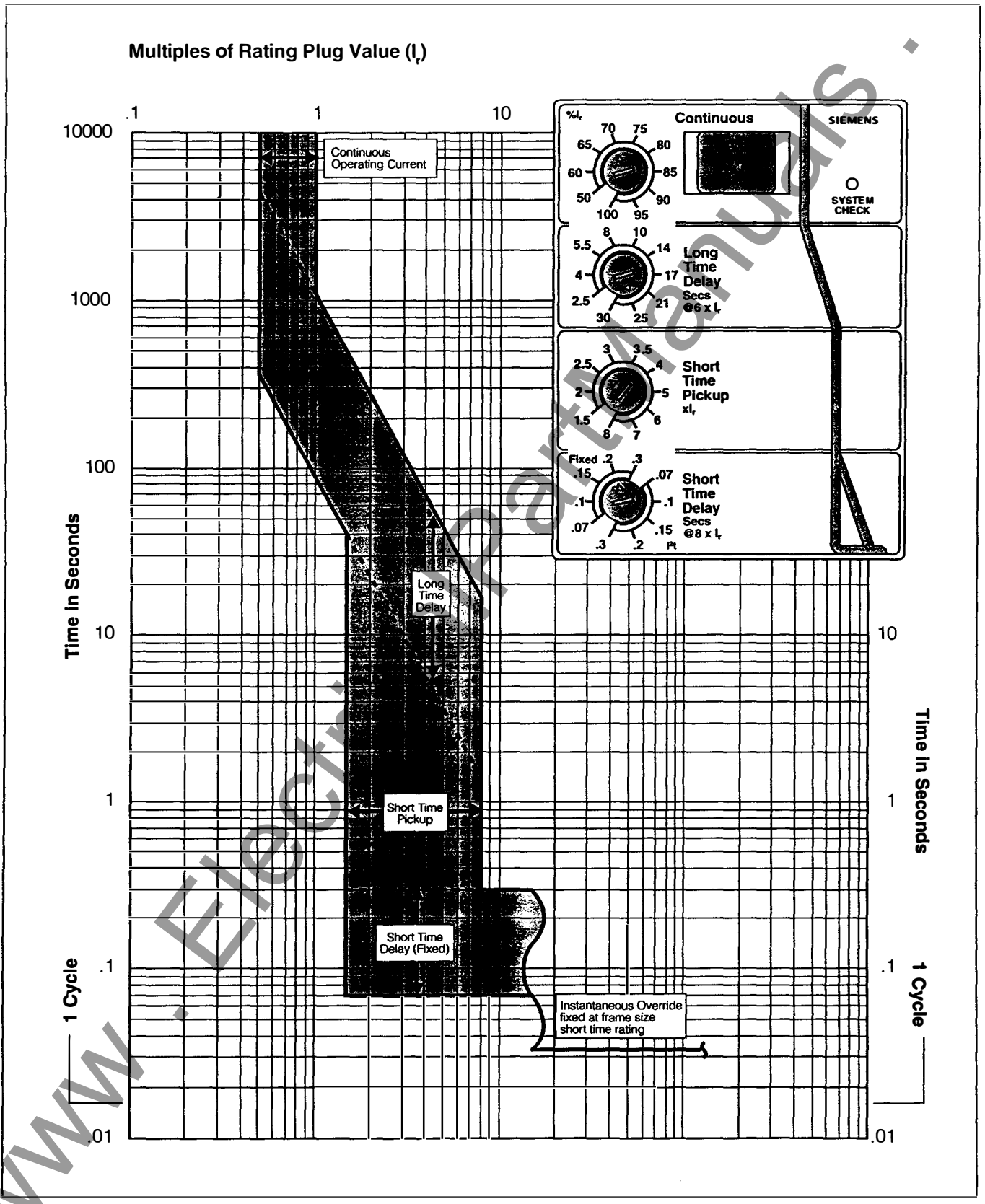
Time Current Characteristic Curve

Time Current Curve - 4000A Frame Size
Long Time/Instantaneous Protection Configuration



