

# Programming S&C Overcurrent Control

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## Introduction

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### Qualified Persons

#### **WARNING**

The equipment covered by this publication must be operated and maintained by qualified persons who understand any hazards involved and are thoroughly trained in the operation and maintenance of electronic control devices which are used in conjunction with power distribution equipment. These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

### Read this Instruction Sheet

#### **NOTICE**

Thoroughly and carefully read this instruction sheet before programming, operating, or maintaining your S&C Overcurrent Control. Familiarize yourself with the Safety Information on page 3. The latest version of this instruction sheet is available online in PDF format at [sandc.com/Support/Product-Literature.asp](http://sandc.com/Support/Product-Literature.asp)

### Retain this Instruction Sheet

This instruction sheet is a permanent part of your S&C Vista SD Underground Distribution Switchgear. Designate a location where you can easily retrieve and refer to this publication.

### Warranty

The warranty and/or obligations described in S&C's standard conditions of sale, as set forth in Price Sheet 150, plus any special warranty provisions, as set forth in the applicable product-line specification bulletin, are exclusive. The remedies provided in the former for breach of these warranties shall constitute the immediate purchaser's or end user's exclusive remedy and a fulfillment of all seller's liability. In no event shall the seller's liability to immediate purchaser or end user exceed the price of the specific product that gives rise to the immediate purchaser's or end user's claim. All other warranties, whether express or implied or arising by operation of law, course of dealing, usage of trade or otherwise, are excluded. The only warranties are those stated in Price Sheet 150, and **THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY EXPRESS WARRANTY OR OTHER OBLIGATION PROVIDED IN PRICE SHEET 150 IS GRANTED ONLY TO THE IMMEDIATE PURCHASER AND END USER, AS DEFINED THEREIN. OTHER THAN AN END USER, NO REMOTE PURCHASER MAY RELY ON ANY AFFIRMATION OF FACT OR PROMISE THAT RELATES TO THE GOODS DESCRIBED HEREIN, ANY DESCRIPTION THAT RELATES TO THE GOODS, OR ANY REMEDIAL PROMISE INCLUDED IN PRICE SHEET 150.**

### Warranty Qualifications

The seller's standard warranty does not apply to components not of S&C manufacture that are supplied and installed by the purchaser or to the ability of seller's equipment to work with such components.

**Understanding Safety-Alert Messages**

Several types of safety-alert messages may appear throughout this instruction sheet and on labels attached to the S&C Overcurrent Control. Familiarize yourself with these types of messages and the importance of these various signal words:

<b>⚠ DANGER</b>
“DANGER” identifies the most serious and immediate hazards that <i>will likely</i> result in serious personal injury or death if instructions, including recommended precautions, are not followed.


<b>⚠ WARNING</b>
“WARNING” identifies hazards or unsafe practices that <i>can</i> result in serious personal injury or death if instructions, including recommended precautions, are not followed.

<b>⚠ CAUTION</b>
“CAUTION” identifies hazards or unsafe practices that <i>can</i> result in minor personal injury if instructions, including recommended precautions, are not followed.

<b>NOTICE</b>
“NOTICE” identifies important procedures or requirements that <i>can</i> result in product or property damage if instructions are not followed.

**Following Safety Instructions**

If you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C’s website [sandc.com](http://sandc.com). Or call the S&C Global Monitoring and Support Center at 1-888-456-1100.

<b>NOTICE</b>	
Thoroughly and carefully read this instruction sheet before programming your S&C Overcurrent Control.	

**Replacement Instructions and Labels**

If you need additional copies of this instruction sheet, contact your nearest S&C Sales Office, S&C Headquarters, or S&C Electric Canada Ltd.

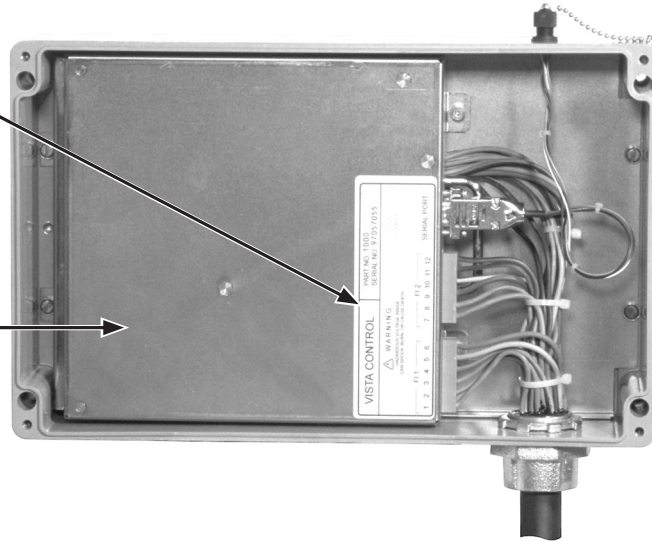
It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting your nearest S&C Sales Office, S&C Headquarters, or S&C Electric Canada Ltd.

# Safety Information

## Location of Safety Labels

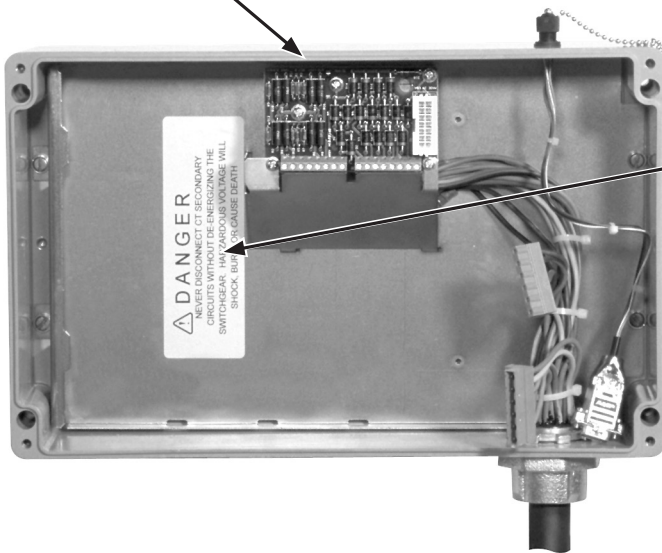
**⚠ WARNING**  
Hazardous voltage inside can shock, burn, or cause death.

Electronics module



Enclosure for overcurrent control with cover removed to show electronics module.

Burden-board module



**⚠ DANGER**  
Never disconnect current transformer secondary circuits without de-energizing the switchgear. Hazardous voltage will shock, burn, or cause death.

Electronics module removed to show burden-board module.

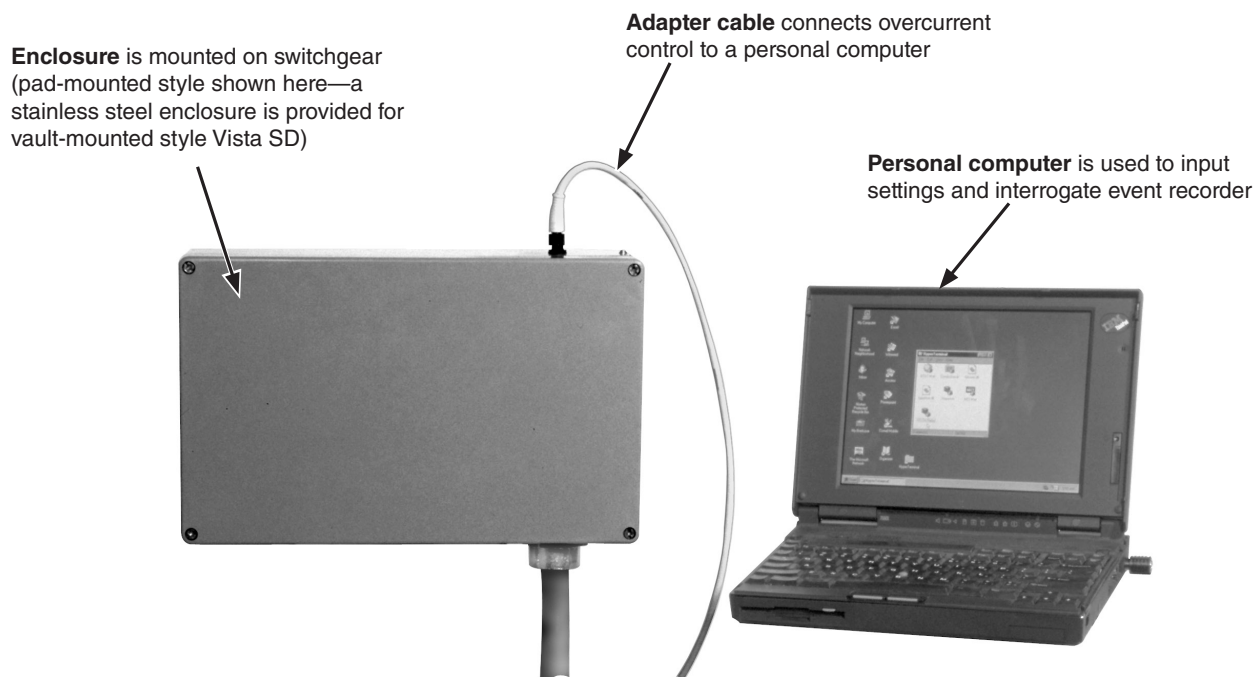
## General

The following instructions are for field and shop programming of the S&C Overcurrent Control. This microprocessor-based control is designed for use on S&C Vista SD Underground Distribution Switchgear to provide fault detection and operation of the resettable vacuum fault interrupters. Each overcurrent control operates up to two three-pole fault interrupters. The control is housed in an enclosure mounted to the operating mechanism enclosure. For vault-mounted style Vista SD units, the overcurrent control enclosure is fully submersible. The electronics module is removable for programming in the shop.

