SURE-TRIP
DC-2000

PROGRAMMABLE CURRENT MEASUREMENT

SURE-TRIP
RETRO KITS

DC CIRCUIT BREAKER
SOLID STATE PROTECTION

All Solid State Tripping Systems Have Been Designed, Tested
And Produced To All Applicable NEMA and UL Standards.

Patent No. 4,866,557

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SURE-TRIP DC-2000 SOLID STATE RETROFIT KIT

The SURE-TRIP DC-2000 solid state retrofit kit is a current monitoring system that is designed to work with Hall Effect Current Sensors. When retrofitted on DC air circuit breakers the retrofit kit will provide more precise tripping characteristics than the thermal trip units, which it normally replaces. The Retrofit kit comes standard with the programmer, trip actuator, and sensors. On the most common breaker types, mounting hardware and brackets will also be supplied.

The programmer comes with 'Long Time', 'Short Time', and 'Instantaneous' as standard trip functions. The ability to defeat these functions using the 'Defeat' switch eliminates the need to special order the units. An 'LED' provides visual indication for each function that has been defeated. 'Loss of Voltage', and 'Trip Test', are also standard trip functions but can not be defeated unless requested at the time of order.

Trip indicators, trip indicator reset switch, pick-up lights, amp tap switch, and a power indicator light are all standard features of the unit. 'Reverse Current', 'Current Imbalance', and 'Communications Interface' capabilities are offered as optional equipment. These features are discussed in greater detail in the following pages

The programmer is a single unit configuration, which contains a switching power supply that is protected against transient voltage.

LOSS OF VOLTAGE PROTECTION

In the event there is a voltage drop, below approximately 100 volts, the DC Programmable Logic Control will loose power causing the breaker to trip and the Loss of Voltage target indicator to flip to yellow. This function can only be defeated at the factory and must be requested at the time of order. When this function is defeated, the unit will not trip upon loosing power, which will allow the breaker and/or equipment to operate without protection.

TRIP TEST

The 'Trip Test' feature provides a simple method of testing the tripping action of the breaker or contactor that is being protected. After installing and powering the logic controller you can test the tripping of the unit by inserting a paper clip into the hole in the lower right hand side of the faceplate. A push button switch located behind the faceplate of the logic controller will click when depressed and the unit should cause the contacts to open. The 'Trip Test' LED will light to indicate the trip and can be reset by pressing the 'Indicator Reset' Switch.

REVERSE CURRENT PROTECTION

Low-level reverse current protection may be required in some applications. For these applications, the 'Reverse Current' protection is offered as optional equipment. The Pick-Up level and time delay is preset at the factory according to the customer's needs. The Pick-Up level will be fixed at a predetermined level of current while the time delay will be fixed. This function must be defeated when testing at higher levels on AC. The minimum setting on the 'Reverse Current' is 10% of the Sensor rating.

COMMUNICATIONS INTERFACE

The optional 'Communications Interface' gives the customer the ability to interface with an existing communications system or with a new system such as "Power Measurements". The interface is contained within the original unit and does not require any additional mounting requirements. It consists of a set of normally open contacts that represent the trip functions of the logic. These contacts will close on the corresponding trip condition and will not open until they have been reset. The following outputs are available; 1> Trip Relay, 2>Long Time Trip, 3> Short Time Trip, 4> Instantaneous Trip, 5> Broken Wire Trip, 6> Loss of Voltage Trip, 7> Reverse Current, 8> Rate-Of-Rise. The relays can be reset using the 'Indicator Reset' switch on the logic controller or remotely using a switch across the remote reset terminals. A connector will be supplied on the right side of the logic controller that allows access to each of the required outputs and the remote reset.

DESCRIPTION OF STANDARD FEATURES

The list below shows the features that are included on the SURE-TRIP DC-2000. The information that follows gives a brief description of each of these features.