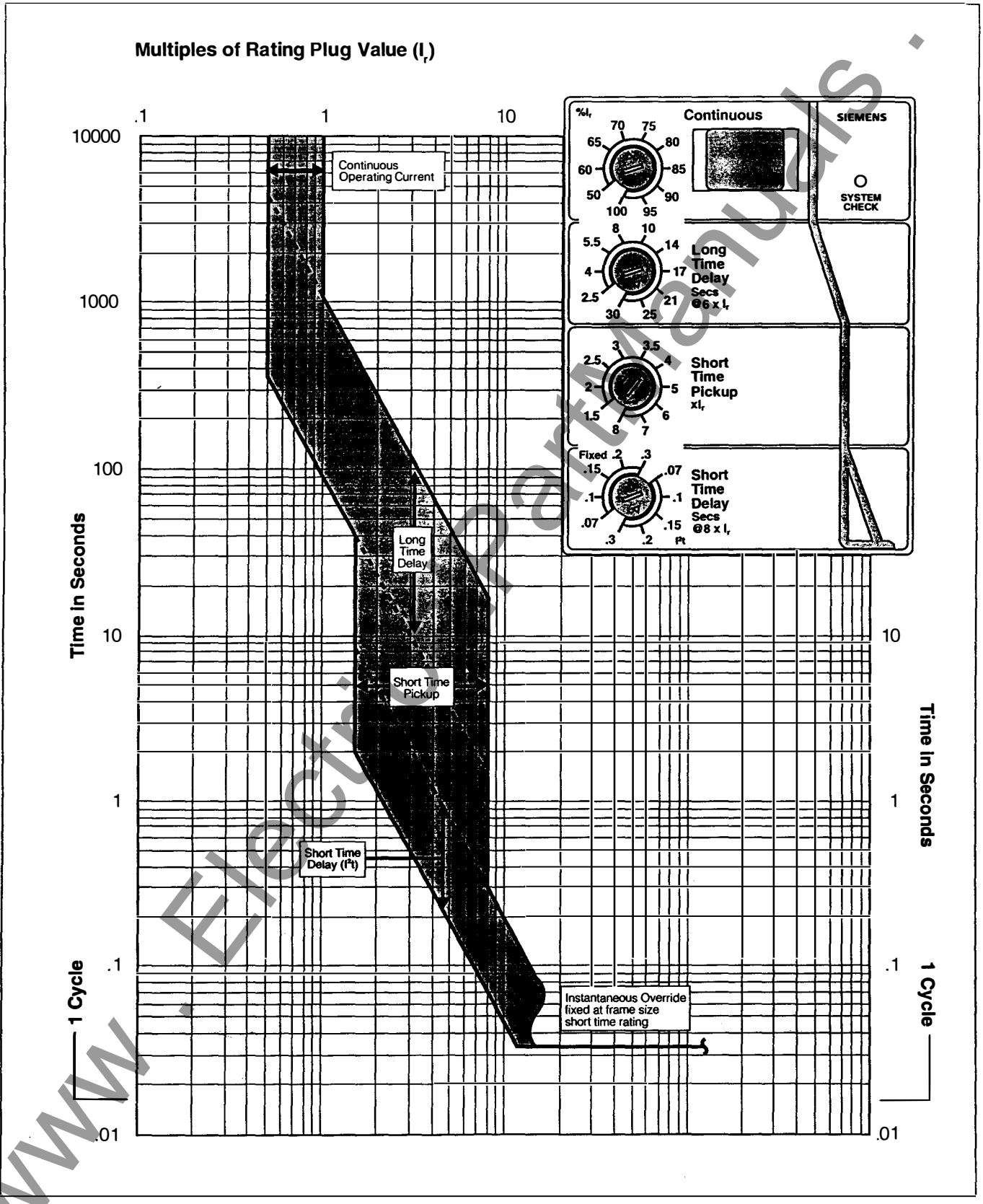
Time Current Characteristic Curve

Time Current Curve - 4000A Frame Size
Long Time/Short Time (Fixed) Delay Protection Configuration



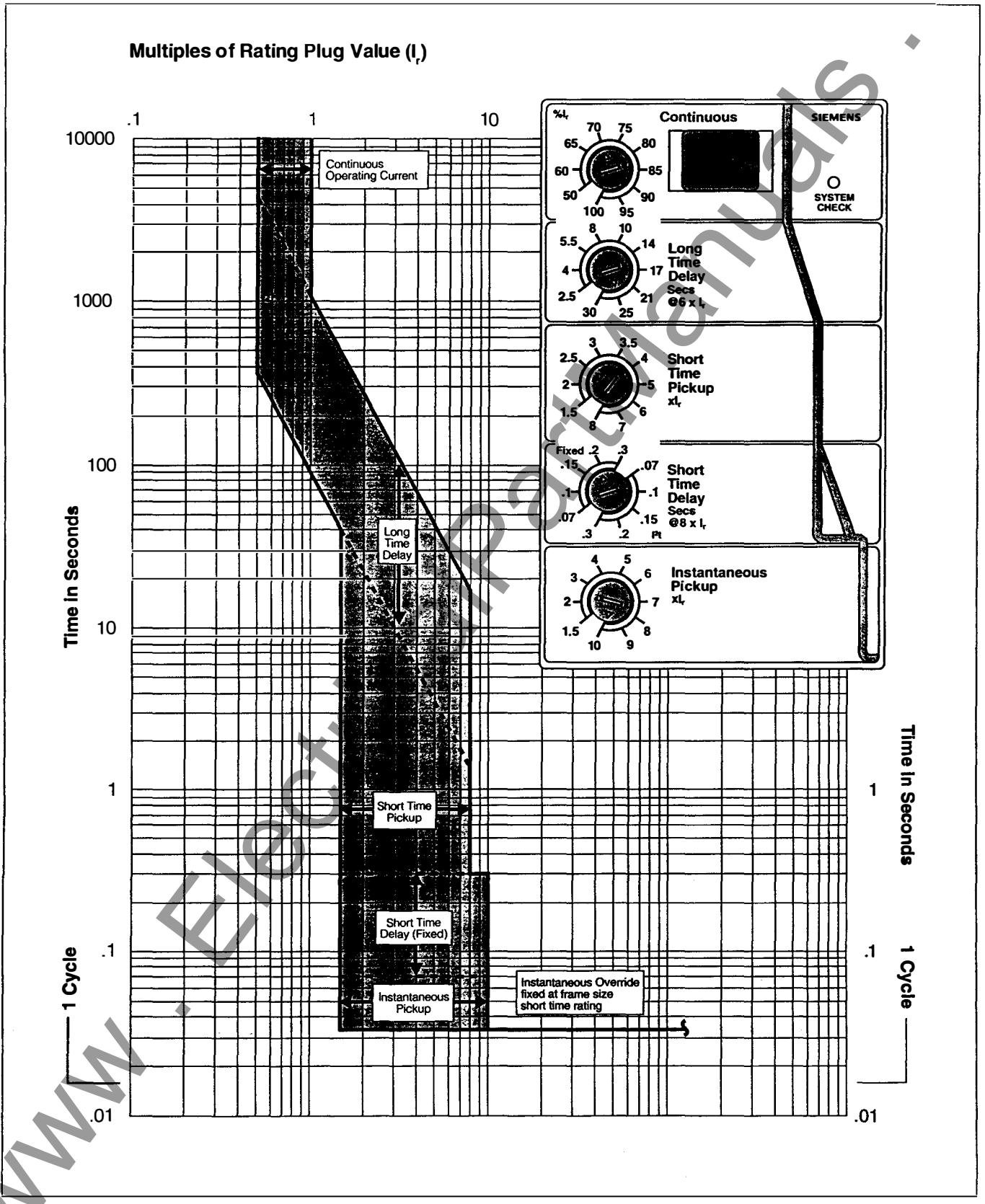
Time Current Characteristic Curve

Time Current Curve - 4000A Frame Size
Long Time/Short Time (I^2t Delay) Protection Configuration