## Programming

A personal computer furnished by the user is to be used to input settings, review settings, and interrogate the event recorder. The software for programming the overcurrent control is contained within the control. Two data ports are provided—one on the enclosure for programming in the field and another on the electronics module for programming in the shop. Adapter cables are available from S&C (see Instruction Sheet 695-515A) to connect the computer to the control.

An external power source is required for programming and interrogating the control. A source of dc power is available from the mouse or USB port on the personal computer. The adapter cables contain connectors for data and power to use the power available from the computer.



## Description

---

### Power and Sensing

Current transformers are provided for each three-pole fault interrupter. These current transformers provide primary current sensing ranging from 50 to 12,500 amperes. S&C Vista SD Underground Distribution Switchgear rated above 12.5 kA short circuit will respond to fault currents above 12.5 kA, but the event log will only record that a fault above 12.5 kA has occurred. The overcurrent control is capable of sensing and responding to both phase overcurrents and ground overcurrents.

The power derived from the current transformers is used to operate the control and to charge the trip capacitors that discharge into magnetic latching solenoids to trip the fault interrupters during a fault. No external power is required for operation of the control in the field.

### Time-Current Characteristics

The overcurrent control features time-current characteristic (TCC) curves consisting of phase-overcurrent curves and ground-overcurrent curves. The families of curves are included as follows:

- S&C standard speed curves (for use in place of conventional “E” rated power fuses)
- S&C “K” speed curves (for use in place of conventional “K” rated power fuses)
- Tap fault interrupter curves
- Main fault interrupter curves
- ANSI U.S. and IEC curves per IEEE Standard C37.112-1996 U1, U2, U3, U4, U5, C1, C2, C3, C4, and C5

The tap and main fault-interrupter TCC curves can be customized into hundreds of different curves using a variety of instantaneous-pickup settings (discrete choices from 0.2 kA through 6 kA) and definite-time delay settings (discrete choices from 32 ms through 128 ms). For even more specialized shapes, an instantaneous-pickup setting can be combined with a definite-time delay setting. The minimum total clearing time—from initiation of the fault to total clearing—is 40 milliseconds.▲

### Settings

(See Appendix E for a complete list of settings)

The overcurrent control has a phase-overcurrent pickup setting and an independent ground-overcurrent pickup setting for each three-pole fault interrupter.

The input parameters for both the phase- and ground-overcurrent curves include minimum pickup levels, instantaneous-pickup levels, and definite-time delays. Phase-overcurrent pickup settings and ground-overcurrent pickup settings are made independently. If desired, the ground-overcurrent curve and the instantaneous-pickup and definite-time-delay attributes can be disabled. When E-speed or K-speed curves are selected, the ground-overcurrent pickup setting is disabled as are the instantaneous-pickup and definite-time-delay attributes. An example of how to select settings for the overcurrent control is shown in Appendix D.

A choice of 50- or 60-hertz operation is also offered.

▲ The definite-time delay setting will override the instantaneous setting when the definite-time delay setting is activated before the instantaneous setting.

**Event Recording**

The overcurrent control features an internal event recorder that captures the last 12 fault operations for each fault interrupter. The event log indicates which poles have experienced a fault, the magnitude of the fault, and whether a ground overcurrent was involved. This information can be accessed via a personal computer connected to the data port of the control.

**Self Testing**

Whenever the overcurrent control is powered up—and then periodically thereafter—it automatically goes through a self-test procedure to test vital subsystems and ensure proper operation. The control checks the trip capacitors, power-supply voltage, RAM, EEPROM, integrity of the data, and voltage control. It then flags whatever fails the self-test.

# Setting Up for Programming

## Connecting a Personal Computer

### NOTICE

S&C does not recommend removing the S&C Overcurrent Control from its enclosure for workbench programming. The Overcurrent Control is in a submersible enclosure. Opening the enclosure may damage the sealing gasket. Contact your local S&C Sales Office for details.

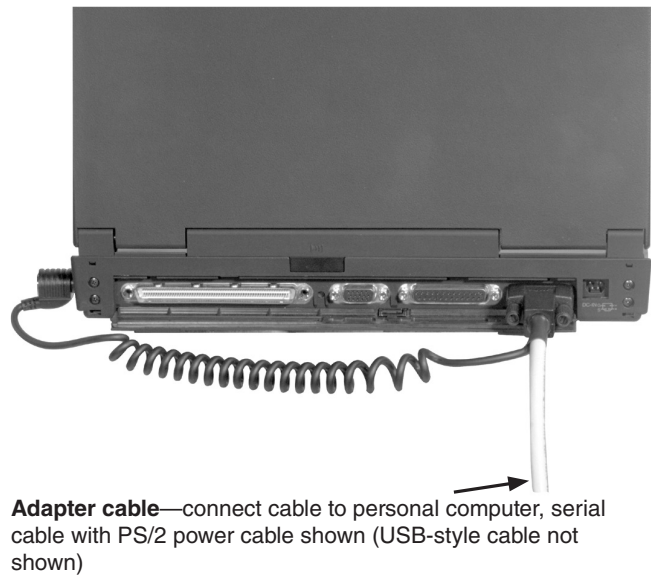
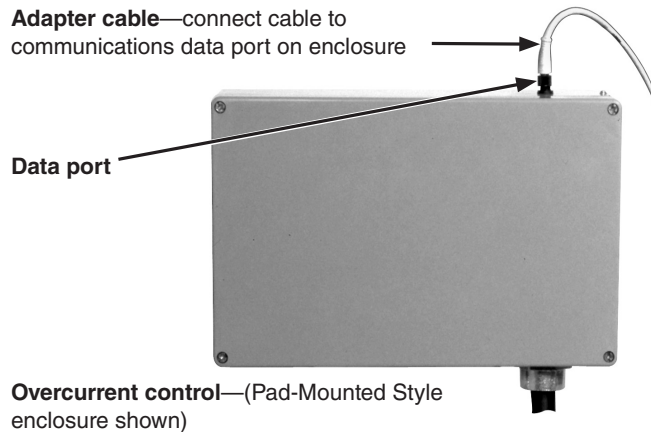
A data port for communications is provided at the top of the enclosure that houses the overcurrent control. This data port, which is connected to the electronics module inside the enclosure, cannot draw power from the control and must be powered from an external source while in use. When the data port is in use, the power-connection points (Pins 1 and 4) power the control. The allowable voltage range is 4–5 Vdc, and the power consumption is 1.8 W nominal, 2.2 W maximum.

Adapter cables are available from S&C (see Instruction Sheet 695-515A) for connecting the control to a user-furnished personal computer in the field. These cables provide for both communications and power.

For Microsoft Windows® users, no special software is required to communicate with the control. The user interface is menu driven within the control. Use the HyperTerminal program provided with Microsoft Windows or other terminal emulator program to set or interrogate the control. Microsoft Windows Vista™, Windows® 7, and Windows® 8 users will have to install a terminal emulator program. See Appendix C for further instructions.

### Setting the Communication Parameters

Set the communication parameters shown in Appendix B. Refer to Appendix C for additional instructions regarding terminal emulation programs.





**Factory-Default Settings**

The overcurrent control is provided with the factory-default settings shown here.

TCC curve type	= E
Curve selection	= 200E
Instantaneous pickup (amps)	= NA
Definite-time delay (ms)	= NA

**Fault Interrupters 1 and 2**

Each overcurrent control is capable of operating up to two fault interrupters. To differentiate between the two fault interrupters, the programming software refers to Fault Interrupter 1 and Fault Interrupter 2. If the control is operating two fault interrupters, the fault interrupter to the left of the control (as you are facing the front of the switchgear) is Fault Interrupter 1, and the fault interrupter to the right of the control is Fault Interrupter 2. If there is only one fault interrupter, it is Fault Interrupter 2.

**Passwords**

Factory-Default Passwords

<u>Type of Password</u>	<u>Password</u>
User	6601
Group Configure	4731

Two passwords—the User and Group Configure Passwords—control access to the sensitive areas of the menu system. The User Password must be entered to change control settings, test trip the solenoids, and change the User Password.

The Group Configure Password is required to change the global settings, download firmware, and change the Group Configure Password.