1. Instantaneous Pick-Up
2. Short Time Pick-Up
3. Long Time Pick-Up
4. Function Defeat Switch
5. Long Time Delay Band Adjustment
6. Short Time Delay Band Adjustment
7. Trip Indicating Targets and LED's
8. Pick-Up LED
9. Power LED
10. Amp Tap Switch
11. Trip Test Button

INSTANTANEOUS PICK-UP (#1)

This function determines the level at which the breaker will trip without adjustable time delay. This instantaneous interruption occurs only as a result of a severe short circuit within .06 second of the fault condition.

SHORT TIME PICK-UP (#2)

This function controls the amount of high current the breaker can carry for short periods of time without tripping. A ten-step switch allows selectability between 150% and 1000% of the Current rating as a multiple of the 'Amp Tap' Switch setting.
Example:
With a 600 amp Current Sensor, 'Amp Tap' Switch setting at .5, 'Short Time' Pick-up set at 10 times equals a 3000 amp 'Short Time' Current rating.

LONG TIME PICK-UP (#3)

The 'Long Time Pick-Up' switch provides additional adjustable current capabilities of the breaker with seven steps from 40% to 100% in 10% increments. When used with the 'Amp Tap' switch the breaker can monitor a continuous current between 20% and 100% of the current rating. Changing this setting does not affect any other function.
Example:
With a 1600 amp Current Sensor, 'Amp Tap' Switch setting at 1, 'Long Time Pick-up' set at .4x equals a 640 amp 'Long Time' Current rating. This means the breaker can have a maximum continuous current of 640 amps without tripping.

FUNCTION DEFEAT SWITCH (#4)

The 'Function Defeat' switch allows the user to customize the logic trip functions as the need demands. The 'Long Time' can be defeated along with the 'Short Time' or 'Instantaneous'. The 'Short Time' and 'Instantaneous' functions can not be defeated at the same time. An additional position will be available when the unit has Reverse Current. This allows the Reverse Current to be defeated when testing on AC.

LONG TIME DELAY BAND ADJUSTMENTS (#5)

This three-step adjustment varies the length of time that the breaker will operate under sustained overload without tripping. These times vary with the overload amplitude relative to the 'Long Time Pick-Up' setting. The higher the overload the quicker the trip times. The time-current curve shows the tripping characteristics of the 'Long Time' function as it relates to the level of the overload current.

SHORT TIME DELAY BAND ADJUSTMENT (#6)

This three-step delay adjustment provides further coordination between circuit breakers. It allows the breaker a time interval before responding to the selected 'Short Time' Pick-Up current level.

TRIP INDICATING TARGETS AND LED'S (#7)

These fault indicators identify the cause of a trip and help reduce system down time by allowing the user to more quickly diagnose the problem. Four electronic flip-flag indicators analyze the fault and provide a memory of the trip for 'Long Time', 'Short Time', 'Instantaneous', and 'Loss-Of-Voltage' functions. Two LED's provide indication for 'Broken Wire' and 'Trip Test'. The 'Indicator Reset' switch located at the upper right side of the trip indicators resets the Trip Indicating Targets and LED's after a fault condition.

PICK-UP LED (#8)

The 'Long Time Pick-Up' LED provides visual indication that an overload condition exist and the long time timing function has started. When the LED turns off the timing function is reset and starts over when the LED turns on again.

POWER LED (#9)

This feature provides visual indication to show that the logic controller is operating properly. The LED will remain lit until the 'Control Voltage' to the logic is disconnected.

AMP TAP SWITCH (#10)

The six-step adjustable ampere setting from 50% to 100% varies the level of current the logic monitors from the Current Sensor in 10% increments. Changing this setting has the same effect as changing the value of the Current Sensor.

Example:

With a 1600 amp Current Sensor, 'Amp Tap' switch setting at .5 equals 800 amps maximum current, with 'Long Time', 'Short Time', and 'Instantaneous' Pick-Ups coordinated to the 800 amp level.

General Installation Instructions
SURE-TRIP DC-2000 SENSOR

Install the positive sensor on the bus bar making certain the terminal side is facing the positive supply. Center the sensor on the bus bar and secure it. The sensor(s) can be mounted on the line or load side of the breaker.