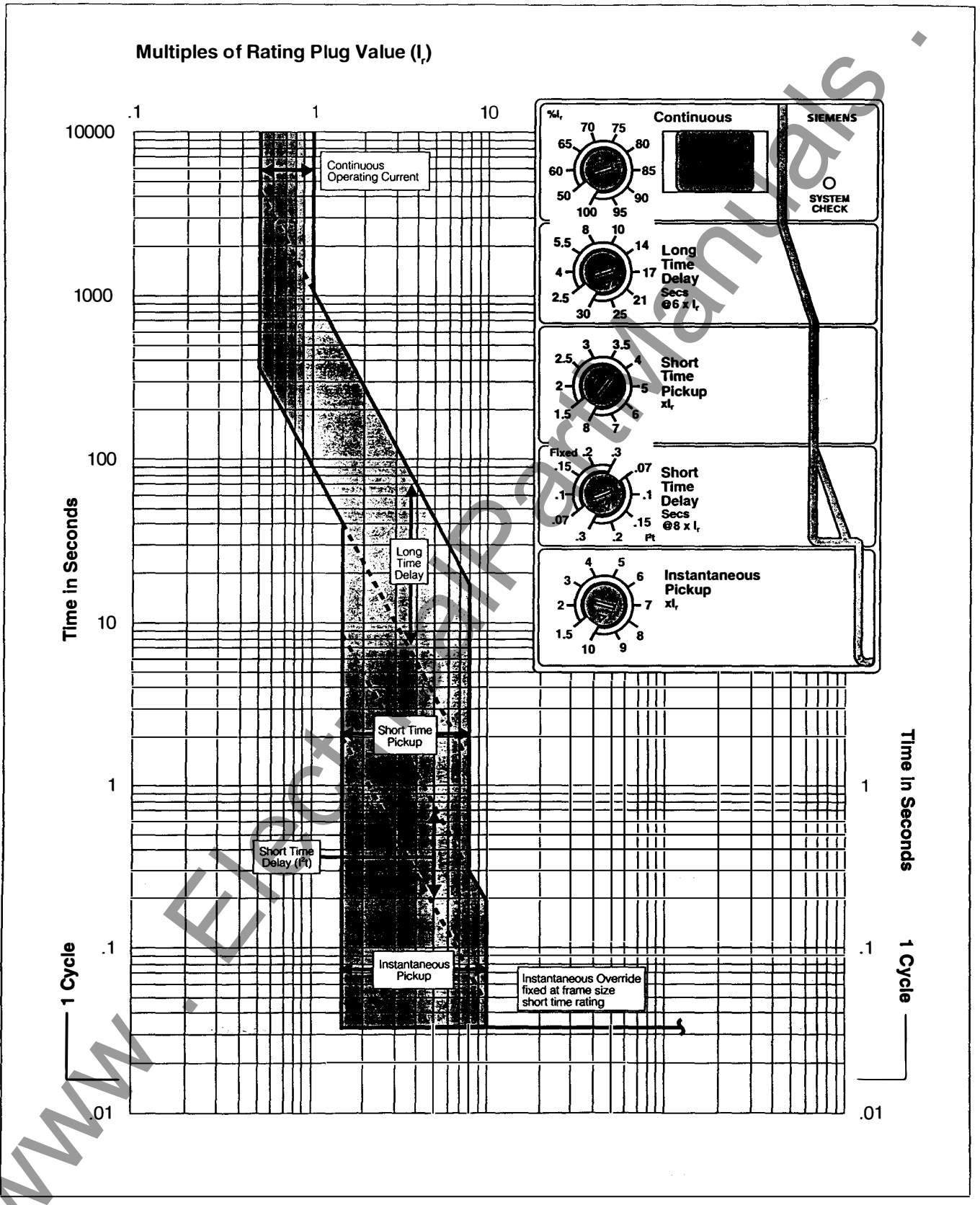
Time Current Characteristic Curve

Time Current Curve - 4000A Frame Size
Long Time/Short Time (Fixed Delay)/Instantaneous Protection Configuration



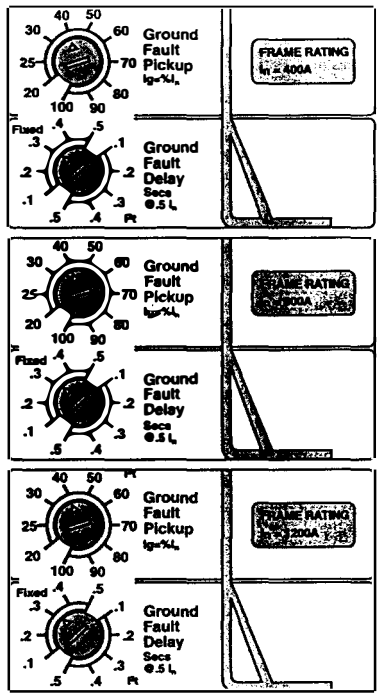
Time Current Characteristic Curve

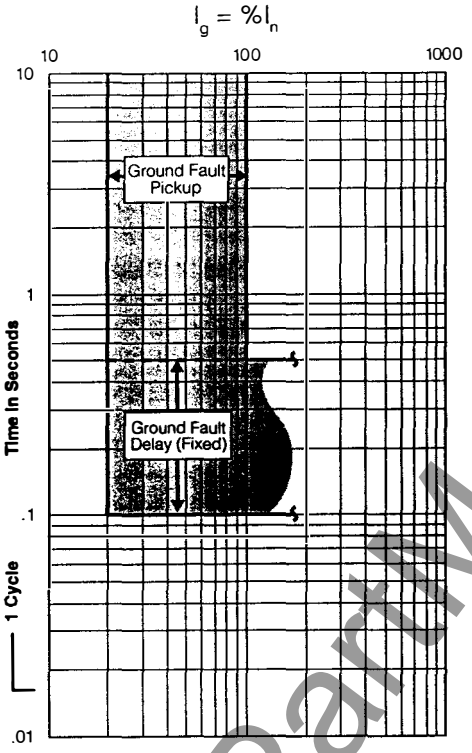
Time Current Curve - 4000A Frame Size
Long Time/Short Time (I^2t Delay) Instantaneous Protection Configuration