Passwords must contain four numeric characters. Each control is provided with factory- default passwords. The User and Group Configure Passwords can be changed, but the default passwords will always allow access.

**Main Menu**

**Step 1**

To begin communications, open the terminal emulator program and press the Enter button (refer to Appendix C for additional instructions regarding terminal emulation). The control will respond with the main menu and an “=” prompt.

**Step 2**

Select the desired option from the Main Menu and input the corresponding number after the “=” prompt. Press <ENTER>. (Option 1 is shown as an example.)

```

Main Menu: <select number>
1. View Menu 1                INTERRUPTER 1
2. Configure Menu 1           INTERRUPTER 1
3. View Menu 2                INTERRUPTER 2
4. Configure Menu 2           INTERRUPTER 2
5. Change User Password
6. Switch to Group Configure
7. Test Trip Menu

= 1
    
```

### Step 3

Refer to one of the following sections for further information:

<u>Option</u>	<u>Page</u>
View Menu 1 .....	10
Configure Menu 1 .....	12
View Menu 2 .....	10
Configure Menu 2 .....	12
Change User Password .....	14
Group Configure Menu .....	14
Test Trip Menu .....	16

## View Menu 1 or 2

The **View Menu** option allows review of the settings and status of the control. (The **View Menu** option shown below is for Fault Interrupter 1.)

### Step 1

Select the desired option from the *View Menu* screen and enter the corresponding number after the “>” prompt. Press the **Enter** button. (Option 1 is shown as an example.)

### Step 2

Refer to the appropriate subsection below for further information on the selected option.

### Step 3

To return to the main menu, enter “9” after the “>” prompt, and press the **Enter** button.

```
View Menu INTERRUPTER 1: <select number>
  1. View event report (last 12 events)
  2. View load current
  3. View relay settings
  4. View relay self-test
  9. Switch to Main Menu
= View FI 1 > 1
```

### **View Event Report**

The **View Event Report** option allows viewing of the last 12 recorded events for the selected fault interrupter. The report includes faulted poles and whether ground was involved, primary RMS current magnitude, and ground current for each pole at the exact instant fault current is detected (which values may not always make sense), and the time since the last event. The time is not displayed if there has been no other event since power up or if more than 60 seconds has elapsed since the previous report.

New events are inserted at the number 1 position. When the list is full, the oldest event will drop from the list. Faulted poles are indicated by an “X.”

The overcurrent control stores a nonvolatile short event report each time it issues a trip pulse. The short event report contains the following information:

The faulted pole(s) and whether ground was involved. The “target” (X) logic is as follows:

1. Target any faulted poles that caused a trip.
2. Target any phase faulted pole with current greater than the phase time overcurrent pickup setting.

INTERRUPTER 1									
*Eve*	**Faulted Poles**				**** * Amperes ****				Elapsed **Time**
#	1	2	3	G	1	2	3	G	(Seconds)
1		X	X	X	4	2040	1829	1908	0.019
2		X		X	24	1926	18	1908	
3	X			X	2010	22	18	1992	

Press <ENTER> for menu

**NOTE:** The “X” targets are used under fault conditions. In test mode, fault poles are randomly selected.

3. Target the ground-faulted pole if ground current is greater than the ground pickup setting or if ground current is greater than or equal to 50A and greater than 10% of the maximum phase current.
4. If only one target is declared from the previous logic, target the faulted pole (of the remaining three with the highest current).

The primary RMS magnitude of each pole and ground current. Current greater than 14,500 amperes will be reported as “>14500”.

The event report is reset when the fault-interrupter settings are changed and saved.

**View Load Current**

The **View Load Current** option allows viewing a snapshot of the load current sensed by the current transformers for each pole and ground for the selected fault interrupter.

INTERRUPTER 1				
	1	2	3	G
Load current (Amperes)	50	49	48	2

Press <ENTER> for menu

**View Relay Settings**

The **View Relay Settings** option allows viewing of the time-current characteristic curve settings, trip mode, and frequency for the selected fault interrupter.

INTERRUPTER 1		
	PHASE	GROUND
TCC curve type	E	NA
Curve selection	200E	NA
Inst. pickup (kA)	N/A	N/A
Definite-time delay (ms)	N/A	N/A
Trip mode	3	
Frequency	60	

Press <ENTER> for menu

## View Relay Self-Test

The **View Relay Self-Test** option allows viewing of the self-test status report for the selected fault interrupter. This report includes the status of the trip capacitors, supply voltage, RAM, integrity of the data, CR-RAM, EEPROM, and voltage control. See “Self-Test Failures and Warnings” section on page 18 for more information.

```
INTERRUPTER 1
FID = S&C-1000-R100-970317
SELF TESTS
W = Warn  F = Fail

Pole #          1      2      3
Trip Caps       OK    OK    OK

Supply          + 5V  + 12V

Voltage         4.99  12.26

RAM      FLASH  CR_RAM  EEPROM  V_CONTROL
OK       OK     OK     OK     OK

Press <ENTER> for menu
```

## Configure Menu 1 or 2

The **Configure Menu** option allows review and changes to the TCC curve settings for the selected fault interrupter. (The **Configure Menu** box below is for Fault Interrupter 1.)

### Step 1

Select the desired option from the *Configure Menu* screen and enter the corresponding number after the “>” prompt. Press the **Enter** button. (Option 1 is shown as an example.)

### Step 2

Refer to the appropriate subsection below for further information on the selected option.

### Step 3

To return to the main menu, enter “9” after the “>” prompt, and press the **Enter** button.

```
Configure Menu INTERRUPTER 1: <select number>
1.  Change relay settings
2.  View relay settings
9.  Switch to main menu
= Config FI 1 > 1
```

**Change Relay Settings**

The **Change Relay Settings** option allows changes to the TCC curve settings for the selected fault interrupter. There is a prompt for the input for each setting.

**Step 1**

After each prompt, enter the new setting and press the **Enter** button. The available choices are shown in parenthesis. To retain the previous selection shown after the "=", press the **Enter** button.

**Step 2**

After all of the settings have been entered, the new settings will be displayed in a table. Enter "Y" for the **Yes** option or "N" for **No** option after the "Save Changes (Y/N)?" prompt. A confirmation of the choice will be shown and the settings will be displayed. Note that when new settings are saved, the event report discussed in "View Event Report" on page 10 will be reset.

```

<Press 'Q' to return to menu>
Phase TCC Curve (E, K, TAP, MAIN, U1, U2, U3, U4, U5, C1, C2, C3, C4, C5) = E ?tap
Minimum Pickup (Amps) (50, 65, 80, 100, 150, 200, 250, 300, 350, 400) = 50 ?200
Instantaneous Pickup (kA) (OFF, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6) = OFF ?5
Definite-Time Delay (ms) @ 60Hz (OFF, 32, 48, 64, 80, 96) = OFF ?32
Ground TCC Curve (OFF, TAP, MAIN) = OFF ?tap
Minimum Pickup (Amps) (50, 65, 80, 100, 150, 200, 250, 300, 350, 400) = 50 ?200
Instantaneous Pickup (kA) (OFF, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6) = OFF ?1
Definite-Time Delay (ms) @60Hz (OFF, 32, 48, 64, 80, 96) = OFF ?32

          PHASE          GROUND
TCC Curve Type          TAP          TAP
Min. Pickup (Amperes)   200          200
Inst. Pickup (kA)       5            1
Definite-Time Delay (ms) 32           32

Save Changes (Y/N)? y
SETTINGS SAVED

          PHASE          GROUND
TCC Curve Type          TAP          TAP
Min. Pickup (Amperes)   200          200
Inst. Pickup (kA)       5            1
Definite-Time Delay (ms) 32           32
    
```

## View Relay Settings

The **View Relay Settings** option allows viewing of the current control settings for the selected fault interrupter. The trip mode and frequency settings are included.

INTERRUPTER 1		
	PHASE	GROUND
TCC Curve Type	TAP	TAP
Min. Pickup (Amperes)	200	200
Inst. Pickup (kA)	5	1
Definite-Time Delay (ms)	32	32
Trip Mode	3	
Frequency	60	
Press <ENTER> for menu		

## Change User Password

The **Change User Password** option allows changing of the user password. After the new password has been entered, the control will return to the main menu.

### Step 1

Enter the current user password after the first prompt.

### Step 2

Enter the new password after the second prompt. The password must have four numeric characters.

### Step 3

To confirm the new password, re-enter it after the third prompt.

USER PASSWORD: ?*****
CHANGE USER PASSWORD
Enter new password (four digits, blank for no change) *****
Re-enter new password *****

## Group Configure Menu

The **Group Configure** option allows viewing and changing of the global settings, changing of the Group Configure Password, and downloading of firmware.

### Step 1

Select the desired option from the **Group Configure** menu and enter the corresponding number after the “>” prompt. Press the **Enter** button. (Option 1 is shown as an example.)

### Step 2

Refer to the appropriate subsection below for further information on the selected option.

### Step 3

To return to the main menu, enter “9” after the “>” prompt and press the **Enter** button.