Mount the logic control near the front of the breaker or cubicle so that the switches and indicators can easily be accessed. Mounting brackets will be provided on most standard breaker sizes. If brackets are not available for a specific breaker type, a 1" x 2" x 9.5" piece of aluminum angle will be supplied. Care should be taken not to block access to any of the Switches, Targets, or LED's when mounting the logic controller. Four (4) 8-32 x ¾" bolts are provided to mount the logic box on the bracket and the bracket to the frame. Specific breakers may have different mounting depending on established designs.

Refer to wiring diagram on page 7. The logic has a 3 terminal blocks that are accessible from the front of the unit. The positions of each terminal are labeled on the faceplate to show the designation for each position.

The 3 position terminal block is used for connecting the 'Field Ground', 'Negative Control Voltage', 'Positive Control Voltage'. The 2 position terminal block is for the Actuator or Relay output. The 6 position terminal block located at the top of the unit is used to connect the Sensors.

Mount the latch per the circuit breaker mounting instructions for the breaker type that the unit is being installed on. Mounting brackets and hardware are supplied for mounting the latch on the breaker.

If the Logic Controller is supplied with Solid State Relay rather than a latch, it will be built into the unit. The outputs of the Relay are available at the left side terminal block. Polarity must be observed when wiring the Relay output terminals to insure proper operation. Improper connections may cause the Relay to fail, thus preventing the logic from opening the breaker on a fault condition. Relay contacts are rated to handle 300 VDC, 6 ADC maximum. For other requirements please contact the factory.

Use caution when routing any of the wiring within the Breaker frame. Moving parts must not come in contact with the wires at any position. All wiring should be fastened securely to prevent any movement after breaker has been put into service. The length of the shielded cable should be kept to a minimum.

Using the four conductor shielded cable, connect the 'Term #1' terminal on the logic to the #1 terminal on the sensor using the Red wire from the shielded cable. Connect the 'Term #2' terminal on the logic and the Cable Shield to the #2 terminal on the sensor using the Black wire. Connect the 'Term #3' terminal on the logic to the #3 terminal on the sensor using the White wire. Connect the '- Vin' terminal on the logic to the #4 terminal on the sensor using the Green wire. The shield should be connected to the #2 terminal on the positive sensor.

If the unit is supplied with a latch, a set of 22 Awg white and black wires will also be supplied. Connect the White wire between the 'Latch Positive' terminal on the logic and the latch positive (white wire). Connect the Black wire between the 'Latch Negative' terminal and the latch negative (black wire).

If the unit has a Solid State Relay built into it, an installation page will be included in the shipment to describe in detail the wiring connections.

The logic controller can be powered by using either the Control Voltage present on the breaker or by wiring to the Bus. The voltage should be constant and should not exceed 300VDC. Utilization of the Control Voltage is the most common and preferred method. Connect the positive voltage and the negative voltage on the breaker to the corresponding terminals on the terminal block. Connect the 'Field Ground' terminal to the breaker frame or field ground. ***Never Hi-Pot the breaker after wires are installed.***

After wiring, the breaker should be tested per the trip curves. When primary injection or secondary testing the breaker, the 'Control Voltage' terminals may be connected to 120 VAC or 220 VAC. The Power LED will be lit

whenever the Logic Controller has proper supply voltage. Overvoltage will cause serious damage to the unit so caution should be used when selecting the supply voltage.