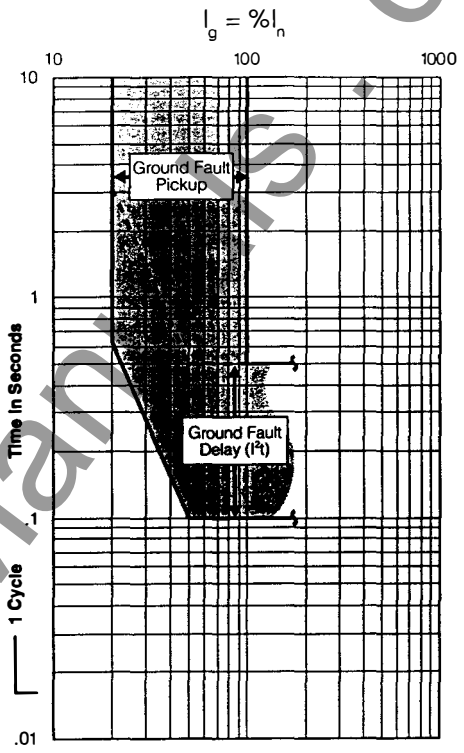


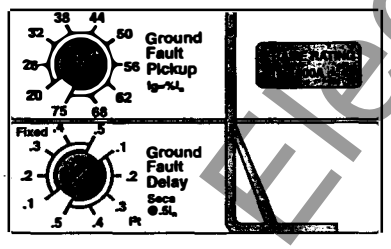
Time Current Characteristic Curve

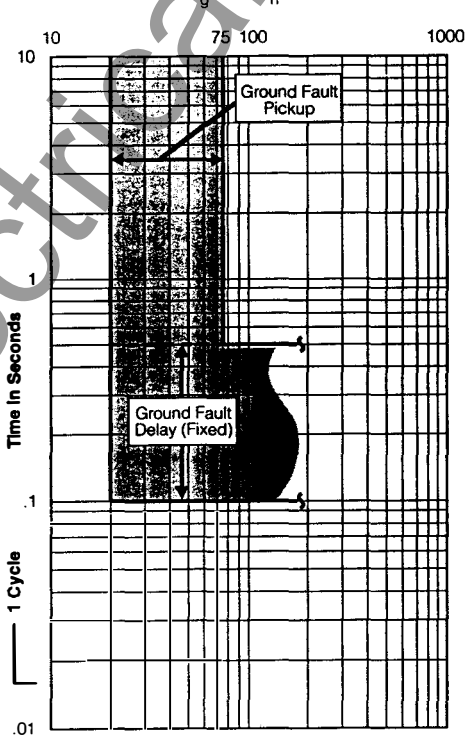
Time Current Curves - 400A, 800A, 1200A and 1600A Frame Ratings
Ground Fault Protection

