Reclosers

COOPER Power Systems

Service Information

Kyle® Form 4C Microprocessor-Based Recloser Control Programming Guide

S280-77-4

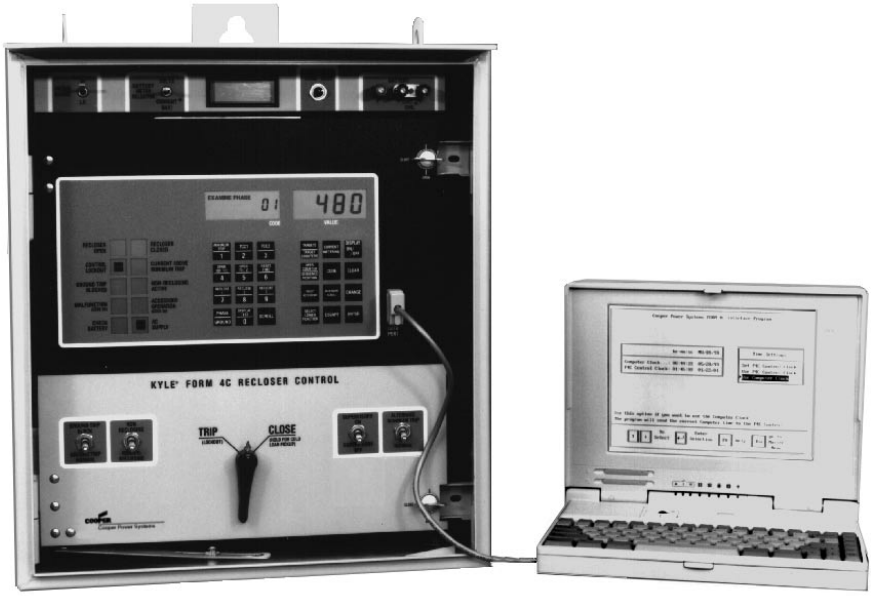


Figure 1.
Kyle® Form 4C Microprocessor-Based Recloser Control shown with KSPS2 software.

Contents

SAFETY FOR LIFE

Cooper Power Systems products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Cooper Power Systems employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment and support our “Safety For Life” mission.

SAFETY INFORMATION

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians, who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- *Is thoroughly familiar with these instructions.*
- *Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.*
- *Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.*
- *Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, hotstick, etc.*

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

DANGER: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety Instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

DANGER: Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high and low voltage lines and equipment. G103.3

WARNING: Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling, or maintenance can result in death, severe personal injury, and equipment damage. G101.0

WARNING: This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury, and equipment damage. G102.1

WARNING: Power distribution equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety prodedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install, or maintain power distribution equipment can result in death, severe personal injury, and equipment damage. G122.2

INTRODUCTION

CAUTION: Equipment misoperation. Do not connect this control to an energized recloser until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and recloser misoperation, equipment damage, and personal injury. G110.3

This guide is designed to assist engineers and qualified technicians with programming of the Form 4C control. These individuals must be familiar with the functions and programming parameters required for specific recloser installations.

This guide contains a listing of all access codes, program settings, and detailed operating descriptions of the code parameters. The codes, settings, and parameter descriptions are also listed on the control information label located inside the cabinet door.

CAUTION: Recloser misoperation. The control must be removed from service prior to performing any maintenance, testing, or programming changes. Failure to comply can result in misoperation (unintentional operation) of the recloser. T216.2

CONTROL SECURITY

The Form 4C control's three-level security system limits personnel access to only those control functions appropriate to their responsibilities. The four-digit security code prohibits unauthorized keyboard access to programming and operating parameters. No programming commands are accepted by the control unless the operator enters the appropriate four-digit security code. Be sure the necessary security codes are available to programming personnel.

Interrogation of the control to display all operating parameters and read-only functions of the control panel does not require entering a security code.

Note: Turning off the display at the keyboard removes any security code previously entered via the keyboard.

Any security level entered is disabled 10 minutes after keying in the last instruction or interrogation.

During programming, if identical codes are selected for different security levels, the higher security level code is recognized by the control.

First Level Security

First level security authorizes changes to the following operating parameters:

- Minimum trip values
- Number of operations to lockout
- Time–current curves
- Reclose time
- Current-transformer selection
- Supervisory close reset time
- Phase identification
- Feature ON/OFF commands
- Selection of metering integration intervals
- Access to TCC timing groups
- Activation of Sensitive Ground/Earth Fault, High-Current Trip, and High-Current Lockout
- Event Recorder
- Duty Cycle Monitor Factor

Second Level Security

The second level allows modification of these parameters:

- Set control identification number
- Close retry time and number of attempts
- Operations counter

Third Level Security

The third level allows changes to these parameters:

- Security codes for levels 1, 2, and 3
- Line frequency

IMPORTANT: These security levels are designed to be accessible only to personnel completely familiar with the operation of these functions. Faulty programming could lead to unintentional control performance.

Factory Programmed Security Codes

The Form 4C is programmed at the factory with standard security codes for first (1111), second (2222), and third (3333) level security. These codes are changeable to any four-digit number using the third level security.

KEYBOARD FUNCTIONS

Prior to interrogation and programming, the operator should be familiar with the control's keyboard. Figure 2 shows each key and its description of operation.

MINIMUM TRIP / 1
Interrogates or programs minimum trip (Phase and Ground)
"1" numeric value

TCC1 / 2
Interrogates or programs 1st TCC (Phase and Ground)
"2" numeric value

TCC2 / 3
Interrogates or programs 2nd TCC (Phase and Ground)
"3" numeric value

TARGETS / TARGET COUNTERS
Displays fault target information
Displays cumulative total of fault current trip phase and ground. (Used with SELECT LOWER FUNCTION key)

CURRENT METERING
Displays Phase and Ground load current and demand metering readings

DISPLAY ON / OFF
Turns keyboard and display ON and OFF

OPER 1ST TCC / 4
Interrogates or programs number of trip operations on 1st TCC (Phase and Ground)
"4" numeric value

OPER TO L.O. / 5
Interrogates or programs number of operations to lockout (Phase and Ground)
"5" numeric value

RESET TIME / 6
Interrogates or programs reset after successful reclose time delay
"6" numeric value

OPER. COUNTER / SEQUENCE POSITION
Displays total number of control trip operations
Displays control operating sequence position. (Used with SELECT LOWER FUNCTION key)

CODE
Provides direct entry of access codes

CLEAR
Clears pending keyboard entries; resets targets, counters and demand drag hand

RECLOSE 1 / 7
Interrogates or programs reclosing time after 1st trip operation
"7" numeric value

RECLOSE 2 / 8
Interrogates or programs reclosing time after 2nd trip operation
"8" numeric value

RECLOSE 3 / 9
Interrogates or programs reclosing time after 3rd trip operation
"9" numeric value

SELECT ACCESSORY
Displays status of individual control features with programmable values

ACCESSORY SCROLL
Displays individual parameters of programmable control features and accessories

CHANGE
Initiates change to programmed parameter

PHASE / GROUND
Toggles between Phase and Ground Display

DISPLAY TEST / 0
Checks LCD operation by displaying all numeric segments and messages
"0" numeric value

SCROLL
Permits display of the programmed values of most common control operating features

SELECT LOWER FUNCTION
Provides access to Target Counters and Sequence Position

ESCAPE
Escape key ignores recent keystroke and returns to ready (rdY) prompt

ENTER
Enters changed parameter into program

Figure 2.
Keyboard Functions.

SETTING THE CONTROL CLOCK

(Access Codes 153–156)

The Form 4C control is equipped with a 24-hour notation time clock that records the year, month, day, hour, minute, and seconds of recorded events. The clock begins operation upon connection to the control's ac power or backup power supply.

The clock must be set at the time the control is installed and reset whenever control power is disconnected. When the control is first energized, the clock default month and day are 1/1 and the year is 2001. The clock must be set prior to programming or interrogation for the recorded events to be logged to the proper day and time.

The clock is used in conjunction with the event recorder and load profile monitor to store events recorded in the control. No security code is required to set the clock or change clock settings.

To set, examine, or change clock settings, refer to Access Codes 153 through 156.

1. Connect the ac supply and the control battery. Four dashes (----) will appear on the LCD display to indicate that the clock needs to be set.
2. From the keyboard, press DISPLAY ON. The Ready (rdY) prompt appears indicating the control is ready for programming.

To set the year:

1. Press the CODE key and the numbers 1-5-3 (for access code 153). Then press ENTER.
2. Press the CHANGE key. Enter the four digits of the current year. Press ENTER.

To set the date:

1. Press the SCROLL key to advance the control to Access Code 154. Code 154 can also be entered manually.
2. Press CHANGE. Enter four digits for the month (01 to 12) and day (01 to 31). Single-digit months and days are preceded by a zero. Press ENTER.

To set hour and minute:

1. Press SCROLL to advance the control to Access Code 155. Code 155 can also be entered manually.
2. Press CHANGE and enter four digits for the hour (01 to 24) and minute (01 to 59). Press ENTER.

To set seconds:

1. Press SCROLL to advance the control to Access Code 156. Code 156 can also be entered manually.
2. Press CHANGE and enter two digits for the seconds (01 to 59) and press ENTER.