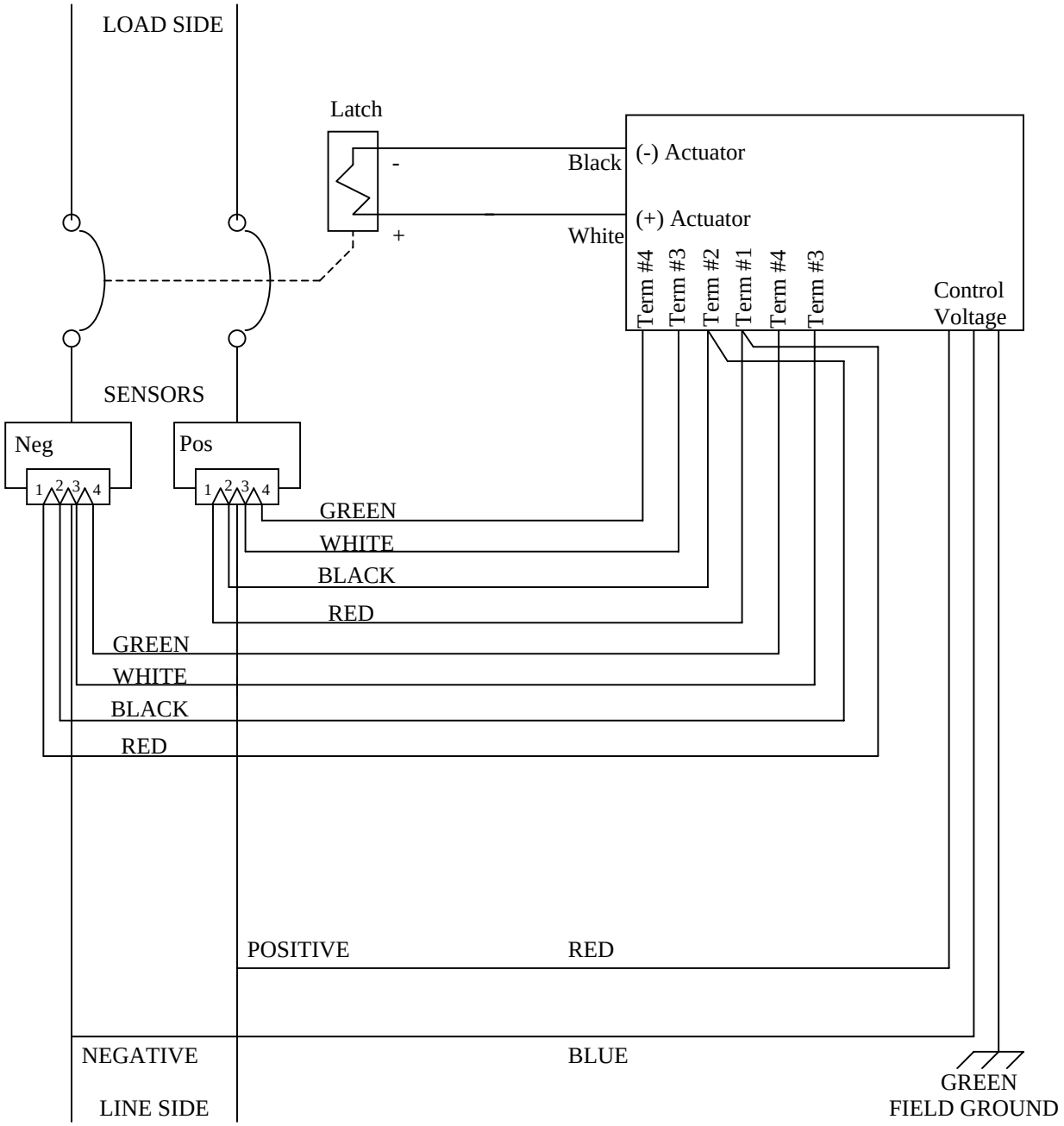
Dual Sensor Installation

The positive sensor is put on the positive bus as per above and the negative sensor is put on the negative bus, with the terminals facing towards the negative supply. Refer to wiring diagram below. In addition to the 9 position terminal block on the front-left side of the unit, there will be a second terminal also located on the left side. The two terminal block is used for connecting the #3 and #4 Sensor Terminals.

Using the second four conductor shielded cable, connect the #1 terminal on the sensor to the 'Term #1' terminal on the logic using the Red wire from the shielded cable. Connect the 'Term #2' terminal on the logic and the Cable Shield to the #2 terminal on the sensor using the Black wire. Connect the #3 terminal on the negative sensor to the 'Negative Sensor Term #3' terminal on the logic using the White wire. Connect the #4 terminal on the negative sensor to the 'Negative Sensor Term #4 terminal on the logic using the Green wire. The shield should be connected to the #2 terminal on the negative sensor.