Group Configure Menu: <select number>
1. Change global settings
2. View global settings
3. Change group configure password
4. Download firmware
9. Switch to main menu
=Group Config > 1

**Change Global Settings**

The **Change Global Settings** option allows changing of the fault interrupter ID, trip mode, and frequency.

<b>⚠ CAUTION</b>
Do not program three-pole fault interrupters to operate in single-pole trip mode. Single-pole tripping is not possible with three-pole fault interrupters.

**Step 1**

After each prompt, enter the new setting and press the **Enter** button. The available choices are shown in parenthesis. To retain the previous selection shown after the "=", press the **Enter** button.

**Step 2**

After all of the settings have been entered, the new settings will be displayed in a table. Enter "Y" for the **Yes** option or "N" for the **No** option after the "Save Changes (Y/N)?" prompt. A confirmation of the choice will be shown and the settings will be displayed.

```

<Press 'Q' to return to menu>
ID for Interrupter 1 (20 characters) = INTERRUPTER 1
?interrupter pole 1
ID for Interrupter 2 (20 characters) = INTERRUPTER 2
?interrupter pole 2
1-pole or 3-pole trip mode for Interrupter 1 (1,3) = 1 ?3
1-pole or 3-pole trip mode for interrupter 2 (1, 3) = 1 ?3
50 Hz or 60 Hz Operation (50, 60) = 60 ?

ID Interrupter 1           INTERRUPTER POLE 1
ID Interrupter 2           INTERRUPTER POLE 2
Trip Mode Interrupter 1    3
Trip Mode Interrupter 2    3
Nominal Frequency          60

Save Changes (Y/N)? n
SETTINGS NOT SAVED

ID Interrupter 1           INTERRUPTER 1
ID Interrupter 2           INTERRUPTER 2
Trip Mode Interrupter 1    1
Trip Mode Interrupter 2    1
Nominal Frequency          60
    
```

**2. View Global Settings**

The **View Global Settings** option allows viewing of the global settings including the fault interrupter ID, trip mode, and frequency.

ID Interrupter 1	INTERRUPTER 1
ID Interrupter 2	INTERRUPTER 2
Trip Mode Interrupter 1	3
Trip Mode Interrupter 2	3
Nominal Frequency	60
Press <ENTER> for menu	

## **Change Group Configure Password**

The **Change Group Configure Password** option allows changing of the Group Configure Password. After the new password has been entered, the control will return to the Group Configure Menu.

### **Step 1**

Enter the current Group Configure Password after the first prompt.

### **Step 2**

Enter the new password after the second prompt. The password must have four numeric characters.

### **Step 3**

To confirm the new password, re-enter it after the third prompt.

```
CHANGE GROUP PASSWORD
Enter new password (four digits, blank for no change) ****
Re-enter new password ****
```

## **4. Download Firmware**

The **Download Firmware** option allows the control to be disabled for downloading and uploading of firmware. Refer to the nearest S&C Sales Office for instructions.

## **Test Trip Menu**

The **Test Trip Menu** option allows test tripping of the fault interrupters—all three poles or single poles.

### **Step 1**

Select the desired option from the **Test Trip** menu and enter the corresponding number after the “=” prompt. Press the **Enter** button. The selected pole(s) will trip. (Option 1 is shown as an example.)

### **Step 2**

To return to the main menu, enter “9” after the “=” prompt, and press the **Enter** button.

```
Test Trip Menu
1. Trip Mode 3 FI1 All Poles      INTERRUPTER 1
2. Trip Mode 3 FI2 All Poles      INTERRUPTER 2
3. Trip Mode 1 FI1 Pole 1         INTERRUPTER 1
4. Trip Mode 1 FI1 Pole 2         INTERRUPTER 1
5. Trip Mode 1 FI1 Pole 3         INTERRUPTER 1
6. Trip Mode 1 FI2 Pole 1         INTERRUPTER 2
7. Trip Mode 1 FI2 Pole 2         INTERRUPTER 2
8. Trip Mode 1 FI2 Pole 3         INTERRUPTER 2
9. Switch to Main Menu
= 1
```



**Viewing the Self-Test Report**

The **Overcurrent** control tests vital subsystems upon power up and periodically thereafter to ensure proper operation. To view the self-test report, select the **View Relay Self-Test** option from the **View** menu for the selected fault interrupter.

```

INTERRUPTER 1
FID=S&C-1000-R100-970317

SELF TESTS
W = Warn  F = Fail

Pole #          1      2      3
Trip Caps       OK    OK    OK

Supply          + 5V  + 12V
Voltage         4.99  12.26

RAM    FLASH    CR_RAM    EEPROM    V_CONTROL
OK     OK       OK       OK       OK

Press <ENTER> for menu
    
```

**Response to Self-Test Failure**

The following defines each of the self tests and the control’s response to a self-test failure. The control displays the above screen example when none of the self-tests have failed. Actual values may vary.

**FID**

The FID indicates the model, firmware version, and firmware date code.

**Trip Caps**

The status of the trip capacitors is reported for each fault-interrupter pole. If the trip capacitors are not charged to at least 50 volts, a “low” condition is reported. The control cannot issue a trip until the capacitors are fully charged. The capacitors charge from either the CTs or port power. If the control indicates “low” when no trip condition exists, the voltage supplied to the communication port is less than 4 volts or the control is defective and should be replaced.

**Supply Voltage**

The control periodically checks the voltage of each power supply and compares the results with failure thresholds. The self-test report displays the measured values. Protection is disabled and an “F” is placed next to the displayed value if it falls outside the failure threshold. This self-test also detects gross A/D converter failures.

**Threshold Values**

Supply	Low Fail	High Fail
+ 5V	4.5	5.35
+ 12V	11.00	14.00

## RAM

The RAM self-test verifies proper operation of the read/write memory. This test periodically performs a nondestructive write/read to successive blocks of RAM to determine whether a RAM failure has occurred. A failure occurs if the expected data are not read back from the RAM. In this case, protection is disabled and “fail” is reported.

## Flash

The Flash self-test verifies the integrity of the data contained in system program Flash. If Flash is corrupted, protection is disabled and “fail” is reported.

## CR-RAM

Areas of RAM containing constant data that have been copied from EEPROM are periodically examined to verify their integrity. If this critical RAM has been corrupted, protection is disabled and “fail” is reported.

## EEPROM

The EEPROM self-test verifies the integrity of data contained in EEPROM. EEPROM self-test failures are handled differently because self-test failures and control settings are both stored in EEPROM. Following an EEPROM self-test failure, factory-default settings are restored and protection is enabled. The message “Relay enabled using default settings” is displayed at the top of each menu. If the EEPROM failure persists (i.e., if default settings cannot be stored in EEPROM), a self-test failure is also generated.

## Voltage Control

This logic monitors the power shunt circuitry in the power supply. On power up, each phase magnitude is averaged for 0.5 seconds. If the average is greater than or equal to 50 amperes and the associated trip capacitor is not charged, the CT power circuit is defective and a failure is declared.

## Self-Test Failures and Warnings

The following screen is an example of a self-test screen. The +5-volt power supply voltage is flagged with an “F”, and “Relay Disabled” appears above each menu.

The control records self-test failures in EEPROM and remains disabled until power is removed and restored. When power is restored, the self-test is repeated. If no failure occurs, the failure indication changes to “warn”—or “W” in the case of a power supply—and protection is enabled.

```
INTERRUPTER 1
FID=S&C-1000-R100-970317

SELF TESTS
W = Warn  F = Fail
Pole #      1      2      3
Trip Caps   OK    OK    OK

Supply      + 5V  + 12V
Voltage     5.35F 12.12

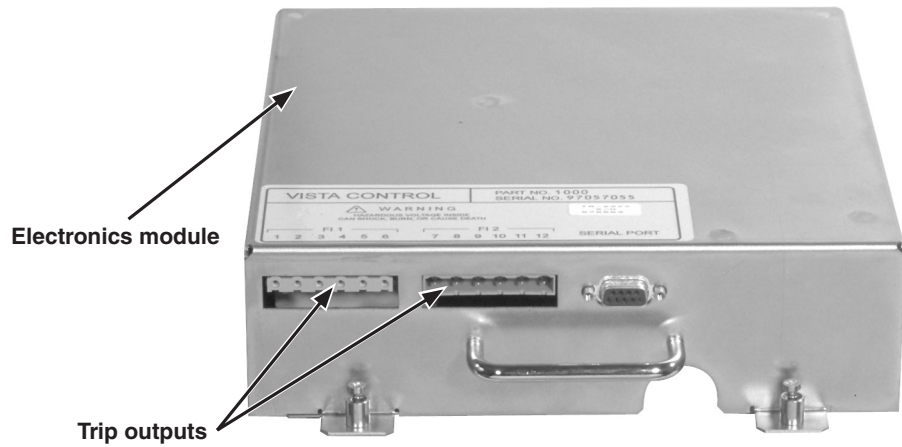
RAM        FLASH    CR_RAM  EEPROM  V_CONTROL
OK         OK        OK      OK      OK

Press <ENTER> for menu
```