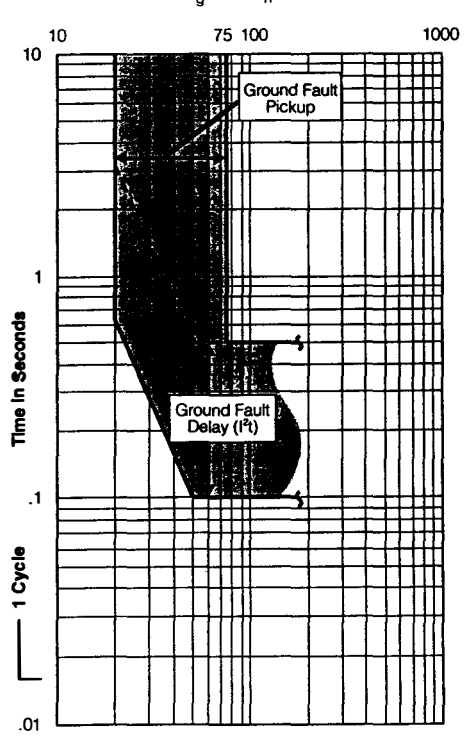






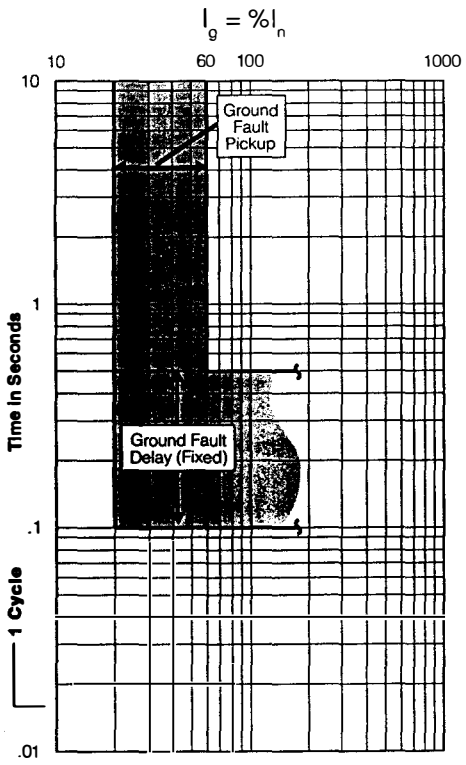


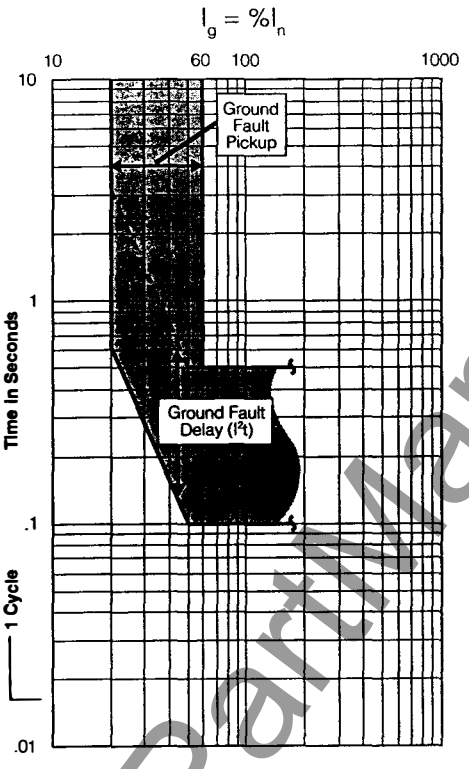


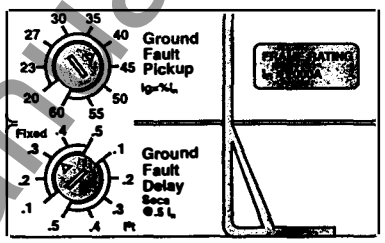


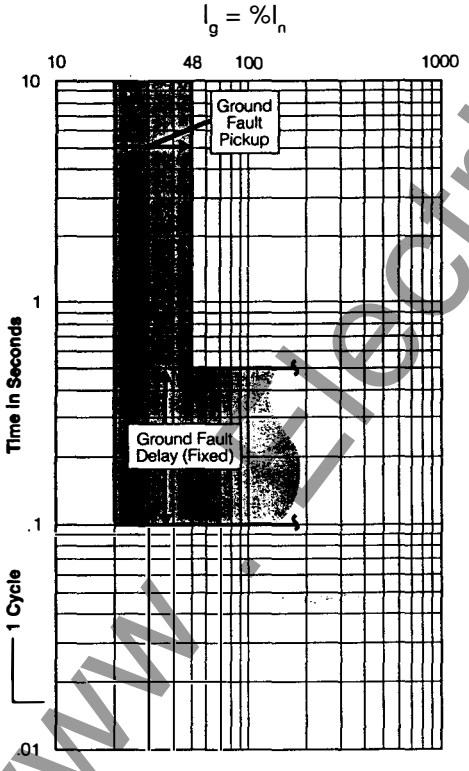
Time Current Characteristic Curve

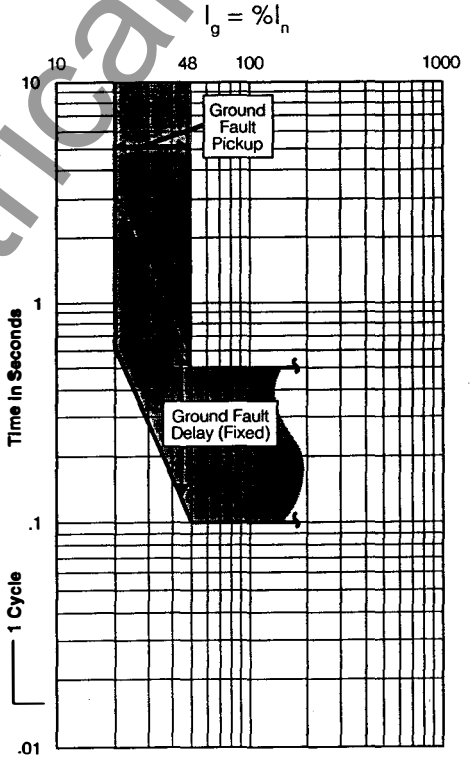
Time Current Curves - 2000A and 2500A Frame Ratings
Ground Fault Protection