All shields in the wiring are connected to the #2 terminal of the ***Positive and Negative Sensor.***

SURE-TRIP DC-2000 CONNECTION DIAGRAM



Caution:
Do not Hi-Pot the Breaker with wiring installed on logic Controller. This may cause extensive damage to the unit.

LATCH

White Latch White to Logic Terminal 'Positive Latch'
Black Latch Black to Logic Terminal 'Negative Latch'

SHIELDED CABLE

Red Sensor Terminal #1 to Logic Terminal '+Ix'
Black Sensor Terminal #2 to Logic Terminal '-Ix'
White Sensor Terminal #3 to Logic Terminal '+Vh'
Green Sensor Terminal #4 to Logic Terminal '-Vh

SURE-TRIP DC-2004S
SHUNT GENERAL INSTALLATION INSTRUCTIONS

Mount the logic control near the front of the breaker or cubicle so that the switches and indicators can easily be accessed. Mounting brackets will be provided on standard breaker frames. Care should be taken not to block access to any of the Switches, Targets, or LED's when mounting the logic controller. Specific breakers will have different mounting depending on established designs.

With Single Shunt:
The logic controller has two terminal blocks located on the left side of the unit. The terminals are labeled on the faceplate to show the designation for each position. The top terminal block has two positions and is used for the Current Shunt inputs. The lower terminal block has 5 positions and is used for 'Field Ground', 'Negative Control Voltage', 'Positive Control Voltage', 'Relay Positive Connection', and 'Relay Output'.

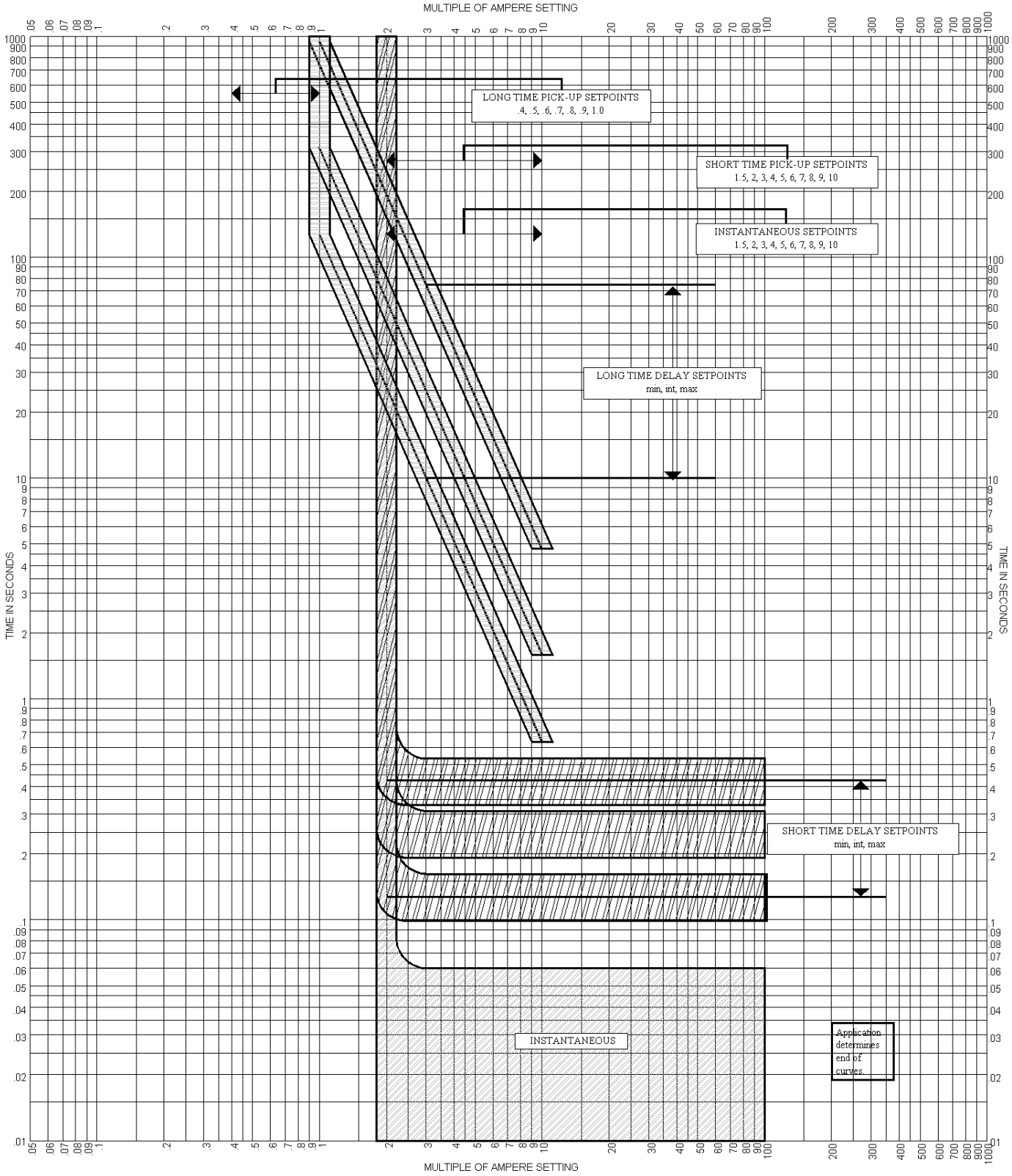
With Trip Relay:
The Logic Controller has a Solid State Relay built into the unit. This Relay comes standard with a set of Normally Open contacts. The contacts can be used in conjunction with existing apparatus, i.e. Shunt Trip, to open the breaker on a fault condition. The Positive and Output connection of the Relay are available at the left side terminal block. Polarity must be observed when wiring the Relay output terminals to insure proper operation. Improper connections may cause the Relay to fail, thus preventing the logic from opening the breaker on a fault condition.
Relay contacts are rated to handle 300 VDC, 6 ADC maximum. For other requirements please contact the factory.