Use the SCROLL key to review the new calendar and clock settings. Press ESCAPE to return to the Ready (rdY) prompt.

USING THE KEYBOARD

The following example of a Display Test illustrates the use of the keyboard for interrogation. The same basic step-by-step descriptive procedure is used for all keyboard interrogation and program change operations.

Each step of the procedure is numbered, the appropriate key to be pressed is illustrated, and the resulting keyboard display is shown.

DISPLAY TEST

Step No.	Touch Key	Display Message / Access Code	Complex TCC / Parameter Value
1.	DISPLAY ON / OFF	CODE	VALUE (rdY)
2.	DISPLAY TEST 0	EXAMINE PHASE SCROLL CODE CHANGE GROUND 188 CODE	88:8.8 VALUE
3.	CLEAR OR ESCAPE	CODE	VALUE (rdY)

Interrogation of Program Settings

The keyboard of the Form 4C control can be used to interrogate and display all programmed parameter settings. The most commonly used parameters have dedicated function keys.

Use the following procedures for interrogation of control parameters. Be sure the display is ON and the rdY prompt is displayed.

INTERROGATION OF MINIMUM TRIP

Step No.	Touch Key	Display Message	Access Code	Complex TCC	Parameter Value
1.	MINIMUM TRIP / 1	EXAMINE PHASE	01 (CODE)	*displays the latest recorded value of the appropriate parameter*	VALUE
2.	PHASE / GROUND	EXAMINE GROUND	01 (CODE)	*displays the latest recorded value of the appropriate parameter*	VALUE
3.	ESCAPE		CODE	rdy	VALUE

To interrogate other dedicated control parameters or status information, press any of the function keys, listed below, at Step 1. Repeat Step 2 for any parameter with a phase and ground function. When pressed, the PHASE/GROUND key will alternately display the phase and ground values of the appropriate parameters. (If the PHASE/GROUND key is inadvertently pressed for a parameter without a phase and ground value, the control will ignore the command.)

TCC1 / 2	TCC2 / 3	OPER 1ST TCC / 4	OPER TO L.O. / 5	RESET TIME / 6	RECLOSE 1 / 7
RECLOSE 2 / 8	RECLOSE 3 / 9	TARGETS / TARGET COUNTERS	CURRENT METERING	OPER. COUNTER / SEQUENCE POSITION	

Changing and Verifying Control Program Settings

Before making changes to control parameters, the operator must enter a security code that qualifies him to make changes to control settings.

The security code must be re-entered if the display is turned off (or shuts off automatically after 10 minutes with no further keyboard entry). This feature ensures that the Form 4C control returns to the read-only security access mode, after the programming operator leaves the control.

The control can be programmed via the keyboard, independent of the position of the Supervisory ON/OFF switch.

The Supervisory ON/OFF switch must be ON when programming via the data port or through the digital communications accessory.

The following example illustrates how the control's phase and ground minimum trip levels are changed and verified, using the keyboard. Phase minimum trip is changed from 100 A to 200 A. Ground minimum trip is changed from 50 A to 100 A.

Change Phase Minimum Trip Value

Step No.	Touch Key	Display Message / Access Code	Complex TCC / Parameter Value
1.	DISPLAY ON / OFF	CODE	VALUE: rdy
2.	CODE	CODE: CODE	VALUE: ---
3.	RECLOSE 3 9 RECLOSE 3 9	CODE: CODE	VALUE: _99
4.	ENTER	CODE: 99	VALUE: ----
5.	ENTER SECURITY CODE	CODE: 99	VALUE: *As the security code is entered, the dashes disappear. The security code will not appear in the display.*
6.	ENTER	CODE	VALUE: rdy
7.	MIN TRIP 1	CODE: EXAMINE PHASE 01	VALUE: 100
8.	CHANGE	CODE: PHASE CHANGE 01	VALUE: ----
9.	ENTER NEW VALUE	CODE: PHASE CHANGE 01	VALUE: _200
10.	ENTER	CODE: EXAMINE PHASE 01	VALUE: 200

Step No.	Touch Key	Display Message	Access Code	Complex TCC	Parameter Value
11.	PHASE / GROUND	EXAMINE GROUND	01		50
12.	CHANGE	CHANGE GROUND	01		- - - -
13.	ENTER NEW VALUE	CHANGE GROUND	01		100
14.	ENTER	EXAMINE GROUND	01		100

To change the other control parameters, press any of the following keys after step 6. Repeat Steps 11 through 14 for any parameter with a phase and ground function. When pressed, the PHASE/GROUND key will alternately display the phase and ground values of the appropriate parameters. (If the PHASE/GROUND key is inadvertently pressed for a parameter without a phase and ground value, the control will ignore the command.)

TCC 1 / 2	TCC 2 / 3	OPER 1ST. TCC / 4	OPER. TO L.O. / 5
RESET TIME / 6	RECLOSE 1 / 7	RECLOSE 2 / 8	RECLOSE 3 / 9

Changing Control Settings Using Access Codes

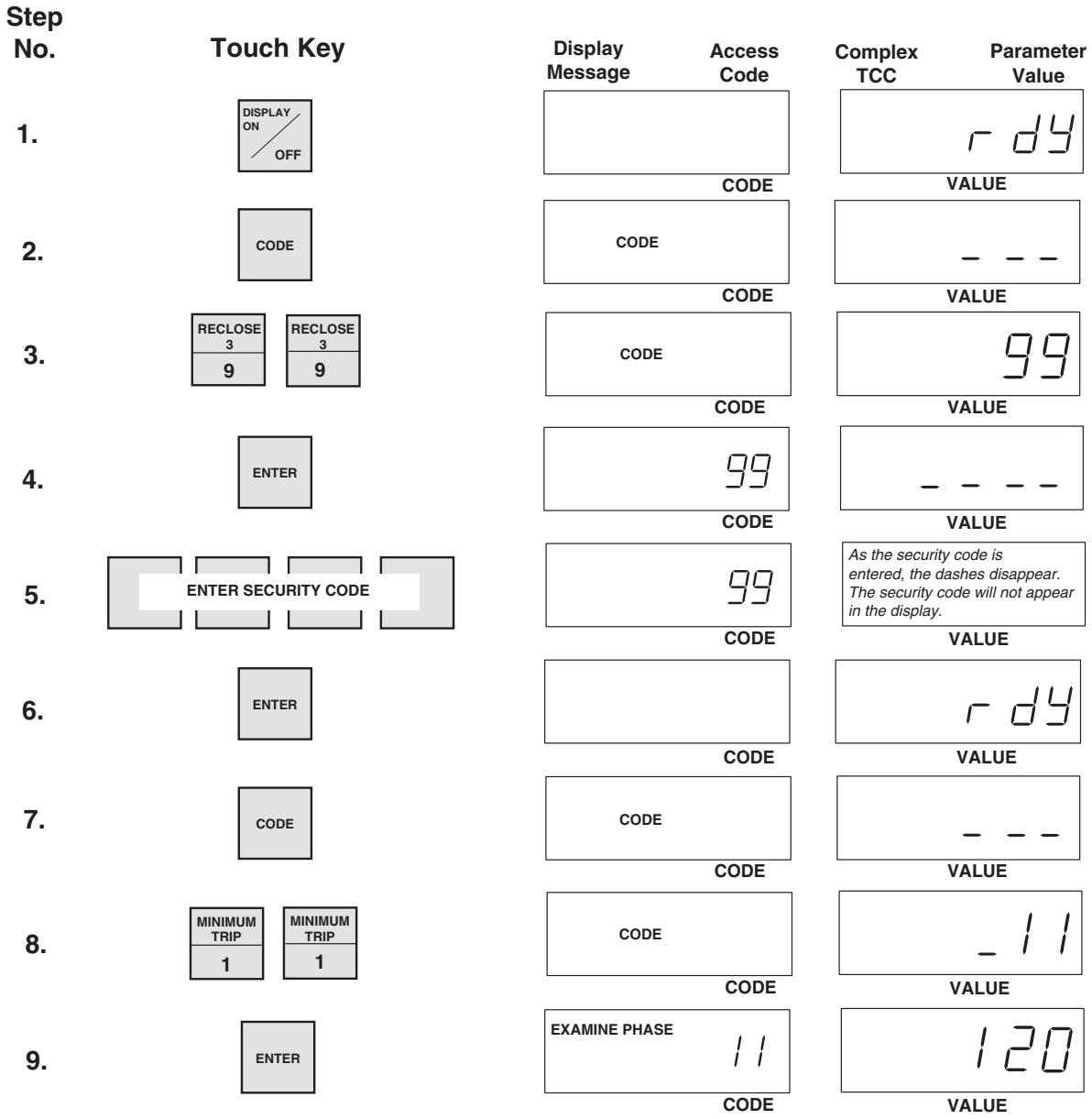
Use the following procedure to interrogate or change any control settings of parameters without dedicated keys. Refer to Table 1 or to the control information label located inside the cabinet door to locate the desired parameter and appropriate access code. Enter the desired access code at Step 8.