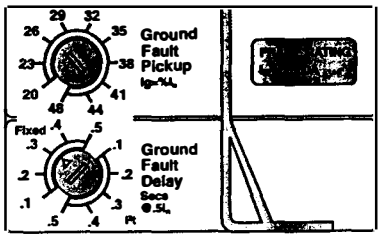






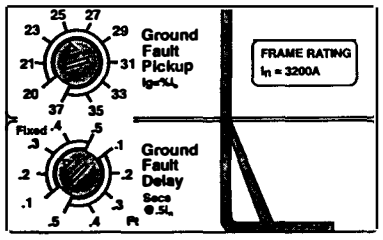


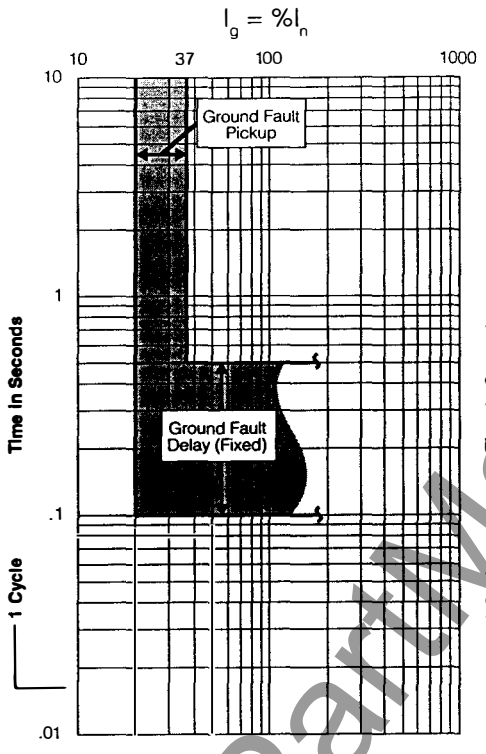


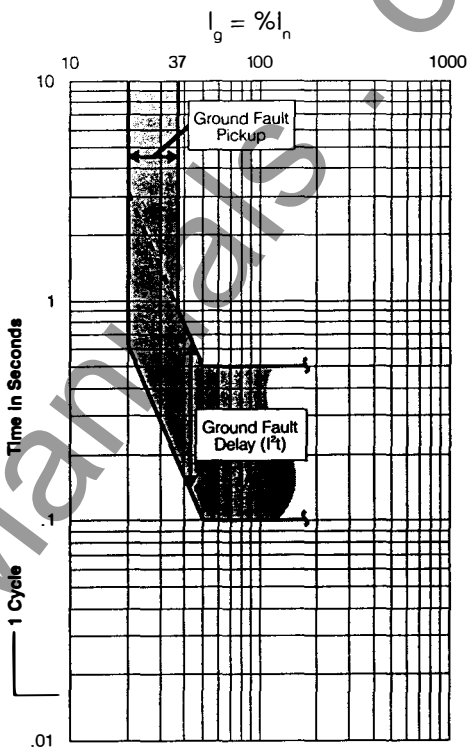


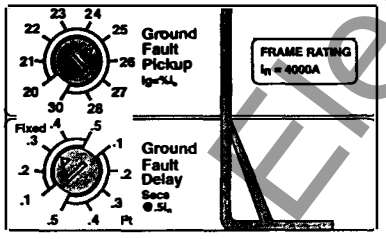
Time Current Characteristic Curve

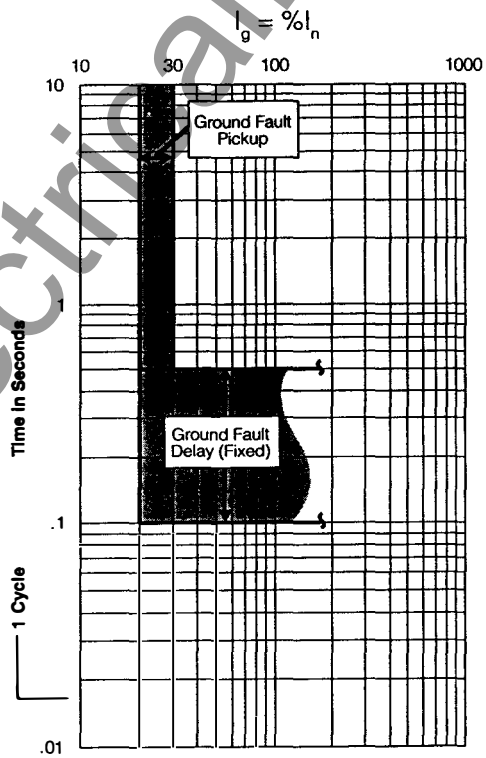
Time Current Curves - 3200A and 4000A Frame Ratings
Ground Fault Protection