Wiring:
Refer to the wiring diagram on page 8. The Shunt should be connected to the Logic Controller using a two- (2) conductor, or more, shielded cable. The cable should be a minimum size of 16 Awg wire and have a voltage withstand rating sufficient to handle the Bus Voltage. Connect the High Side and the Low Side of the Shunt to the corresponding input terminal on the logic controller. The Shield can be terminated at the Low Side of the Shunt or to Field Ground. Do not attach the shield from the cable to both the Shunt and Field Ground at the same time. The Logic should not be powered until the shunt is connected.

The logic controller can be powered by using either the Control Voltage present on the breaker or by wiring to the Bus. The voltage should be constant and should not exceed 300VDC. Utilization of the Control Voltage is the most common and preferred method. Connect the positive voltage and the negative voltage on the breaker to the corresponding terminals on the five position terminal block. Connect the 'Field Ground' terminal to the breaker frame or Field Ground. ***Never Hi-Pot the breaker after the wires are installed.***

Use caution when routing any of the wiring within the Breaker frame. Moving parts must not come in contact with the wires at any position. All wiring should be fastened securely to prevent any movement after breaker has been put into service. The length of the shielded cable should be kept to a minimum.

After wiring, the breaker should be tested per the trip curves. When primary injection or secondary testing the breaker, the 'Control Voltage' terminals may be connected to 120 VAC or 220 VAC. The Power LED will be lit whenever the Logic Controller has proper supply voltage. Over-voltage will cause serious damage to the unit so caution should be used when selecting the supply voltage.



DC-2000 Programmable Logic Controller

TIME-CURRENT CHARACTERISTIC CURVES

FOR **SURE-TRIP, INC.**

DATED APRIL 1, 2005

STANDARD DEVIATION **FOR AMPERE SETTING IS +/- 10%**