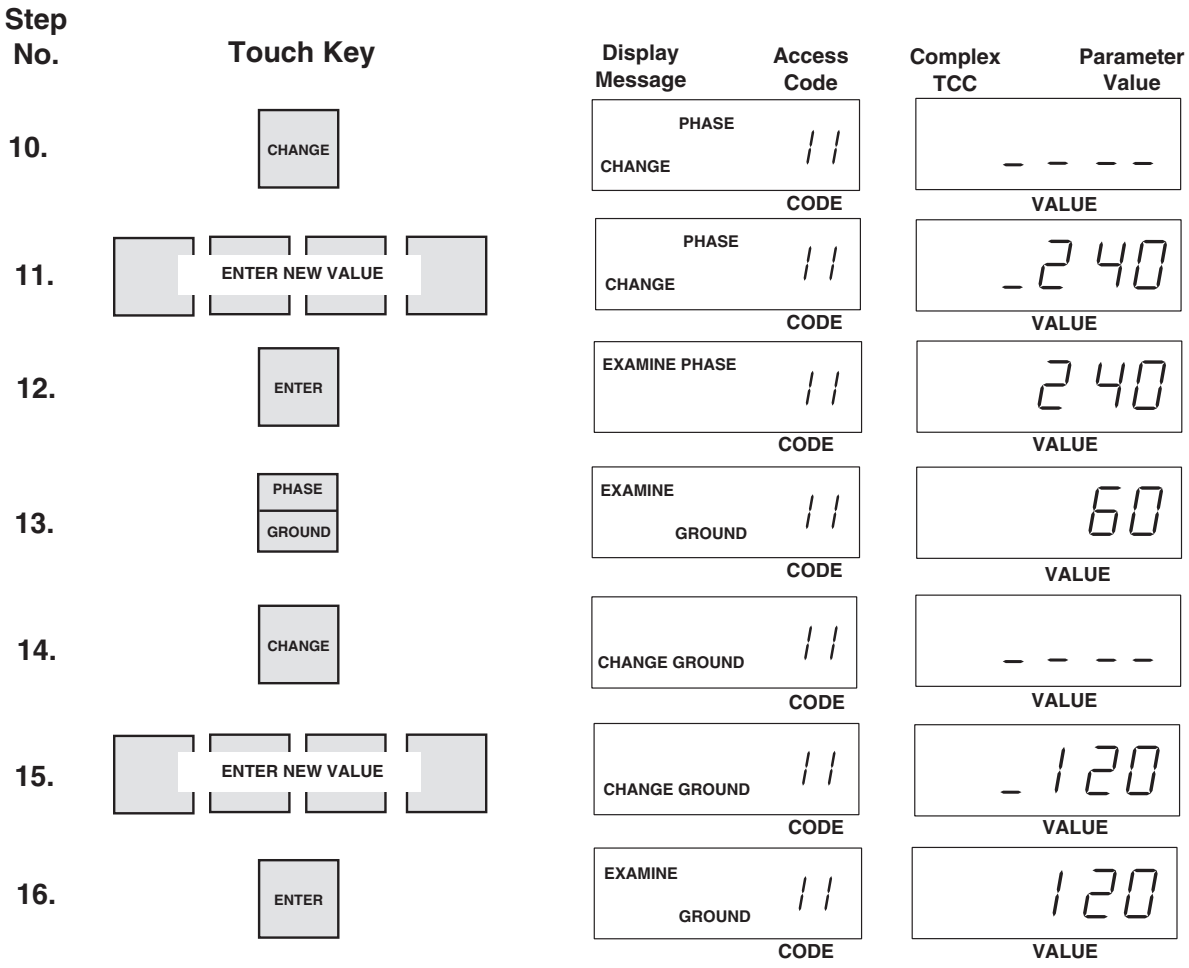
Change Alternate Phase Minimum Trip Value

(Steps 2 through 6 are required to enter security code. If already in security, omit steps 2 through 6.)

Alternate phase minimum trip is changed from 120 A to 240 A.

Alternate ground minimum trip is changed from 60 A to 120 A.





Control Interrogation Using The SCROLL Key

The scroll key provides parameters and status of the following access codes in numerical sequence, offering the convenience of obtaining basic parameter and control status information without selecting individual access codes. The code groups are:

- Basic programming settings (Codes 01 through 09)
- Alternate minimum trip (Code 11)
- Supervisory close reset time (Code 12)
- Features ON/OFF (Codes 20 through 26)

In the *Access Code Description* section of this manual, a YES in the Scroll column indicates that the SCROLL key can be used for interrogation; a NO indicates that the scroll function is not accessible.

Control Interrogation Using The SELECT ACCESSORY Key

The SELECT ACCESSORY key provides ON/OFF status information of enhanced features:

- Complex TCC Setup (Codes 100 and 110)
- Sensitive Ground/Earth Fault (Code 120)
- High-Current Trip (Code 130)
- High-Current Lockout (Code 140)

This allows the operator a quick overview of modifications to the control parameters without individual code selection.

Control Interrogation Using The Accessory SCROLL Key

Some features on the Form 4C control contain multiple settings. These features are:

- Complex TCC1 Code 100 through 104
- Complex TCC2 Setup Code 110 through 114
- Sensitive Ground/Earth Fault Code 120 through 124
- High-Current Trip Code 130 through 134
- High-Current Lockout Code 140 through 143

The ACCESSORY SCROLL key provides the specific parameters of the features obtained with the SELECT ACCESSORY key.

DOWNLOADING TO A DATA READER

The Data Reader (Figure 3) can be used with the Cooper Power Systems Form 4C recloser control and CL-4, CL-4B, CL-4C, and CL-5A regulator controls. Data gathered from recloser and regulator controls is stored in the Data Reader for later downloading into a personal computer for system analysis. A single Data Reader can collect and store data from 20 Form 4C controls, 100 regulator controls, or any equivalent combination of readings from the two types of controls. The Form 4C control is compatible with Data Reader Software DOS Version 4.0 or above and with Windlows-based software, CCI version 1.02 and CCI version 3.01.

To operate the Data Reader:

1. Connect the Data Reader to the data port (Figure 2).
2. Press and hold the START DATA READING button. All three LED lights will illuminate.
3. When the READING and READING COMPLETE lights go out, release the START DATA READING button. The BATTERY OK light will remain illuminated.

   The READING light will illuminate and remain on while the data reader obtains data from the control.

   When the data has been recorded, the READING COMPLETE light will illuminate.
4. Disconnect the Data Reader from the data port.

For additional information on the operation of the Data Reader, refer to *Service Information S225-30-1 Data Reader Operating and Maintenance Instructions*.

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Figure 3.
Data Reader plugs into data port on the Form 4C Control Panel.

CONTROL INTERFACE SOFTWARE PROGRAM

An optional Form 4C INTERFACE™ software program is available to enable the control to be programmed and operated with a personal computer. It is used to send and receive data from the control and to provide access to the Data Reader's data files.

Form 4C INTERFACE software permits complete uploading and downloading of all data stored in the control. It includes a database manager that allows the operator to import, export, or delete data, such as control settings and data records from the database.

The software enables the user to print various reports and provides organized menus of data including:

- all control programming parameters
- event recorder information
- load profile records
- demand metering records
- duty cycle monitor data

The software also allows the user to operate the control directly. Form 4C controls with the Sensitive Ground/Earth Fault feature must use KSPS2 software DOS version 2.0 or later.

The Form 4C INTERFACE program (catalog number KCCI-30-F4) can be used on any personal computer with a minimum of Microsoft® Windows 95® operating system, 16 MB of RAM, and a 266 MHz Intel® Pentium® processor.

CONTROL OPERATION WITH A PERSONAL COMPUTER

A Data Port-to-Computer Interface Cable is available to permit connection of a personal computer to the data port on the front panel of the Form 4C control. The interface cable consists of an EIA232-connector on one end and a data port 9-pin connector on the other end.

The cable includes an adapter that converts low-power Form 4C control data-port signals to an EIA232 interface. This will connect directly to personal computers with a 25-pin serial port and allows downloading of data from the control into the computer (Figure 4).

The personal computer can also be used to upload all control parameter settings into the control for convenient programming. The complete set of control operating parameters can be programmed and verified locally at the installation site or at a remote site. Programming data for each control is stored in the computer and can be printed out and archived for future reference. A printout of each control's program settings can also be kept at the installation site for reference during future inspections.

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Figure 4.
The Form 4C Control can be programmed directly from a personal computer (screen shown with KSPS2 software).

STANDARD ACCESS CODES AND PARAMETERS

Table 1 is a list of the standard access codes provided on all Form 4C controls. A detailed list of program settings, parameter descriptions, and keyboard access codes appears in the *Access Code Description* section of this manual. Access codes and parameter descriptions can also be found on the control information label located inside the cabinet door.