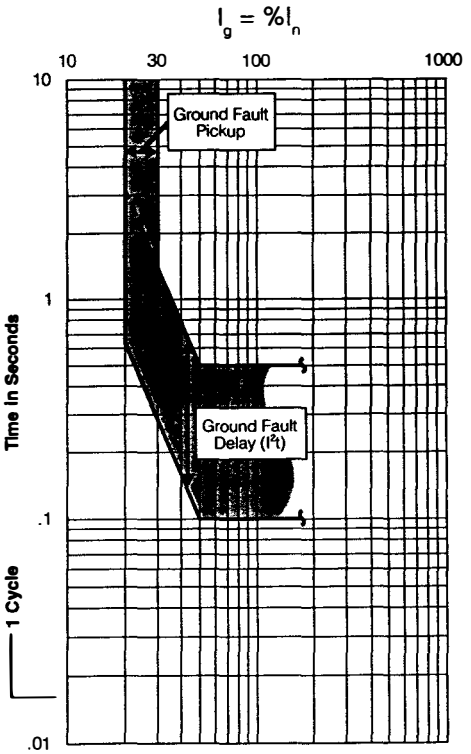




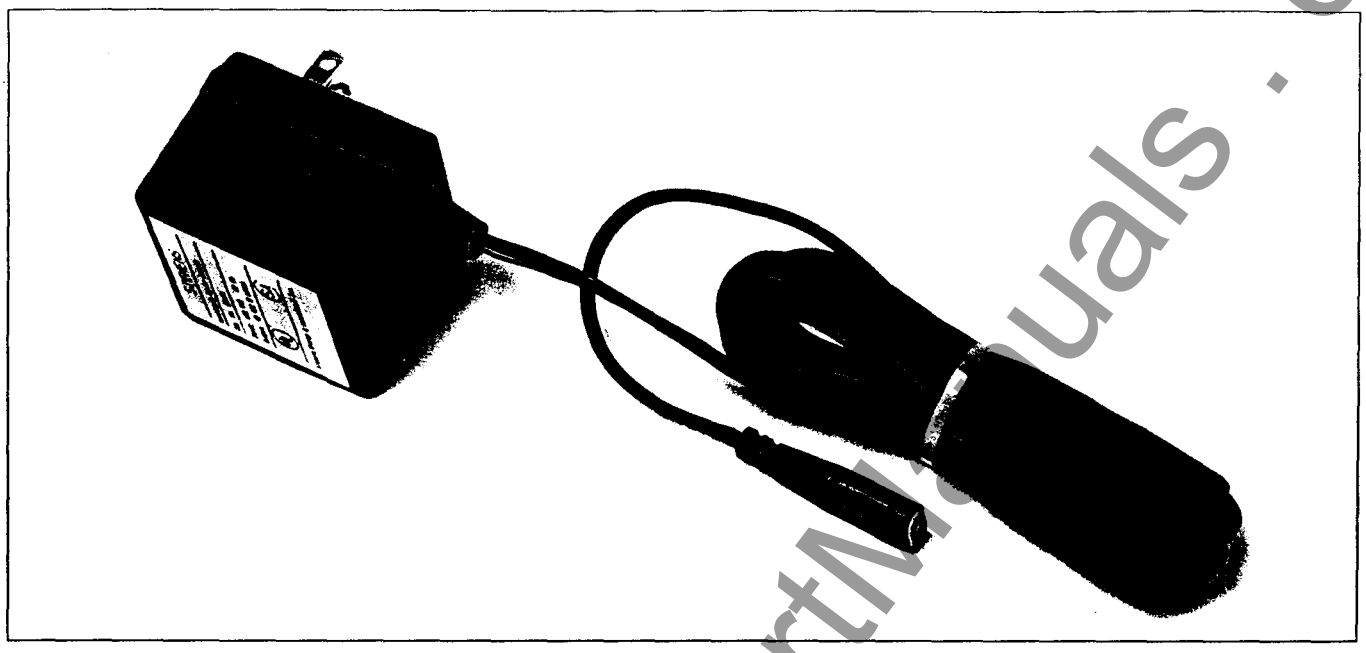






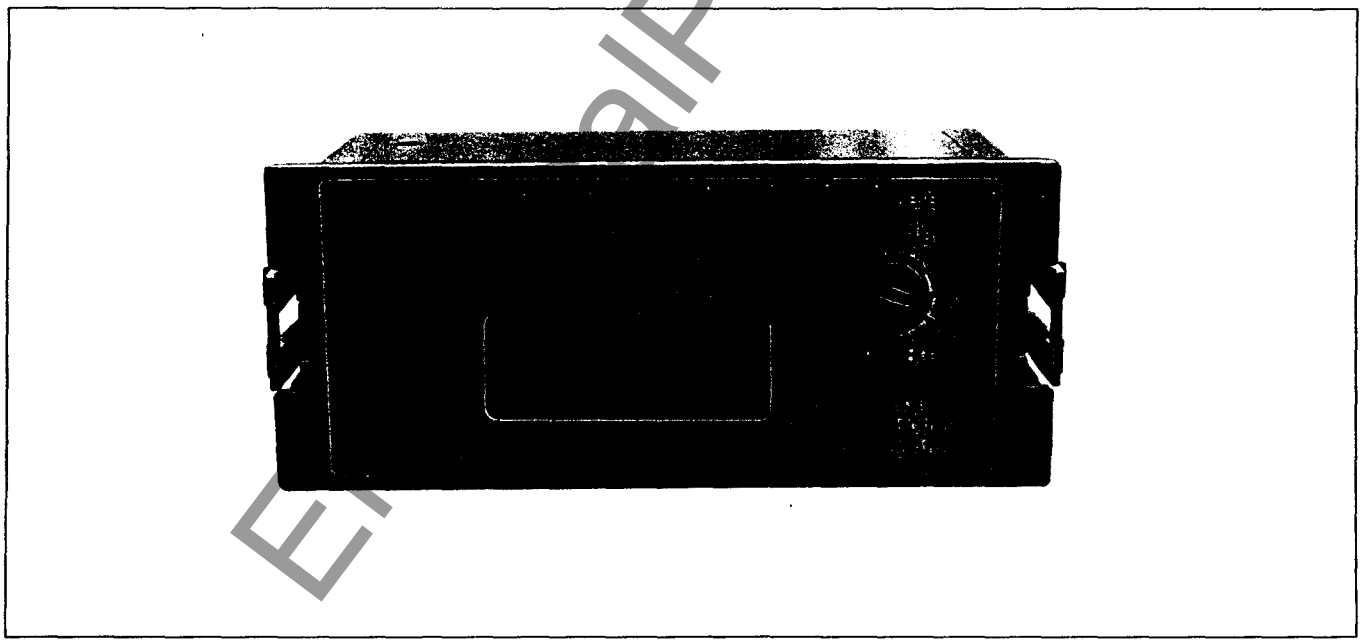


Auxilliary Power Module (APM)



Plug-in Power Supply for bench testing of the Electronic Trip Unit for Siemens Type SB Systems Breaker.

Display Module



Current monitoring Display Module, see page 21.

⚠ DANGER

Hazardous Voltage.
Will cause severe injury or death.

Turn power off supplying device before installing.

⚠ Safety Instructions

Universal Test Kit

The TS-31 is used to test the operation of the fault protection functions of the Type SB Electronic Trip Unit. It has been designed to be user friendly. The user is prompted by the TS-31, in a step-by-step format, as to the required input information and test instruction. The test results are visually displayed to the user.

NOTE: Utilize individual instructions supplied with Test Kit for Type SB Encased Circuit Breaker testing.

CAUTION: Before conducting a "Trip" test on a circuit breaker which is "Closed" and in service, caution should be taken to evaluate effects on downstream loads. The breaker *will* open during testing, resulting in a disruption of service and possible erroneous readings might occur due to the effect of a systems load.

Operating Instructions

A. Remove electrical loads from circuit breaker.

B. Plug the TS-31 test set into a grounded 120 VAC receptacle and turn it on. You will be greeted by the identifying turn-on message:

Siemens Energy & Automation, Inc. TS-31 Test Set. Press ENTER to continue

C. Select the appropriate ribbon cable assembly and connect it between the TS-31 and the circuit breaker, making sure of alignment and polarity. After pressing ENTER, the TS-31 will prompt:

Enter Catalog Number

D. Type in the catalog number and then press the ENTER key. The catalog number can be found on the nameplate of the circuit breaker. The TS-31 will respond with:

Searching Catalog . . . Searching Family Series . . .

If an invalid catalog number has been entered, the TS-31 will respond with:

Catalog Number xxxxxx Not Found. Press Enter to Continue

and you will be asked to enter another catalog number.

E. If valid catalog number has been entered, the TS-31 will prompt for the Breaker switch settings. The TS-31 will respond with:

Enter continuous current setting in %.
Enter instantaneous pickup setting.
Enter long time delay in seconds.

For breakers with short time functions you may be asked one of the following:

Enter short time Pickup.
Select Short Time Delay: 1-Fixed 2-I^2t
Enter short time delay in seconds.
Enter I^2t delay in seconds.

For breakers with ground fault you will be asked:

Enter ground fault pickup setting in %
Enter ground fault delay in seconds

In each case, enter your breaker's switch settings. For example if your breaker is set for a continuous current of 70%, type 70 and then press enter. Entry of erroneous data in the above steps will result in false tests and results.

F. After entering the breaker switch setting you must select the test you wish to perform. The TS-31 will request:

Enter test to perform; see instructions.

Type in one of the following letters depending upon the test you wish to perform:

"L" – Long time or overload test,
"S" – Short time test,
"I" – Instantaneous test.
"G" – Ground fault test,
"C" – Current transformer continuity test,

G. The TS-31 will report the type of test you selected and give you a chance to abort the test. For example, if "I" was pressed above. The TS-31 will display:

Instantaneous Test Press ENTER to continue or A to abort

If you pressed the letter "A" to abort, you will be asked again:

Enter Test to perform

H. If you press ENTER, you will be prompted for the phase to test: The TS-31 will display:

Enter phase to test.

Enter one of the following letters:
"A" – Phase A or left pole.
"B" – Phase B or center pole.
"C" – Phase C or right pole.

I. Press Enter again to start the test. Press any other key to STOP the test. Once a test has been started, the TS-31 will respond with:

Testing . . .

Be careful at this time. Any key press will abort the test.

CAUTION: Handling of the test cable, the breaker, or the trip unit at this time can cause electric shock which may result in injury and/or death.

J. The test may take anywhere from a fraction of a second to minutes to complete, depending on which procedure was run. If the test passes, the display will show the following, depending on whether the breaker tripped or not.

Passed Test xxx.xx seconds Press ENTER to continue,

If the circuit breaker tripped during the test, RESET the circuit breaker before continuing.

K. The TS-321 will prompt for the next instructions. The display will show:

Change: 1 - Test 2 - Catalog 3 - Settings

Enter one of the following numbers:
"1" – Select a new test
"2" – Enter a new catalog number
"3" – Enter new switch settings

If you enter "1" you will be sent to step F. Choosing a "2" will send the program back to step C and entering a "3" will route program control back to step E. Entering "3" which sends you back to step E, will be slightly different the second time through. On the second line after the prompt for the setting, a number or text in angle brackets will appear. This will indicate the last setting you entered. If you DON'T wish to change a setting, just press ENTER. If you DO wish to change a setting, type in the new setting and press ENTER.