<b>Port Power</b>	<b>Input Voltage Range:</b> <b>Input Power:</b>	4.0 to 5.0 Vdc 1.8 W typical
<b>CT Power</b>	<b>Minimum current on any phase:</b> 600-A models: <b>Maximum current on all phases:</b> 600-A models:  <b>Maximum measured current:</b> 600-A models:	45 A RMS  720 A continuous 12 kA for 1 s 25 kA for 0.25 s  14.5 kA
<b>Steady State Accuracy</b>	<b>CT:</b> <b>Burden Board:</b> <b>Main Board:</b>	±0.2% typical ±0.3% typical ±0.2% typical
<b>Time-Overcurrent Pickup Accuracy</b>	<b>E, K, Coordinating-Tap, and Coordinating-Main Curves:</b> -0 to +10% Nominal pickup setting +5% typical  <b>U.S. and IEC Curves:</b> ±5 A primary and ±5% of setting	
<b>Time-Overcurrent Response</b>	<b>E, K, Coordinating-Tap, and Coordinating-Main Curves:</b> -0 to +10% in terms of current OR -0 to +20% in terms of time OR -0 to +6 ms, whichever gives the greater allowed operating time  4 to 10 ms for currents greater than 2 times the current corresponding to a 10 ms minimum response  <b>U.S. and IEC Curves:</b> ±1.5 cycles and ±10% of curve time for current between 2 and 30 multiples of pickup, for faults not exceeding the maximum current rating	
<b>Instantaneous Pickup Accuracy</b>	<b>600-A models:</b>	-0 to 10%
<b>Instantaneous Response</b>		4 to 10 ms for currents greater than 2 times the instantaneous pickup setting
<b>Definite-Time Response</b>		-0 to +8 ms

## External Connections

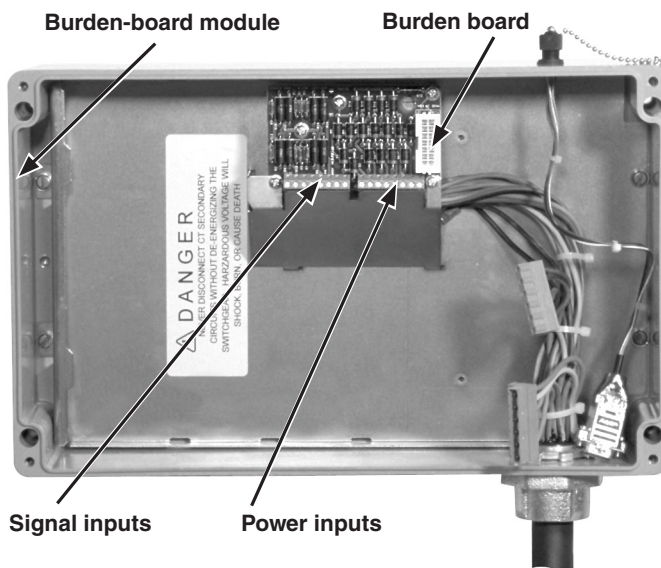
This section describes each of the external connections to the control. Included in the following tables are terminal numbers, terminal names, mating-connector part numbers (where applicable), and the pin-out of the data-port connectors. Terminal numbers are identified by labels on the electronics module or terminal block.



### Trip Outputs ①

Terminal Number (1,2)	Pole	Mating-Connector Part Number
1, 2	Fault Interrupter 1, Pole 1	Phoenix 1783999
3, 4	Fault Interrupter 1, Pole 2	
5, 6	Fault Interrupter 1, Pole 3	
7, 8	Fault Interrupter 2, Pole 1	Phoenix 1876194
9, 10	Fault Interrupter 2, Pole 2	
11, 12	Fault Interrupter 2, Pole 3	

① Trips are polarized.

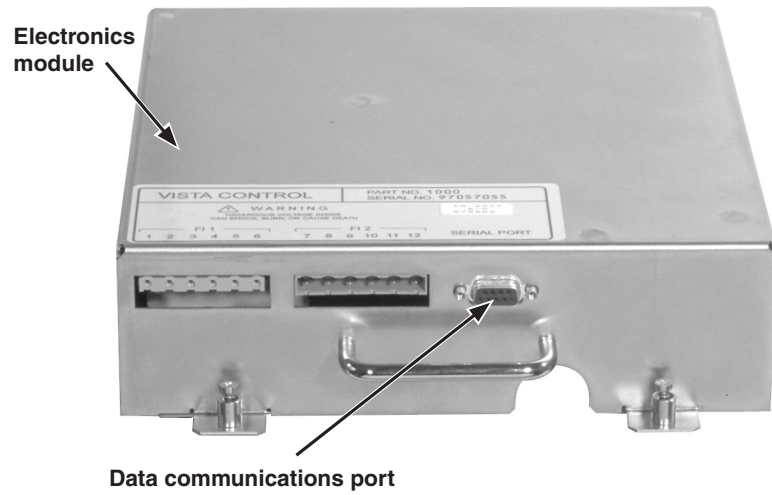


**Signal Inputs**

Terminal Number	Signal Pole
13	Fault Interrupter 1, Pole 1
14	Fault Interrupter 1, Pole 2
15	Fault Interrupter 1, Pole 3
16	Fault Interrupter 1 Residual
17	Fault Interrupter 2, Pole 1
18	Fault Interrupter 2, Pole 2
19	Fault Interrupter 2, Pole 3
20	Fault Interrupter 2 Residual

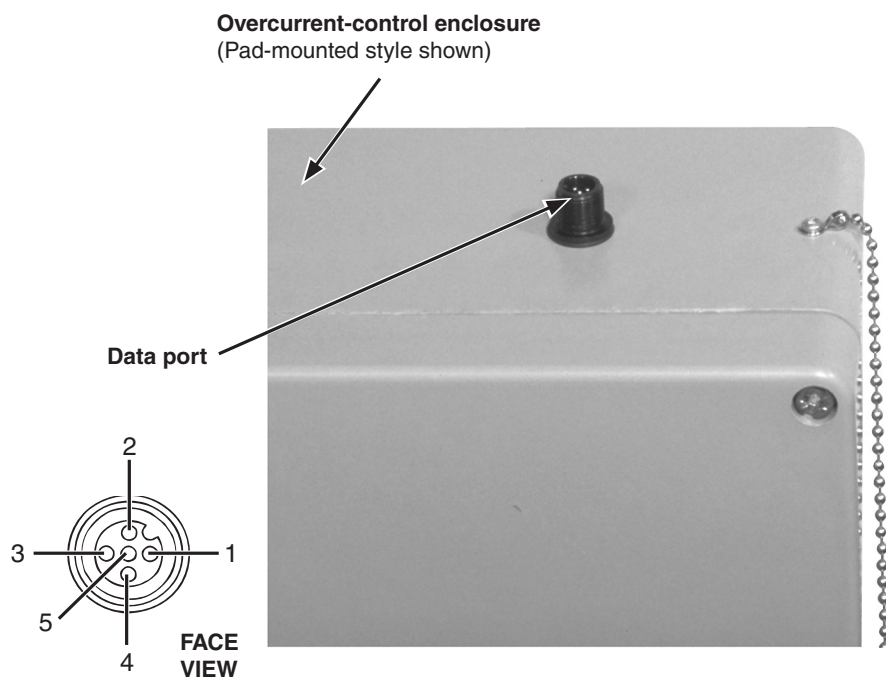
**Power Inputs**

Terminal Number	Power Pole
21	Fault Interrupter 1, Pole 1
22	Fault Interrupter 1, Pole 2
23	Fault Interrupter 1, Pole 3
24	Fault Interrupter 1 Residual
25	Fault Interrupter 2, Pole 1
26	Fault Interrupter 2, Pole 2
27	Fault Interrupter 2, Pole 3
28	Fault Interrupter 2 Residual



**Communication Port Pin-Out—Electronics Module**

Pin	Function
1	Power in
2	RXD (Data In)
3	TXD (Data Out)
4	No connection
5	Signal reference
6	No connection
7	No connection
8	No connection
9	Power return



**Data Port Pin-Out—Control Enclosure**

Pin	Function
1	Power return
2	RXD (Data In)
3	TXD (Data Out)
4	Power in
5	Signal reference

## Communication Parameters

### NOTICE

Before using any Microsoft terminal-emulator program, disable any PDA synchronizing software programs. Failure to do so may cause communication problems when connecting to the S&C Overcurrent Control.

### HyperTerminal

Parameter	Setting
Baud Rate	9600
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	XON/XOFF▲

▲ The overcurrent control does not use hardware flow control (RTS, CTS).

### AcSELerator Quickset SEL-5030

Parameter	Setting
Device	★
Data Speed	9600
Data Bits	8
Stop Bits	1
Parity	None
RTS/CTS	OFF
DRT	ON
RST	ON

★ Specify the assigned COM # from the drop down list. The assigned COM # can be found under Control Panel, System, Hardware, Device Manager. Expand the **Ports** menu. The COM # will be adjacent to "SEL to UART Bridge Controller."