***Note:** Programming of these access codes is required for basic control operation.

TABLE 1
Form 4C Control Standard Access Codes

ACCESS CODE	PARAMETER
PROGRAMMING	
* 01	Minimum Trip - Phase and Ground
* 02	TCC1 - Phase and Ground
* 03	TCC2 - Phase and Ground
* 04	TCC1 Operations - Phase and Ground
* 05	Operations to Lockout - Phase and Ground
* 06	Reset Time
* 07	Reclose #1
* 08	Reclose #2
* 09	Reclose #3
* 10	CT Selection
* 11	Alternate Minimum Trip - Phase and Ground
12	Supervisory Close Reset Time
PHASE IDENTIFICATION	
17	Bushings 1-2 Phase Identifier
18	Bushings 3-4 Phase Identifier
19	Bushings 5-6 Phase Identifier
FEATURE ON/OFF	
20	Sequence Coordination
21	Target Reset After Successful Reclose
22	Operations Counter
23	Event Recorder
*24	Recloser Duty Monitor
25	Ground Trip Precedence
26	Supervisory Via Momentary Contact
TARGETS	
30	Target Status/Reset
32	Target Counter - Ground
33	Target Counter - Phase 1-2
34	Target Counter - Phase 3-4
35	Target Counter - Phase 5-6
36	Target Counter - Sensitive Ground Fault
SEQUENCE POSITION	
38	Sequence Position
OPERATIONS COUNTER	
39	Operations Counter
METERING	
40	Instantaneous Current - Ground
41	Instantaneous Current - Phase 1-2
42	Instantaneous Current - Phase 3-4
43	Instantaneous Current - Phase 5-6
44	Demand Current- Ground
45	Demand Current- Phase 1-2
46	Demand Current- Phase 3-4
47	Demand Current- Phase 5-6
48	Maximum Demand Current - Ground
49	Maximum Demand Current - Phase 1-2
50	Maximum Demand Current- Phase 3-4
51	Maximum Demand Current - Phase 5-6
57	Select Integration Intervals - Phase and Ground
STATUS CODES	
65	Accessory Status Code
67	Alternate Minimum Trip Status
MALFUNCTION CODES	
66	Malfunction Status Code
TCC GROUP	
* 70	TCC Group
LINE FREQUENCY	
* 71	Line Frequency
FIRMWARE VERSION/CONTROL ID	
72	CPU Firmware Version
76	Control Identification Number
77	CPU Firmware Revision Number
78	Display Board Firmware Version Number
CLOSE/RETRY	
74	Close Retry Time
79	Number of Close Retry Attempts

TABLE 1 (cont'd)
Form 4C Control Standard Access Codes

ACCESS CODE	PARAMETER
DIGITAL COMMUNICATIONS	
80	Data Port Baud Rate Code
81	Real-Time Digital Communications Port Baud Rate Code
82	Control Communications Address
83	Real-Time Digital Communications Port Hand-shake Mode Code
84	Number of Line-Sync Characters
85	Real-Time Communications Port Transmit Enable Delay
86	Auto Time-Tagged Reset
SECURITY CODES	
90	Security Code for Level 1
91	Security Code for Level 2
92	Security Code for Level 3
99	Enter System Security
TIME–CURRENT CURVE MODIFIERS	
100	Complex TCC1 (ON/OFF) - Phase and Ground
101	TCC1 Selection - Phase and Ground
102	TCC1 Constant Time Adder - Phase and Ground
103	TCC1 Multiplier Value - Phase and Ground
104	TCC1 Minimum Response Time - Phase and Ground
110	Complex TCC2 (ON/OFF) - Phase and Ground
111	TCC2 Selection - Phase and Ground
112	TCC2 Constant Time Adder - Phase and Ground
113	TCC2 Multiplier Value - Phase and Ground
114	TCC2 Minimum Response Time - Phase and Ground
SENSITIVE GROUND/EARTH FAULT	
120	Sensitive Ground/Earth Fault (ON/OFF)
121	Percent of Ground Minimum Trip
122	Percent of Alternate Ground Minimum Trip
123	Sensitive Ground/Earth Trip Time
124	Operations to Lockout
125	Sensitive Ground/Earth Fault Status
HIGH-CURRENT TRIP	
130	High-Current Trip - Phase (ON/OFF)
131	High-Current Trip - Ground (ON/OFF)
132	High-Current Trip (Multiple of Minimum Trip)-Phase and Ground
133	High-Current Trip (Trip Time Delay) - Phase and Ground
134	High-Current Trip (Active Shot Number)- Phase and Ground
HIGH-CURRENT LOCKOUT	
140	High-Current Lockout - Phase (ON/OFF)
141	High-Current Lockout - Ground (ON/OFF)
142	High-Current Lockout (Multiple of Minimum Trip) - Phase and Ground
143	High-Current Lockout (Active Shot Number)-Phase and Ground
CLOCK	
* 153	Time Clock - Year
* 154	Time Clock - Month and Day
* 155	Time Clock - Hour and Minute
* 156	Time Clock - Second
EVENT RECORDER	
160	Number of Events Since Last Reset
161	Event Number
162	Event Type
163	Month and Day
164	Hour and Minute
165	Second
166	Ground Current
167	Phase 1-2 Current
168	Phase 3-4 Current
169	Phase 5-6 Current
DUTY CYCLE MONITOR	
* 170	100% Duty Factor
171	Phase 1-2 Duty Cycle
172	Phase 3-4 Duty Cycle
173	Phase 5-6 Duty Cycle
LOAD PROFILE MONITOR	
180	Reading Number
181	Time - Hour and Minute
182	Ground Current
183	Phase 1-2 Current
184	Phase 3-4 Current
185	Phase 5-6 Current
SWITCH MODE	
190	Active TCC Selection
191	Minimum Target Sensing, Phase and Ground
192	Alternate Minumum Trip Target Sensing, Phase and Ground

ACCESSORY ACCESS CODES AND PARAMETERS

Table 3 is a list of the access codes for the firmware accessories available for the Form 4C control. A detailed list of program settings, parameter descriptions, and keyboard access codes appears in the *Access Code Description* section of this manual. Access codes and parameter descriptions can also be found on the control information label located inside the cabinet door.

The Form 4C control has numerous firmware accessories available to provide the user with new alternatives for improving the performance of the distribution system.

The firmware accessories include not only new functional firmware, but also additional hardware and operation with KSPS2 Interface software Version 4.0. Each firmware accessory includes local operation via a toggle switch, LED indication of the status, and an LED test pushbutton. Access codes interrogated via the front panel keypad are also available for status.

The firmware accessories include the Optional Universal I/O board as part of the design for access to the CPU, control points, and status points. Each status point is available via a single-pole, double-throw contact.

Serial communications are also included for all the available firmware accessories and documented in Reference Information *R280-90-11 Communications Point Data Base for Digital Communications Protocol Data 2179*.

The CPU firmware (Access Code 72) varies based upon the functionality required. Table 2 lists the values for Protocol 2179.

TABLE 2
CPU Firmware Accessories

Firmware Accessory	CPU Firmware (Access Code 72) Protocol 2179					
	8.15	**9.15**	**10.15**	**11.15**	**12.15**	**13.15**
Hot Line Tag	✓	✓	✓			
Trip On TCC2			✓	✓		✓
Sensitive Ground/Earth Fault ON/OFF		✓			✓	✓
Switch Mode	✓			✓	✓	

TABLE 3
Form 4C Control Accessory Access Codes

ACCESS CODE	PARAMETER	ACCESS CODE	PARAMETER
STATUS CODES		**SWITCH MODE**	
63	Hot Line Tag (HLT) Status	190	TCC Selection
64	Switch Mode Status	191	Minimum Target Sensing
68	Trip on TCC2 Status	192	Alternate Minimum Target Sensing
125	Sensitive Ground/Earth Fault Status		

ACCESS CODE DESCRIPTIONS

Access codes, parameter descriptions, and security levels used in programming the Form 4C control are listed in this section of the programming guide. The high and low limits and increments of the code parameter values are also specified.

The control is furnished with indicated factory settings. These settings are not recommended for customer use. The control must be programmed with applicable settings prior to installation.

Programming

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
01	**1**	**0**	**YES**	**1600**	**50**	**1**	**Minimum Trip - Phase**	**100**
01	**1**	**0**	**YES**	**800**	**5**	**1**	**Minimum Trip - Ground**	**50**

- Minimum trip is a threshold value at which a system overcurrent is detected.
- Minimum Trip is set for both phase and ground through a range of settings based on the recloser's CT ratio.

  CT ratio 500:1 allows a range from 25 to 800 A phase and 2 to 400 A ground.

  CT ratio 1000:1 allows a range from 50 to 1600 A phase and 5 to 800 A ground.

  CT ratio 2000:1 allows a range from 100 to 2400 A phase and 10 to 1600 A ground.
- All values are adjusted in increments of 1.
- The control accepts only the values within the limits preset in the control. Attempts to enter other values results in a LO/HI message.
- Use the PHASE/GROUND key to select phase and ground.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
02	**1**	**0**	**YES**	**--**	**--**	**--**	**TCC1 - Phase**	**104**
02	**1**	**0**	**YES**	**--**	**--**	**--**	**TCC1 - Ground**	**106**

- TCC is an abbreviation for time–current curve. A TCC is used as a protective response to initiate a trip signal when the minimum trip value (phase or ground) is exceeded.
- Identifies the programmed TCC1 - phase and ground curves selected from the TCC timing groups of the Form 4C control. (Reference Access Code 70). In most situations, TCC1 is designated as the fast curve.
- Time–current characteristics for TCC1 - phase are independent of time–current characteristics for TCC1 ground.
- Time–current characteristics of TCC1 - phase and ground are independent of time–current characteristics of TCC2 - phase and ground.
- When TCC characteristics are modified, the control readout indicates a modified curve by prefixing the TCC number with a lower-case *c* (Access Codes 100-114).