L. If you pressed "C" when asked,

Enter test to perform; see instructions,

you will first be prompted by,

Current Transformer Test Press ENTER to continue or A to abort,

and then by the phase to test. One of the following messages will then appear depending on the test results:

CT Resistance Test. Phase X Passed Press ENTER to exit test and continue

CT Resistance Test. Phase X Failed Press ENTER to exit test and continue
CT Resistance Test. Phase X Open Press ENTER to exit test and continue
CT Resistance Test. Phase X Short Press ENTER to exit test and continue

The "Phase X Failed" message indicates that the CT resistance is neither open nor shorted, but is not within design tolerance.

M. There are additional ERROR messages which may appear on the display during this operation which were not covered previously:

Test Not Running! Check test cable connection. Press ENTER to continue.

The test set has sensed that current is not flowing properly in the breaker under test and that there is either an open or short circuit between the TS-31 and the breaker trip unit.

Function Not Available Press ENTER to continue.

You will get this error message if you enter a choice that is not available, such as entering "G" in step F for ground fault test on a catalog number that does not have ground fault.

Inconclusive Test, check settings Press ENTER to continue or A to abort

NOTE: This warning will appear if you attempt to run a short time test with the instantaneous pickup set equal to or below the short time pickup. It would also appear if you tried to run a long time test with short time pickup set to 2. This is only a warning: the test can still be run. However, passing or failing the test may not be conclusive.

Invalid Input Press Enter to continue

NOTE: This message will appear if you enter a setting value that does not exist. For example, a Type SB Electronic Trip Unit has continuous current settings of 50, 60, 65, 70, 75, 80, 85, 90, 95, and 100 percent. If you enter any other value than those listed, the above message will appear.

Test exceeds capability of TS-31 Press ENTER to continue

NOTE: This message is not likely to occur. If it does, it means that a test requires more current to run than the TS-31 can produce.

Unit too hot, please wait

NOTE: Running many successive high-current long time tests may over-heat the test set. It will protect itself from damage by preventing further tests until it has had a chance to cool down. The display will indicate when testing can resume.

Electronic Trip Unit, 800A Frame Size

Catalog Number	Frame Ampere Rating	Continuous Current Setting	Long Time Delay	Short Time Pickup/Delay	Instantaneous Pickup	Ground Fault Pickup/Delay
SB04TLI	400	x	x		x	
SB04TLS	400	x	x	x		
SB04TLSI	400	x	x	x	x	
SB04TLIG	400	x	x		x	x
SB04TLSG	400	x	x	x		x
SB04TLSIG	400	x	x	x	x	x
SB08TLI	800	x	x		x	
SB08TLS	800	x	x	x		
SB08TLSI	800	x	x	x	x	
SB08TLIG	800	x	x		x	x
SB08TLSG	800	x	x	x		x
SB08TLSIG	800	x	x	x	x	x

Electronic Trip Unit, 2000A Frame Size

Catalog Number	Frame Ampere Rating	Continuous Current Setting	Long Time Delay	Short Time Pickup/Delay	Instantaneous Pickup	Ground Fault Pickup/Delay
SB12TLI	1200	x	x		x	
SB12TLS	1200	x	x	x		
SB12TLSI	1200	x	x	x	x	
SB12TLIG	1200	x	x		x	x
SB12TLSG	1200	x	x	x		x
SB12TLSIG	1200	x	x	x	x	x
SB16TLI	1600	x	x		x	
SB16TLS	1600	x	x	x		
SB16TLSI	1600	x	x	x	x	
SB16TLIG	1600	x	x		x	x
SB16TLSG	1600	x	x	x		x
SB16TLSIG	1600	x	x	x	x	x
SB20TLI	2000	x	x		x	
SB20TLS	2000	x	x	x		
SB20TLSI	2000	x	x	x	x	
SB20TLIG	2000	x	x		x	
SB20TLSG	2000	x	x	x		x
SB20TLSIG	2000	x	x	x	x	x

Electronic Trip Unit, 4000A Frame Size

Catalog Number	Frame Ampere Rating	Continuous Current Setting	Long Time Delay	Short Time Pickup/Delay	Instantaneous Pickup	Ground Fault Pickup/Delay
SB25TLI	2500	x	x		x	
SB25TLS	2500	x	x	x		
SB25TLSI	2500	x	x	x	x	
SB25TLIG	2500	x	x		x	x
SB25TLSG	2500	x	x	x		x
SB25TLSIG	2500	x	x	x	x	x
SB32TLI	3200	x	x		x	
SB32TLS	3200	x	x	x		
SB32TLSI	3200	x	x	x	x	
SB32TLIG	3200	x	x		x	x
SB32TLSG	3200	x	x	x		x
SB32TLSIG	3200	x	x	x	x	x
SB40TLI	4000	x	x		x	
SB40TLS	4000	x	x	x		
SB40TLSI	4000	x	x	x	x	
SB40TLIG	4000	x	x		x	x
SB40TLSG	4000	x	x	x		x
SB40TLSIG	4000	x	x	x	x	x

Rating Plugs, 400A Frame Ampere Rating

Catalog Number	Plug Rating
04SB200	200
04SB225	225
04SB250	250
04SB300	300
04SB350	350
04SB400	400

Rating Plugs, 800A Frame Ampere Rating

Catalog Number	Plug Rating
08SB400	400
08SB450	450
08SB500	500
08SB600	600
08SB700	700
08SB800	800

Rating Plugs, 1200A Frame Ampere Rating

Catalog Number	Plug Rating
12SB600	600
12SB700	700
12SB800	800
12SB1000	1000
12SB1200	1200

Rating Plugs, 1600A Frame Ampere Rating

Catalog Number	Plug Rating
16SB800	800
16SB1000	1000
16SB1200	1200
16SB1600	1600

Rating Plugs, 2000A Frame Ampere Rating

Catalog Number	Plug Rating
20SB1000	1000
20SB1200	1200
20SB1600	1600
20SB2000	2000

UL Listings and File Numbers

Trip Unit & Breaker	E9896
Accessories	E57501
Drawout	E135453
CSA	LR57039