## Using Terminal Emulator Programs

### NOTICE

Because of the nature of the internal connections of some secondary injection-style relay-test sets, a ground-loop condition can develop when *both* the test set and a PC are connected to an ac wall outlet. The ground-loop condition may damage the PC data port. Always isolate the PC by running it on an isolated ac supply or by running the PC on its battery packs.

The procedures for starting and using terminal-emulator program will vary depending on the specific terminal-emulator program. A simple terminal-emulator program was included with every copy of Microsoft Windows.

### NOTICE

Windows Vista, Windows 7, and Windows 8 do not include a terminal-emulation program. Users must select and install a terminal-emulator program to be able to communicate with the S&C Overcurrent Control. S&C recommends downloading one of two terminal-emulator programs listed below.

Manufacturer: Schweitzer Engineering Laboratories, Inc.  
 Program: AcSELerator QuickSet 5030  
 Website: [www.selinc.com/sel-5030.htm](http://www.selinc.com/sel-5030.htm)  
 Note: This software is available to download for free.

Manufacturer: Hilgraeve  
 Program: HyperTerminal  
 Website: [www.hilgraeve.com/hyperterminal.html](http://www.hilgraeve.com/hyperterminal.html)  
 Note: This software is the same software supplied with previous versions of Microsoft Windows. It is available for purchase.

Basic instructions for the terminal-emulator programs “HyperTerminal” (which comes with Windows 95, 98, 2000, NT, ME, and XP, and available for download for Windows Vista, 7, and 8 users) and “AcSELerator QuickSet 5030” (available for download) are provided on page 26.

## HyperTerminal

**For Windows 95, 98, 2000, NT, ME, XP, Vista, 7, and 8:**

### Step 1

Click on the **Start** button.

- (a) For Windows 95, 98, and ME select **Programs** and then **Accessories**. In the **Accessories** folder, select the **HyperTerminal** icon. Then double-click on **Hypertrm.exe**.
- (b) For Windows 2000, NT, and XP select **Programs**, then **Accessories**, then **Communications** (or **HyperTerminal**). Then select the **HyperTerminal** icon.
- (c) For Windows Vista, 7, and 8 open the **HyperTerminal** program from its file location (probably on the desktop).

### Step 2

A dialog box will then ask for a “connection description.” This is a file that will be saved in the **HyperTerminal** folder with its own name and icon. It stores the appropriate settings for connecting to the S&C Overcurrent Control so they do not have to be entered every time. In the “connection description” dialog box, enter a name for this file (for example, “Vista”).

### HyperTerminal continued

#### Step 3

The next dialog box asks for a phone number to dial. Ignore this and go to the **Connect Using** list at the bottom of the dialog box. With the relay connected, select the correct COM # from the drop down menu. The assigned COM # can be found under *Control Panel>System>Hardware>Device Manager*. Expand the **Ports** menu. The COM # assignment is adjacent to “SEL to UART Bridge Controller.” Click on the **OK** button.

#### Step 4

The next dialog box asks for the connection parameters. Enter the settings listed in Appendix B and click on the **OK** button.

#### Step 5

HyperTerminal should now be connected to the S&C Overcurrent Control. To initiate the data flow between the computer and the control, press the **Enter** key on the computer. **Until the Enter key on the computer is pressed, nothing will be displayed on the screen.** It may be necessary to click on the **Disconnect** button on the toolbar. This function is also located under the **Call** menu. After disconnecting, click on the **Reconnect** button on the toolbar. Again, this function is located under the **Call** menu.

#### Step 6

To exit this session, select **File:Exit** or click on the **X** button in the upper right-hand corner of the window. HyperTerminal will ask if you want to save the session settings. Click on **Yes** so that, in the future, all of the above instructions can be bypassed by simply clicking on the icon that you just created.

### AcSELerator® QuickSet 5030™

**For Windows Vista, 7, and 8:**

#### Step 1

Open the AcSELerator QuickSet 5030 program from its file location (probably on the desktop).

#### Step 2

Select the **Parameters** option from the **Communications** drop-down menu.

#### Step 3

With the overcurrent control relay connected, select the correct COM # from the **Device** drop down menu. (The assigned COM # can be found under *Control Panel> System> Hardware> Device Manager*. Expand the **Ports** menu. The COM # assignment is adjacent to “SEL to UART Bridge Controller”). Then select the parameters in Appendix B. Click the **OK** button.

#### Step 4

To connect to the relay, select **Terminal** from the **Tools** drop-down menu. If the main menu does not automatically appear, press the **Enter** key.

## Coordination

The S&C Overcurrent Control provides the flexibility required to meet the critical needs of protective device coordination between upstream and downstream devices such as circuit breakers and fuses. The example below shows how well the U.S. U4 time-overcurrent curve coordinates with both an upstream protective relay and downstream power fuse. The reference document used for these curve families and their equations is IEEE Standard C37.112-1996 IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays.

As shown in this instruction sheet and as seen on the overcurrent control's user interface, all pickup-current settings selections for E, K, Coordinating-Tap, Coordinating-Main, ANSI/U.S. U1 through U5, and IEC C1 through C5 are expressed in terms of primary amperes. However, in IEEE Standard C37.112-1996, U.S. and IEC curve families are expressed in terms of "multiples of pickup" where 1.0 on this axis represents the pickup setting. The standard uses this method of illustrating time versus current response because different current transformer ratios may be used for each specific application. In Vista SD switchgear, the CT ratio is fixed at 660:1. Consequently, we will refer to the "multiples-of-pickup" nomenclature for this example.

Based on the desired application, any of the 10 curve families can be selected to meet the coordination requirements. Adjusting the minimum pickup setting in terms of primary amperes moves the desired time-overcurrent curve to the left or right on the TCC coordination plot. In addition to the minimum pickup setting, a "time dial" feature is used to move the desired time-overcurrent curve up or down in time (in seconds) to meet the specific coordination requirements.

### Example:

Referring to the coordination plot in Figure 2 on page 30, a Vista SD switchgear assembly with 600-ampere fault interrupters is placed into an electrical system where the upstream protective device is controlled by an overcurrent relay whose phase time-overcurrent curve family is set for a "CO-9" Very Inverse curve. The relay's phase overcurrent pickup is set for 960 amperes with a "time dial" setting of 2. There are two curves shown that take into account the operating time tolerance of the "CO-9" overcurrent relay. Downstream of the switchgear assembly is an S&C SMU-20 power fuse with a 200K-ampere rating. Its minimum melt and total clearing curves are shown on the TCC coordination plot.

It is desired to coordinate the switchgear assembly with the upstream and downstream devices. A review of the ANSI/U.S. and IEC curve families resulted in the selection of the ANSI/U.S. "U4" curve. See Figure 3 on page 31. Its curve shape is similar to the other two devices' curves. Using a TCC coordination program, it is possible to "fit" a time-overcurrent curve "between" the curves of the upstream source-side and downstream load-side devices. Note that the Vista SD curve selected is shown starting at 150% of the actual pickup setting in primary amperes ( $880 \text{ amperes} \times 1.5 = 1320 \text{ amperes}$ ). The **Time Dial** setting selection of 0.8 was selected to maintain an acceptable coordinating time interval (CTI) between the upstream protective relay phase setting, the power fuse, and the Vista SD unit. Because of the extremely fine resolution of pickup current and **Time Dial** settings selections within the ANSI/U.S. and IEC curve families, it is obvious there are other **Pickup Current** and **Time Dial** settings within the U4 family that could accomplish proper device coordination; in this example the S&C Overcurrent Control's time-overcurrent curves are placed equidistant between the upstream and downstream device time-overcurrent curves.

One final consideration in the selection of ANSI/US and IEC curve families to achieve proper power system coordination is the “I<sup>2</sup>t security characteristic” of the S&C Overcurrent Control, included with controls having firmware version R300 or later. The control will self-protect its internal power supply and current-sensing circuitry when a **Pickup** setting (in amperes) and/or a **Time Dial** setting exceeds the thermal limits of the electronic circuitry (in both the electronics module and burden board assemblies). Figure 1 shows the “I<sup>2</sup>t security characteristic” of the S&C Overcurrent Control. When the “I<sup>2</sup>t security characteristic” is enabled, the control may implement a definite-time response characteristic of 0.25 seconds for any current magnitude above 14.5 kA. This matches the performance ratings of the control listed in the “Specifications” section. The “I<sup>2</sup>t security characteristic” does not apply to the E, K, Coordinating-Tap, and Coordinating-Main curve families under all settings.