Programming (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
03	**1**	**0**	**YES**	**--**	**--**	**--**	**TCC2 - Phase**	**117**
03	**1**	**0**	**YES**	**--**	**--**	**--**	**TCC2 - Ground**	**135**

- TCC is an abbreviation for time–current curve. A TCC is used as a protective response to initiate a trip signal when the minimum trip value (phase or ground) is exceeded.
- Identifies the programmed TCC2 - phase and ground curves selected from the TCC timing groups of the Form 4C control. (Reference Access Code 70). In most situations, TCC2 is designated as the slow or delayed curve.
- Time–current characteristics for TCC2 - phase are independent of time–current characteristics for TCC2 ground.
- Time–current characteristics of TCC2 - phase and ground are independent of time–current characteristics of TCC1 - phase and ground.
- When TCC characteristics are modified, the control readout indicates a modified curve by prefixing the TCC number with a lower-case *c* (Access Codes 100-114).

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
04	**1**	**0**	**YES**	**4**	**0**	**1**	**Operations on TCC1 - Phase**	**2**
04	**1**	**0**	**YES**	**4**	**0**	**1**	**Operations on TCC1 - Ground**	**2**

- Selection of zero to four trip operations on TCC1.
- Time–current characteristics for phase are independent of TCC characteristics for ground. The number of phase and ground TCC1 operations do not have to match.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
05	**1**	**0**	**YES**	**4**	**1**	**1**	**Operations to Lockout - Phase**	**4**
05	**1**	**0**	**YES**	**4**	**1**	**1**	**Operations to Lockout - Ground**	**4**

- Lockout is a control state with no further automatic recloses.
- Selection of one to four trip operations before the control locks out.
- The number of operations to lockout for phase and ground do not have to match.
- Use PHASE/GROUND key to select phase or ground.

Programming (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
06	**1**	**0**	**YES**	**180**	**3**	**1**	**Reset Time (seconds)**	**30**

- Reset timing begins after a successful reclose operation.
- Successful reclose is determined when the recloser is closed and the current sensed is below the minimum trip values (phase and ground).

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
07	**1**	**0**	**YES**	**45.0**	**0.3**	**0.1**	**Reclose #1 (seconds)**	**2**

- Reclose #1 is the open time duration after the first trip operation prior to automatic reclosing.
- Selects the reclose interval after the first trip operation.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
08	**1**	**0**	**YES**	**45.0**	**1.8**	**0.1**	**Reclose #2 (seconds)**	**2**

- Reclose #2 is the open time duration after the second trip operation prior to automatic reclosing.
- Selects the reclose interval after the second trip operation.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
09	**1**	**0**	**YES**	**45.0**	**1.8**	**0.1**	**Reclose #3 (seconds)**	**5**

- Reclose #3 is the open time duration after the third trip operation prior to automatic reclosing.
- Selects the reclose interval after the third trip operation.

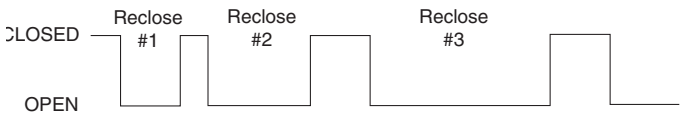


Figure 5.
Typical four trips to lockout operation. Fault current initiated with recloser closed.

Programming (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
10	**1**	**0**	**NO**	**2000**	**500**	**--**	**CT Selection**	**1000**

- Programs the control to operate with a recloser current transformer ratio of 500:1, 1000:1, or 2000:1.
- Select 500 / 1000 / 2000 using the CHANGE key.
- Verify recloser current transformer ratio matches programmed setting.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
11	**1**	**0**	**YES**	**1600**	**50**	**1**	**Alternate Minimum Trip (Amps) - Phase**	**120**
11	**1**	**0**	**YES**	**800**	**5**	**1**	**Alternate Minimum Trip (Amps) - Ground**	**60**

- Sets an alternate minimum trip value for both phase and ground through a range of settings based on programmed CT selection (Access Code 10).

  CT ratio 500:1 allows a range from 25 to 800 A phase and 2 to 400 A ground.

  CT ratio 1000:1 allows a range from 50 to 1600 A phase and 5 to 800 A ground.

  CT ratio 2000:1 allows a range from 100 to 2400 A phase and 10 to 1600 A ground.
- Alternate Minimum Trip is turned on and off via the ALTERNATE MINIMUM TRIP switch on the front panel.
- Alternate Minimum Trip is available using the ALTERNATE MINIMUM TRIP front panel switch or through supervisory control.
- Setting the alternate minimum trip values equal to the values in Access Code 01, disables Access Code 11.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
12	**1**	**0**	**YES**	**60**	**0**	**1**	**Supervisory Close Reset Time (seconds)**	**30**

- Programs the time interval during which the control is set for one trip to lockout on TCC2. This occurs following a supervisory close signal (discrete SCADA or digital communications).
- If programmed for zero seconds, the control performs the normal programmed sequence.
- At the end of this time interval, the control returns to its normal programmed sequence.

Phase Identification

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
17	**1**	**0**	**NO**	**--**	**--**	**--**	**Bushings 1-2 Phase Identifier**	**A**
18	**1**	**0**	**NO**	**--**	**--**	**--**	**Bushings 3-4 Phase Identifier**	**B**
19	**1**	**0**	**NO**	**--**	**--**	**--**	**Bushings 5-6 Phase Identifier**	**C**

- Select phase target identification as A, B, C or 1, 2, 3 using the CHANGE key.
- Targets are examined via Access Code 30.

Feature ON/OFF

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
20	**1**	**0**	**YES**	**--**	**--**	**--**	**Sequence Coordination (ON/OFF)**	**ON**

- Select Sequence Coordination ON and OFF using the CHANGE key.
- Sequence Coordination automatically advances the control sequence one step if both of the following conditions are met:
  - **a.** Line current exceeds the programmed minimum trip value for a time duration shorter than the programmed control response time. No trip signal is issued.
  - **b.** The control is programmed for at least one operation on TCC1.
- Sequence Coordination will not advance the control for those operations programmed for TCC2.
- The Sequence Coordination feature operates for both phase and ground faults; however, its program of advancing the sequence position is controlled only by the setting of Phase TCC1. If the control is programmed for all operations on TCC1, the sequence coordination feature is not operative on the last operation. The feature will not advance the control if advancing produces lockout.
- If non-reclosing is activated, the Sequence Coordination feature is disabled.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
21	**1**	**0**	**YES**	**--**	**--**	**--**	**Target Reset After Successful Reclose (ON/OFF)**	**ON**

- Select the Target Reset feature ON and OFF via the CHANGE key.
- Fault targets may be reset automatically after a successful reclose (see Access Code 06) or manually reset via the CLEAR key.
- With the feature ON, targets are displayed only when the control is in the lockout position.
- With the feature OFF, targets are displayed only after the control has initiated a trip signal independent of any reclosing.

Features ON/OFF (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
22	**1**	**0**	**YES**	**--**	**--**	**--**	**Operations Counter (ON/OFF)**	**ON**

- With the feature ON, the total number of control trip operations is recorded.
- Select Operations Counter ON or OFF using the CHANGE key.
- The Operations Counter automatically returns to the ON position when the front display is OFF.
- Control trip operations are initiated via manual operation of the pistol-grip switch on the front panel or through automatic or supervisory operation (Access Code 39).

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
23	**1**	**0**	**YES**	**--**	**--**	**--**	**Event Recorder (ON/OFF)**	**ON**

- With the feature ON, the event recorder records event history information of up to 50 events, including time, date, and current levels on all three phases and ground (Access Codes 160 through 169).
- The Event Recorder automatically returns to the ON position when the front display is OFF.
- Select Event Recorder ON or OFF using the CHANGE key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
24	**1**	**0**	**YES**	**--**	**--**	**--**	**Recloser Duty Monitor (ON/OFF)**	**ON**

- With feature ON, the recloser duty is recorded for each individual phase (Access Codes 170 through 173).
- The Recloser Duty Monitor automatically returns to the ON position when the front display is OFF.
- Select Recloser Duty Monitor ON or OFF using the CHANGE key.

Features ON/OFF (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
25	**1**	**0**	**YES**	**--**	**--**	**--**	**Ground Trip Precedence (ON/OFF)**	**ON**

- **Ground Trip Precedence ON:** For all faults above the programmed ground minimum trip level, the number of operations to lockout equals the programmed number of ground operations to lockout.
- Select Ground Trip Precedence ON or OFF using the CHANGE key.
- **Ground Trip Precedence OFF:** For all faults between the programmed ground minimum trip level and the programmed phase minimum trip level, the number of operations to lockout equals the programmed number of ground operations to lockout. For all faults above the programmed phase minimum trip level, the number of operations to lockout equals the programmed number of phase operations to lockout.

Sample application utilizing the Ground Trip Precedence feature. Table 4 and Figure 6 reference the following settings:

Minimum Trip - Phase (Access Code 01P) .....200 A
Minimum Trip - Ground (Access Code 01G) .....100 A
TCC1 - Phase (Access Code 02P).....103
TCC1 - Ground (Access Code 02G) 101
TCC2 - Phase (Access Code 03P).....133
TCC2 - Ground (Access Code 03G) 135
Operations on TCC1 - Phase (Access Code 04P) 2
Operations on TCC1 - Ground (Access Code 04G)....1
Operations to Lockout - Phase (Access Code 05P)....4
Operations to Lockout - Ground (Access Code 05G)..2

TABLE 4
Trip sequence to lockout for a ground fault.

Fault Current Level	Ground Trip Precedence ON	Ground Trip Precedence OFF
100 - 200 A	101, 135	101, 135
200 - 818 A	101, 103	101, 103, 135, 135
818 - 1690 A	101, 103	101, 103, 133, 133
1690A and above	103, 103	103, 103, 133, 133

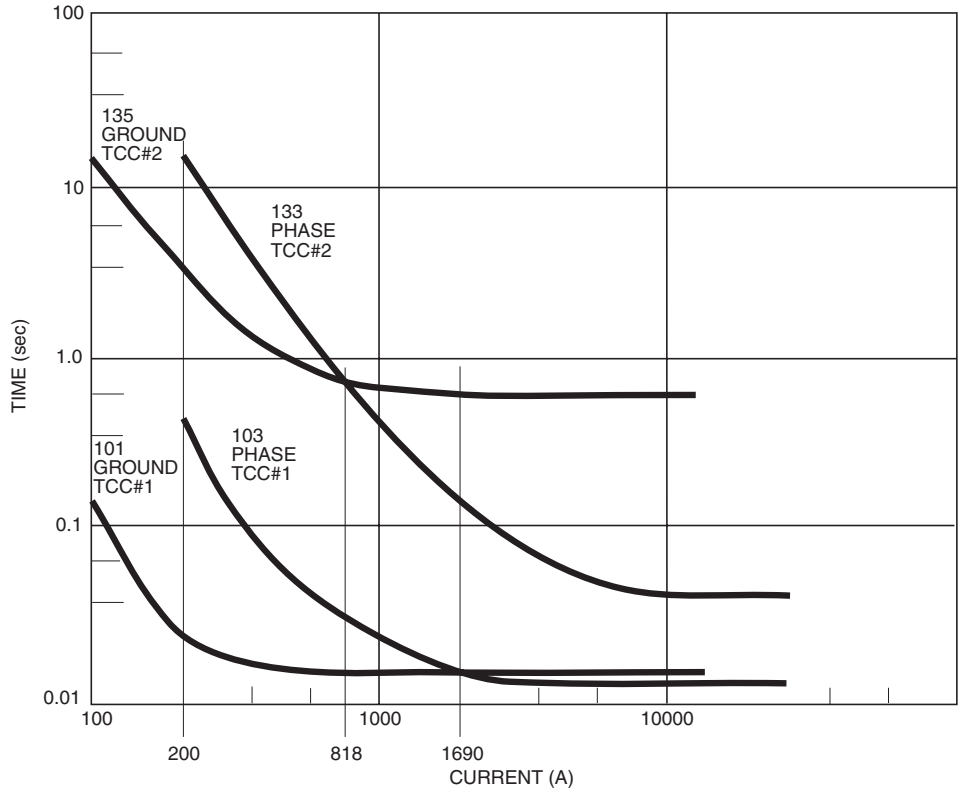


Figure 6.

Ground Trip Precedence Feature.

Features ON/OFF (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
26	**1**	**0**	**YES**	**--**	**--**	**--**	**Supervisory Via Momentary Contact (ON/OFF)**	**OFF**

- With feature ON, supervisory operation is provided with a momentary-pulse contact instead of a maintained contact. If maintained contacts are used with the feature ON, the maintained contacts must be pulsed to obtain the appropriate supervisory function.
- Select Supervisory Via Momentary Contact ON/OFF using the CHANGE key.
- For Loop Scheme (LS) applications (CPU Firmware Version 14.XX), the Supervisory via Momentary Contact cannot be changed.

Targets

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
30	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Examine Targets**	**--**
32	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Examine Target Counter - Ground**	**--**
33	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Examine Target Counter - Phase 1-2**	**--**
34	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Examine Target Counter - Phase 3-4**	**--**
35	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Examine Target Counter - Phase 5-6**	**--**
36	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Examine Target Counter - Sensitive Ground/Earth Fault**	**--**

- Targets indicate which phase(s)/ground was above minimum trip when tripping occurred.
- Press the TARGET key to display the faulted phase(s)/ground.
- Pressing the TARGET COUNTER key the first time displays the cumulative number of ground trip operations. Continuous scrolling with the TARGET COUNTER key advances the display to show the cumulative number of trip operations for each phase and Sensitive Ground/Earth Fault.
- When the Sensitive Ground/Earth Fault feature is ON, the Target Display is altered to distinguish between sensitive ground/earth fault trips and normal ground fault trips. The ground fault portions of the display shows an *E* for sensitive earth fault operation and *G* for normal ground fault operation.
- Reset with CLEAR key.

Sequence Position

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
38	**--**	**0**	**NO**	**--**	**--**	**--**	**Sequence Position**	**--**

- Sequence position is used to verify proper sequencing of the control.
- Displays a readout of the control position in the operations-to-lockout sequence.
- Accessible from the keyboard with the SELECT LOWER FUNCTION and SEQUENCE POSITION key.

Operations Counter

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
39	**Reset 2**	**0**	**NO**	**--**	**--**	**--**	**Operations Counter**	**--**

- This key displays the total number of control trip operations.
- Accessible from the keyboard with OPERATIONS COUNTER key.
- Reset with CLEAR key.
- Control trip operations are initiated via manual operation of the pistol-grip switch on the front panel or through automatic or supervisory operation.

Metering

Using standard sensing current transformers mounted within Kyle electronically controlled reclosers, current metering data is shown on the control panel LCD display, eliminating the need for separate meters and bushing current transformers.

Current metering in the Form 4C control monitors (in rms A):

- Instantaneous current values.
- Phase demand current values integrated over a programmable time interval of 5 or 15 minutes.
- Ground demand current values integrated over a programmable time interval of 1 or 5 minutes.
- Maximum demand current (drag-hand function) values for phase and ground.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
40	**--**	**0**	**NO**	**--**	**--**	**--**	**Instantaneous Current - Ground (A)**	**--**
41	**--**	**0**	**NO**	**--**	**--**	**--**	**Instantaneous Current - Phase 1-2**	**--**
42	**--**	**0**	**NO**	**--**	**--**	**--**	**Instantaneous Current - Phase 3-4**	**--**
43	**--**	**0**	**NO**	**--**	**--**	**--**	**Instantaneous Current - Phase 5-6**	**--**

- Indicates the instantaneous line currents for all phases and ground.
- After interrogating any of these four access codes, use the CURRENT METERING key to scroll to the other current parameters.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
44	**--**	**0**	**NO**	**--**	**--**	**--**	**Demand Current- Ground (A)**	**--**
45	**--**	**0**	**NO**	**--**	**--**	**--**	**Demand Current- Phase 1-2**	**--**
46	**--**	**0**	**NO**	**--**	**--**	**--**	**Demand Current- Phase 3-4**	**--**
47	**--**	**0**	**NO**	**--**	**--**	**--**	**Demand Current- Phase 5-6**	**--**

- Indicates the demand currents for all phases and ground.

Metering (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
48	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Maximum Demand Current - Gnd (A)**	**--**
49	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Maximum Demand Current - Phase 1-2**	**--**
50	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Maximum Demand Current - Phase 3-4**	**--**
51	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Maximum Demand Current - Phase 5-6**	**--**

- Indicates the maximum demand current for all phases and ground.
- Reset with CLEAR key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
57	**1**	**0**	**NO**	**15**	**5**	**--**	**Select Integration Interval - Phase (5 or 15 minutes)**	**5**
57	**1**	**0**	**NO**	**5**	**1**	**--**	**Select Integration Interval - Ground (1 or 5 minutes)**	**1**

- Changes integration time value of demand metering.
- Use PHASE/GROUND key to select phase or ground integration intervals.
- Select Integration Interval using the CHANGE key.

Status Codes

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
63	**--**	**0**	**NO**	**--**	**--**	**--**	**Hot Line Tag (HLT) Status**	**--**

- Applicable to controls with CPU Firmware versions 8.XX, 9.XX, and 10.XX only.
- Indicates ON or OFF status of Hot Line Tag.
- Hot Line Tag is selected either by the front panel HOT LINE TAG switch or from supervisory control.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
64	**--**	**0**	**NO**	**--**	**--**	**--**	**Switch Mode Status**	**--**

- Applicable to controls with CPU Firmware 8.XX, 11.XX, and 12.XX only.
- Indicates the ON or OFF status of the Switch Mode feature. When the front panel switch is in the RECLOSER MODE position, the switch mode is OFF.
- Switch Mode is selected by the front panel RECLOSER MODE/SWITCH MODE switch or from supervisory control.