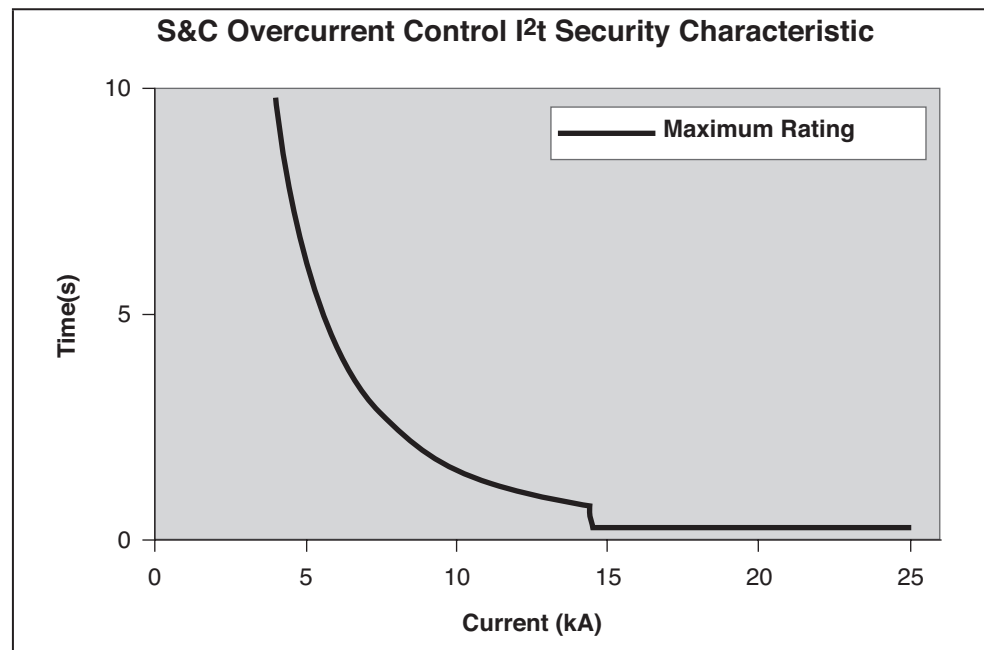


Figure 1. S&C Overcurrent Control maximum current rating adjusted for C.T. saturation.

Table 1 on page 29 should be used to determine whether the “I<sup>2</sup>t security characteristic” will become enabled during the maximum calculated fault levels. In most cases, the **Pickup Current** and **Time Dial** settings selected will be well below the values listed in the table. To prevent the “I<sup>2</sup>t security characteristic” from becoming enabled, the pickup current and **Time Dial** settings must be less than the limits listed in the following table.

The operation time of the U.S. and IEC curves is a function of three variables: the **Pickup** setting, the **Time Dial** setting, and the fault current (measured in multiples of the **Pickup** setting). With this information, the overcurrent control calculates the curve operation time and the I<sup>2</sup>t security characteristic operation time, compares the two, and operates according to the faster time. The table provides example curve settings at sample fault current levels that would cause the curve operation time to be slower than the I<sup>2</sup>t security characteristic operation time for a 660:1 CT.

Table 1. I<sup>2</sup>t Security Characteristic Settings Limits (660:1 CT)

Curve	Affected Settings for Fault Current $\geq 14.5$ kA	Affected Settings for Fault Current = 10.0 kA
U1	Time Dials > 4.3 @ 50 A pickup Time Dials > 3.2 @ 1200 A pickup	Time Dials > 9.1 @ 50 A pickup Time Dials > 5.9 @ 1200 A pickup
U2	Time Dials > 3.9 @ 50 A pickup Time Dials > 3.3 @ 1200 A pickup	Time Dials > 8.3 @ 50 A pickup Time Dials > 5.8 @ 1200 A pickup
U3	Time Dials > 7.3 @ 50 A pickup Time Dials > 6.0 @ 1200 A pickup	Time Dials > 14.9 @ 450 A pickup Time Dials > 10.2 @ 1200 A pickup
U4	Time Dials > 14.9 @ 730 A pickup Time Dials > 10.0 @ 1200 A pickup	Time Dials > 14.9 @ 1100 A pickup Time Dials > 13.2 @ 1200 A pickup
U5	Time Dials > 14.5 @ 50 A pickup Time Dials > 10.6 @ 1200 A pickup	Not applicable
C1	Time Dials > 0.37 @ 50 A pickup Time Dials > 0.27 @ 1200 A pickup	Time Dials > 0.78 @ 50 A pickup Time Dials > 0.48 @ 1200 A pickup
C2	Time Dials > 0.99 @ 760 A pickup Time Dials > 0.61 @ 1200 A pickup	Time Dials > 0.99 @ 1040 A pickup Time Dials > 0.84 @ 1200 A pickup
C3	Not applicable	Not applicable
C4	Time Dials > 0.17 @ 50 A pickup Time Dials > 0.06 @ 1200 A pickup	Time Dials > 0.37 @ 50 A pickup Time Dials > 0.09 @ 1200 A pickup
C5	Not applicable	Not applicable

For our sample coordination study, with a U4 curve selected to have an 880-ampere pickup and a 0.8 **Time Dial** setting, we are well below the limits shown for the operation of the “I<sup>2</sup>t security characteristic” during fault levels up to 14.5 kA. The **Time Dial** setting is below the threshold of 10.0 at a **Pickup** setting of 1200 amperes.

If the setting was above the limit for the “I<sup>2</sup>t security characteristic,” a warning message would be displayed with the calculation of the cross over point in primary amperes of the selected US or IEC curve with the “I<sup>2</sup>t security characteristic” curve. A sample warning message is shown below.

“Phase overcurrent control will operate on the TOC curve for faults up to 18476 A. Phase overcurrent control will operate on its maximum I<sup>2</sup>t (thermal) limit curve for faults above 18476 A. Refer to S&C Instruction Sheet 681-515 Appendix D.”

When this occurs, the user must consider the following:

If the fault level displayed in the warning message is *higher* than the maximum available fault current level at the switchgear assembly, the “I<sup>2</sup>t security characteristic” will not become enabled. If the fault level displayed in the warning message is *lower* than the maximum available fault current level, then the “I<sup>2</sup>t security characteristic” will become enabled resulting in a faster time to operate. To prevent this from occurring, new settings selections should be considered to prevent miscoordination between upstream source-side and downstream load-side devices. Contact S&C Electric Company—Power Systems Solutions for application assistance.

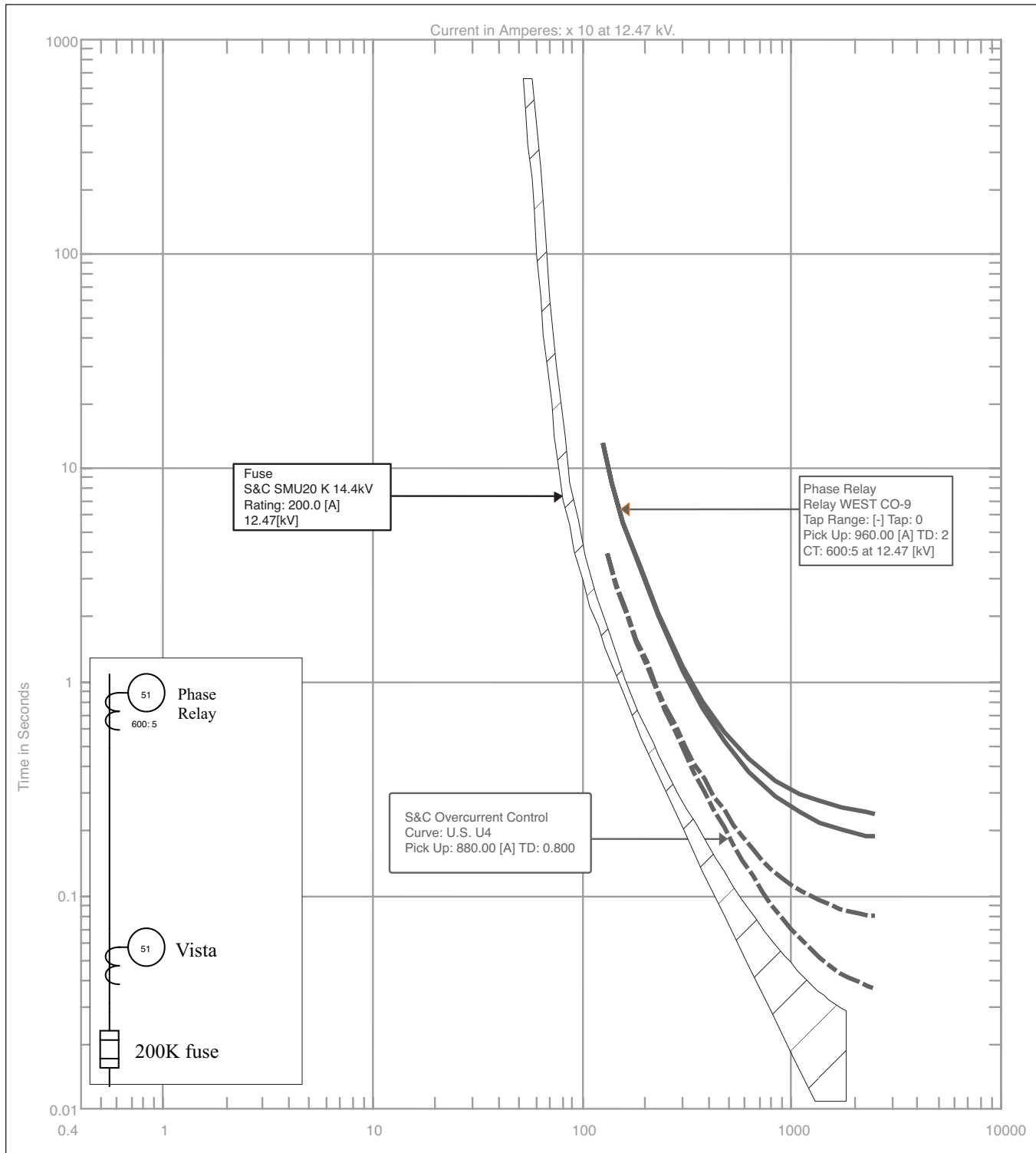


Figure 2. An S&C Overcurrent Control programmed with ANSI/U.S. U4 curve.