Status Codes (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
65	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Accessory Status Codes** **1 - High Current Lockout** **2 - Remote Trip and Lockout** **3 - Supervisory Trip and Lockout**	**--**

- Identifies the specific operation as indicated by the Accessory Operation LCD indicator on the control panel.
- Reset with CLEAR key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
67	**--**	**0**	**NO**	**--**	**--**	**--**	**Alternate Minimum Trip Status**	**--**

- Indicates ON or OFF status of Alternate Minimum Trip.
- Alternate Minimum Trip is selected either by the front panel ALTERNATE MINIMUM TRIP switch or from supervisory control.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
68	**--**	**0**	**NO**	**--**	**--**	**--**	**Trip On TCC2 Status**	**--**

- Appicable to controls with CPU Firmware versions 10.XX, 11.XX, and 13.XX only.
- Indicates the ON or OFF status of Trip on TCC2.
- Trip On TCC2 is selected either by the front panel TRIP ON TCC2 switch or from supervisory control.

Malfunction Code

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
66	**Reset 0**	**0**	**NO**	**--**	**--**	**--**	**Malfunction Status** **1 - Failure to close from a supervisory signal** **2 - Low or high battery voltage** **3 - Power down in less than 48 hours on battery power** **4 - Failed to close from the manual control switch** **5 - Internal diagnostic alarm**	**--**

- Identifies the specific malfunction as indicated by the Malfunction LCD indicator on the control panel.
- Reset with CLEAR key.

TCC Group

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
70	**1**	**0**	**NO**	**4**	**1**	**1**	**TCC Group**	**1**

- Selects any one of four time–current-curve groups.
- TCC's in only one timing group are available for programming at a time.
- Select TCC group using the CHANGE key.
- Display will shut off after a TCC group change.

The table below lists the TCC's for the Form 4C control and provides a cross-reference to the Form 3A control equivalents. The curves are arranged in four keyboard-accessible timing groups. Each timing group contains a selection of 21 TCC's.

Curves 200, 201, and 202 in timing group 4 match IEC curves normally described as inverse, very inverse, and extremely inverse, respectively. Time–current curves can also be selected and programmed via the data port or remotely through the digital communications accessory.

TABLE 5
Time–Current Curve Groups

Form 4C Timing Group†				Form 3A Time–Current Curves	
				Ground	Phase
1	2	3	4	MEA216	MEA217
101	101	101	101		A
102	102	102	102	1	
111	111	111	111	8*	
135	135	135	135	2	
105	105	105	105		R
117	117	117	117		B
133	133	133	133		C
140	140	140	140	3	
116	116	116	116		D
132	132	132	132		E
104	104	104	104		N
142				13	
162					K
165				K	
106	106	106	106	4	
141			141	11	
131			131	9	
114			114	5	
136			136	6	
119			119	14	

Form 4C Timing Group†				Form 3A Time–Current Curves	
				Ground	Phase
1	2	3	4	MEA216	MEA217
138	138		138		W
	164				J
	118				M
	113			8	
	161				T
	152			7	
	163				F
	112			15	
	107				L
		103		17	
		115			P
		121			G
		122			H
		151		18	
		139		16	
		137			V
		134			Z
		120			Y
			200		
			201		
			202		

† All curves in groups are interchangeable for phase and ground.

Line Frequency

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
71	**3**	**0**	**NO**	**60**	**50**	**--**	**Line Frequency**	**60**

- Change the operating frequency from 50 to 60 Hz
- Select Line Frequency (50/60) using the CHANGE key.

Firmware Version / Control Identification

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
72	**--**	**0**	**NO**	**--**	**--**	**--**	**CPU Firmware Version**	**Y.XX***

***** Y represents the version of the CPU firmware:

.XX represents the protocol used.

EXAMPLE:

Y.14 represents CPU firmware with Protocol 2200.

Y.15 represents CPU firmware with Protocol 2179.

IMPORTANT: The version number suffix of the CPU and the Display firmware (Access Code 78) must be identical.

Firmware Version

8.XX includes Hot Line Tag (HLT) and Switch Mode
9.XX includes HLT and Sensitive Ground Fault (SGF)
10.XX includes HLT and Trip on TCC2 (TCC2)
11.XX includes Switch Mode and TCC2
12.XX includes Switch Mode and SGF
13.XX includes SGF and TCC2
14.XX Form 4C/LS Control
15.XX Standard Form 4C

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
76	**2**	**0**	**NO**	**9999**	**0**	**--**	**Control Identification Number**	**#**

Factory setting is the last four digits of the control serial number.

- If the identification number is changed, a record must be kept of the original serial number of the control. The serial number is required for any authorized service or repair work. The complete serial number appears on the nameplate located on the control cabinet.

Firmware Version / Control Identification (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
77	**--**	**0**	**NO**	**--**	**--**	**--**	**CPU Firmware Revision Number**	**--**

- Identifies the CPU firmware revision programmed into the control.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
78	**--**	**0**	**NO**	**--**	**--**	**--**	**Display Board Firmware Version**	**Z.XX**

- Z represents the latest version of the display board.

  .XX represents the protocol used.

  EXAMPLE:

  Z.14 represents display board firmware with Protocol 2200.

  Z.15 represents display board firmware with Protocol 2179.

IMPORTANT: The version number suffix of the CPU (Access Code 72) and the Display firmware must be identical.

Close / Retry

The Close/Retry feature is used to interrupt the closing signal to the recloser when closing power is lost.

If the recloser has not responded with a close operation, the control will turn off the reclose signal and go into the close/retry mode. The number of attempts is programmable from 1 to 5000 in increments of 1 via Access Code 79. In this mode, a close signal is initiated every 15 to 60 seconds via Access Code 74 for a duration of 100 cycles as long as the control is energized. If and when the recloser closes, it will continue to follow the programmed sequence of operations to lockout.

If the control is completely de-energized (no ac or dc power) while in the close/retry mode, it does not remember that it is in the close/retry mode upon re-energization. When the control is re-energized, it goes to the same state as the recloser. If the recloser is open, the control goes to lockout.

When the control and recloser are locked-out and the operator attempts to close the recloser either with the Manual Control Switch or via Supervisory Close, and the recloser closing power is not available, the control makes one attempt to close the recloser and then locks open. The control does not go into the close/retry mode. The front panel Malfunction LCD indicator is displayed. Access Code 66 can be interrogated to determine the malfunction.

The Close/Retry feature is only activated during reclose attempts after a trip operation. If closing power is lost after a trip operation, preventing a reclose operation, the control goes into the close/retry mode.

Operating the manual control switch to the trip position takes the control out of the close/retry mode and locks out the control. Operating the manual control switch while in the Close/Retry cycle will initiate a lockout command to the recloser.

With Close/Retry, the Block-of-Close feature is not required to provide device protection during low-voltage or loss-of-voltage conditions.

If closing power is not restored before the number of close/retry attempts (programmed through Access Code 79) is depleted, the control will lock out.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
74	**2**	**0**	**NO**	**60**	**15**	**1**	**Close Retry Time (seconds)**	**60**

- Set the interval of time between close-retry attempts from 15 to 60 seconds in increments of 1 second.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
79	**2**	**0**	**NO**	**5000**	**1**	**1**	**Number of Close Retry Attempts**	**10***

* Factory setting of 10 attempts on controls with serial numbers 214250 and above.

- Set the number of attempts the control will make to close the recloser before the control locks out.
- Up to 5000 attempts can be selected.

Digital Communications

Codes 81 through 86 establish control communication parameters for digital communications. The values vary based on the system application.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
80	**0**	**0**	**NO**	**4**	**1**	**1**	**Data Reader Port Baud Rate** **1 = 300** **2 = 1200** **3 = 2400** **4 = 4800***	**4**

- Baud rate is the number of bits per second of data that can be transferred.
- Shows the baud rate of the Data Reader Port.
- Baud rates are selectable through the keyboard.

***** Baud rate must be at 4 to communicate with the hand-held Data Reader.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
81	**0**	**0**	**NO**	**6**	**1**	**1**	**Real-Time Digital Communications Port Baud Rate** **1 = 300** **2 = 1200** **3 = 2400** **4 = 4800** **5 = 9600** **6 = 19200**	**2**

- Shows the baud rate of the real-time digital communications port.
- The baud rate code (1-6) must correspond to the baud rate of the system.
- Baud rates are selectable through the keyboard.
- Transmit speed always equals receive speed.
- Changes to the baud rate require re-energizing the control by first disconnecting the battery and ac power, followed by energizing the ac power and battery.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
82	**0**	**0**	**NO**	**200**	**0**	**1**	**Control Communications Address Protocol (2200)**	**1**
82	**0**	**0**	**NO**	**2046**	**0**	**1**	**Control Communications Address Protocol (2179)**	**1**

- Protocol 2200 permits up to 200 unique addresses on each party line, and provisions are also made for broadcasting messages to all controls simultaneously. Refer to *Reference Information R280-90-9* and *R280-90-10* for more information on Protocol 2200.
- Protocol 2179 permits unique address on each party line, and provisions are also made for broadcasting messages to all controls simultaneously. Refer to *Reference Information R280-90-11* and *R280-90-12* for more information on Protocol 2179.