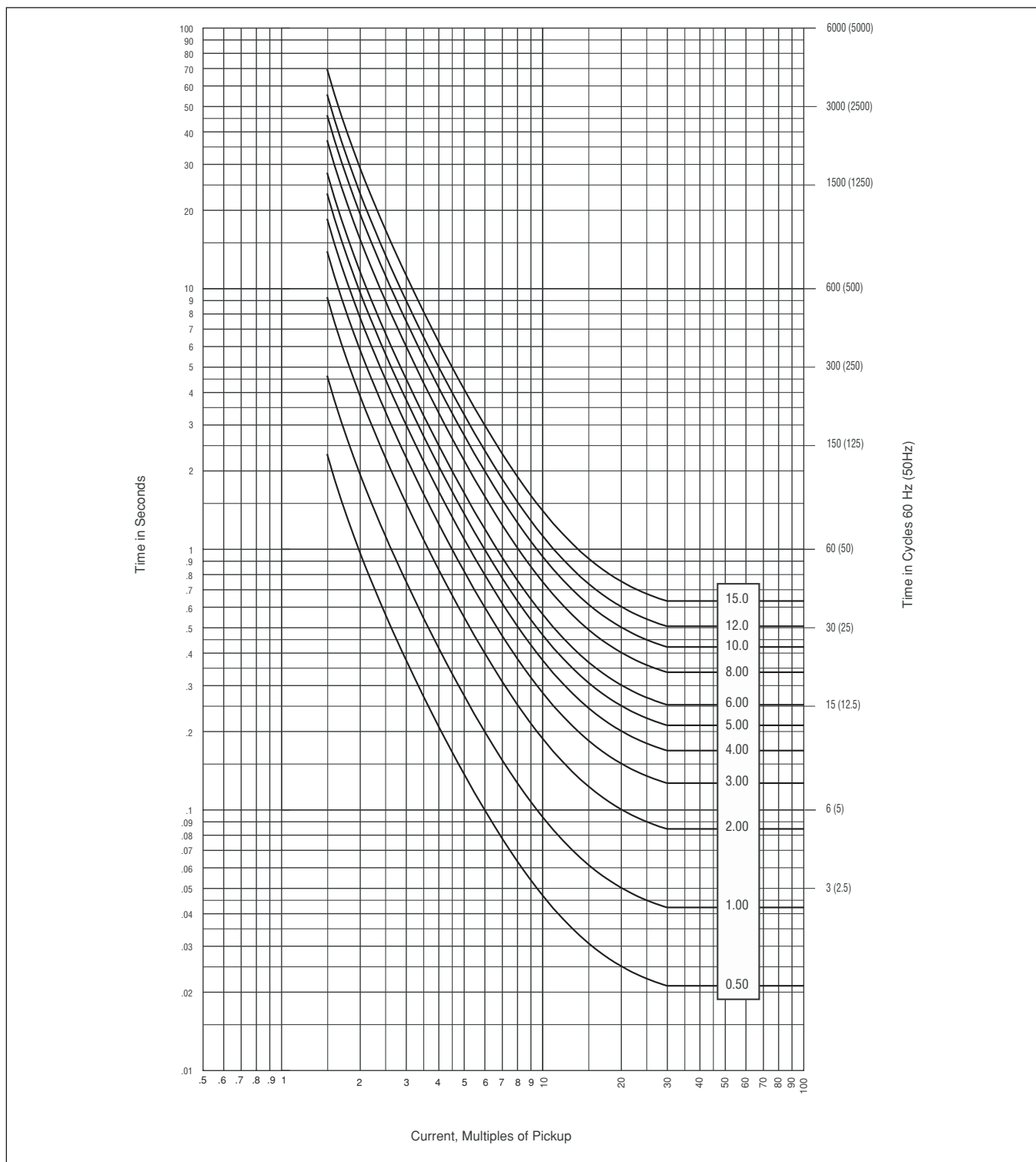


Figure 3. A U.S. Extremely Inverse U4 Curve.

### Overcurrent Control Settings

The S&C Overcurrent Control can be programmed to provide a wide variety of settings combinations. Listed below are the setting ranges that are displayed when the control is connected to a personal computer.

**For C.T. Ratio of 660:1:**

Phase TCC Curve (E, K, TAP, MAIN, U1, U2, U3, U4, U5, C1, C2, C3, C4, C5)

For E-Speed Curves:

Curve Selection (25E, 30E, 40E, 50E, 65E, 80E, 100E, 125E, 150E, 175E, 200E, 250E, 300E, 400E)

For K-Speed Curves:

Curve Selection (25K, 30K, 40K, 50K, 65K, 80K, 100K, 125K, 150K, 175K, 200K)

For Coordinating-Tap Curves:

Minimum Pickup (Amperes) (50, 65, 80, 100, 150, 200, 250, 300, 350, 400)

For Coordinating-Main Curves:

Minimum Pickup (Amperes) (100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800)

For Curves U1-U5 and C1-C5:

Minimum Pickup (Amperes) (50-1200, 1 A steps)

Time-Dial Multiplier U Curves (0.5 – 15.0, 0.1 steps)

Time-Dial Multiplier C Curves (0.05 – 1.0, 0.01 steps)

For Coordinating-Tap and Coordinating-Main Curves:

Instantaneous Pickup (kA) (OFF, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6)

For Curves U1-U5 and C1-C5:

Instantaneous Pickup (Amperes) (OFF, 200 – 13200, 20 A steps)

For Coordinating-Tap and U1-U5 and C1-C5 Curves:

Definite Time Delay (ms) @ 60 Hz (OFF, 32, 48, 64, 80, 96)

Definite Time Delay (ms) @ 50 Hz (OFF, 40, 60, 80, 100, 120)

For Coordinating-Main Curves:

Definite Time Delay (ms) @ 60 Hz (OFF, 64, 80, 96, 112, 128)

Definite Time Delay (ms) @ 50 Hz (OFF, 80, 100, 120, 140, 160)



Ground TCC Curve (OFF, TAP, MAIN) or (OFF, U1, U2, U3, U4, U5, C1, C2, C3, C4, C5)  
See Notes 1 and 2

For Coordinating-Tap Curves:

Minimum Pickup (Amperes) (50, 65, 80, 100, 150, 200, 250, 300, 350, 400)

For Coordinating-Main Curves:

Minimum Pickup (Amperes) (100, 150, 200, 250, 300, 350, 400)

For Curves U1-U5 and C1-C5:

Minimum Pickup (Amperes) (50 – 400, 1 A steps)

Time-Dial Multiplier U Curves (0.5 – 15.0, 0.1 steps)

Time-Dial Multiplier C Curves (0.05 – 1.0, 0.01 steps)

For Coordinating-Tap and Coordinating-Main Curves:

Instantaneous Pickup (kA) (OFF, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6)

For Curves U1-U5 and C1-C5:

Instantaneous Pickup (Amperes) (OFF, 200 – 13200, 20 A steps)

For Coordinating-Tap and U1-U5 and C1-C5 Curves:

Definite Time Delay (ms) @ 60 Hz (OFF, 32, 48, 64, 80, 96)

Definite Time Delay (ms) @ 50 Hz (OFF, 40, 60, 80, 100, 120)

For Coordinating-Main Curves:

Definite Time Delay (ms) @ 60 Hz (OFF, 64, 80, 96, 112, 128)

Definite Time Delay (ms) @ 50 Hz (OFF, 80, 100, 120, 140, 160)

**Note 1:** Ground settings are not displayed and are disabled if the **Trip** mode is set for the **1-Pole Trip** setting or if the Phase TCC curve selected is either E-speed or K-speed.

**Note 2:** Ground curves can be selected to provide a different TCC curve than the phase setting. However, when TAP or MAIN is used for the phase TCC, only MAIN and TAP TCC curves can be selected for the ground TCC setting. When a U or C curve is selected for the Phase TCC, only the U and C families can be selected for the ground TCC setting.