Digital Communications (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
83	**0**	**0**	**NO**	**2**	**0**	**1**	**Real-Time Digital Communications Port Handshake (Transmit Disable Delay) Mode Code** **0 = None** **1 = Not Applicable** **2 = Modem Control (50 mS OFF)** **3 = Modem Control (0 mS OFF)** **4 = Modem Control (10 mS OFF)**	**2**

- The transmit/receive handshaking method allows adaptability of different types of communication system interfaces with the Form 4C control. When using modes 2 through 4, the handshake out signal is used as the transmit enable. The handshaking input signal is ignored.
- Code 83 and Code 85 affect the bandwidth and efficiency of the communication system. Adjusting Codes 83 through 85 to the minimum operable delays, maximizes the efficiency of the communication system.
- **Mode 0:** No handshaking signals. This mode is used for direct connection between the Form 4C and a personal computer. It may also be used with an RTU for point-to-point applications.
- **Mode 1:** Not applicable. Used for internal purposes only.
- **Mode 2:** Transmit Enable with 50 millisecond transmit disable delay. This is applicable to the three available interface cards: fiber optic, user-powered EIA-232, and 202T modem interface. Mode 2 is used where a transmit enable (push-to-talk) is required as part of the handshaking.

  Applications include using the transmit enable to key a radio along with using a fiber-optic ring. Transmit enable is required for control of the fiber-optic ring.
- **Mode 3:** Transmit Enable with 0 millisecond transmit disable delay. This application is identical to Mode 2 without transmit disable delay. Mode 3 is used for fiber optic applications where radio squelching is not a concern.
- **Mode 4:** Transmit Enable with 10 millisecond transmit disable delay. This application is identical to Mode 2 but with a 10 millisecond transmit disable delay. Depending on the communication equipment, a 10 millisecond transmit disable is adequate compared to 50 milliseconds in Mode 2 and results in a shorter bandwidth and improved efficiency.

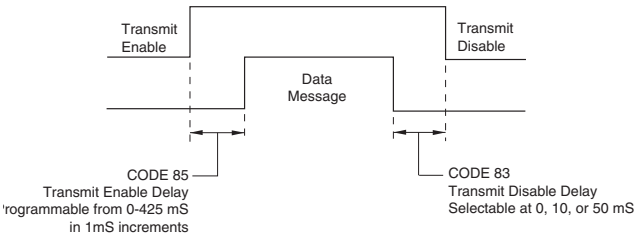


Figure 7.

Data transmission from the Form 4C control to the communication system for handshaking applications.

TABLE 6
Handshaking and Transmit Disable Delay Summary applicable to Access Code 83

Access Code 83 Handshake Mode	Handshaking	Transmit Disable Delay
0	No	Not Applicable
1	Not Applicable	Not Applicable
2	Yes	50 mS
3	Yes	0 mS
4	Yes	10 ms

Digital Communications (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
84	**0**	**0**	**NO**	**10**	**0**	**1**	**Number of Line Sync Characters**	**1**

- Defines the period of time the receive must idle to assume the start of a request message. Dead-line sync is used to determine the start of the request message. When used on a ring-configured or broadcast communication system, the control "hears" messages for devices at other nodes on the received data line. By reading the address, the control determines if the message is intended for it and ignores the remaining bytes if it is not.

  A period of time, during which the received data line is inactive, defines the end of the previous message. This inactive time is the dead-line sync period. The control is now synchronized so that the next byte received is considered the beginning of a new message.

  The value programmed is the equivalent number of characters that the receive line must remain inactive to be considered the end of a message. The control determines the actual time delay internally, taking into account baud rate and the number of bits in the character.

For example:

Baud = 4800

Dead-line sync character = 5 characters

Dead time = 5 characters x $^{10\ bits}/_{character}$* = 50 bits

50 bits ÷ $^{4800\ bits}/_{second}$ = 10.4 mS dead-line sync time

* $^{10\ bits}/_{character}$ applies to Protocol 2179, 8 data bits, 1 start bit, 1 stop bit.

$^{11\ bits}/_{character}$ applies to protocol 2200, 8 data bits, 1 start bit, 1 stop bit, 1 parity bit.

See Figures 8 and 9.

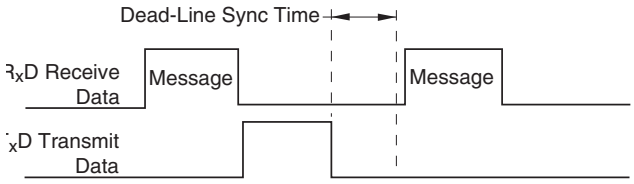


Figure 8.

Message received at Form 4C control; message is for the Form 4C control.

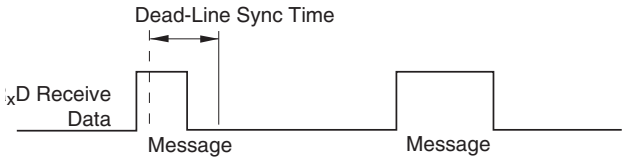


Figure 9.

Message received at Form 4C control; message is not for the Form 4C control.

Digital Communications (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
85	**0**	**0**	**NO**	**425**	**0**	**1**	**Communications Port Transmit Enable Delay (mS)**	**50**

- Defines the delay after the Transmit Enable signal is sent by the Form 4C control and before the transmission of the message. This allows for stabilization of the transmitter hardware before the message is actually sent.
- The value entered specifies the number of milliseconds that elapse before transmission begins. When a modem interface is used, a delay of 50 milliseconds is recommended. See Figure 7 under access Code 83.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
86	**0**	**0**	**NO**	**--**	**--**	**--**	**Auto Time-Tagged Reset (ON/OFF) (communications port buffer clear)**	**ON**

- Select Auto Time-Tagged Reset ON or OFF using the CHANGE key.
- ON position reports only data that occurred since the last time the event recorder or load profile was polled.
- OFF position reports the entire content of the event recorder and load profile regardless of the data previously downloaded.
- This change affects Protocol 2179 only through the communication serial port. This has no effect on the time-tagged buffers addressed by the front panel, via Code 161 (scroll) or via the Data Port (DB9).
- Reset via SCADA enabled if

  1) At least one event previously logged with Code 86 off,

  AND

  2) Code 86 is now one,

  AND

  3) a) The Supervisory Switch is ON

  AND/OR

  b) Code 77 is CPU Firmware Revision number is 14 or higher.

Security Codes

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
90	**3**	**3**	**NO**	**9999**	**0**	**1**	**Level 1 Security Access**	**1111**

- Level 1 permits modifications of standard operating parameters (those addressable on the keyboard) and most feature parameters.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
91	**3**	**3**	**NO**	**9999**	**0**	**1**	**Level 2 Security Access**	**2222**

- Level 2 permits modifications of special features.

IMPORTANT: Level 2 must only be accessible to personnel completely familiar with the special features.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
92	**3**	**3**	**NO**	**9999**	**0**	**1**	**Level 3 Security Access**	**3333**

- Level 3 permits permits changes of Security Levels 1, 2, and 3.
- Level 3 allows access to special operating features.

IMPORTANT: Level 3 must only be accessible to personnel completely familiar with the special features.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
99	**0**	**0**	**NO**	**--**	**--**	**--**	**Enter Security System**	**--**

- Permits entry into the security system.
- The security access number does not appear in the display.

Time–Current Curve Modifiers

The Form 4C control is equipped with 41 standard keyboard-selectable time–current curves, interchangeable for phase and ground TCC1 and TCC2.

Access codes 100 through 114 apply modifiers to the standard curves to assist in system coordination. A time–current curve modifier example is presented at the end of this section to illustrate the modifier options.

The methods of modification include:

- Constant Time Adder: Add a specific time to the selected TCC.
- Multiplier Value: Multiply the entire curve by a programmed value.
- Minimum Response Time Adder: Establish a minimum control response time independent of the selected TCC.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
100	**1**	**0**	**YES**	**--**	**--**	**--**	**Complex TCC1 Setup-Phase (ON/OFF)**	**OFF***
100	**1**	**0**	**YES**	**--**	**--**	**--**	**Complex TCC1 Setup-Ground (ON/OFF)**	**OFF***

- Allows for modification of TCC1.
- Use the PHASE/GROUND key to examine phase and ground.

* Default setting when TCC1 is changed from Access Code 02 (key 2).

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
101	**1**	**0**	**YES**	**--**	**--**	**--**	**TCC1 Selection-Phase**	**104**
101	**1**	**0**	**YES**	**--**	**--**	**--**	**TCC1 Selection-Ground**	**106**

- Allows the selection of a programmed, fast or delayed, time–current curve to be modified. In most situations, TCC1 is designated as a fast curve.
- Use the PHASE/GROUND key to select phase or ground TCC1.
- When TCC characteristics are modified, the readout of Code 02 will indicate a modified curve by prefixing the TCC with a lower case *c*.
- Access codes 101 or 02 can be used to examine TCC1.
- Changes to Access Code 101 automatically update Access Code 02.
- Changes to Access Code 02 automatically update Access Code 101.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
102	**1**	**0**	**YES**	**0.20**	**0.00**	**0.01**	**TCC1 Constant Time Adder-Phase (seconds)**	**0.00***
102	**1**	**0**	**YES**	**0.20**	**0.00**	**0.01**	**TCC1 Constant Time Adder-Ground (seconds)**	**0.00***

- Modifies the programmed TCC1 to delay the time of overcurrent trip.
- Use with the PHASE/GROUND key to modify phase or ground TCC1.

* Default setting when TCC1 is changed from Access Code 02 (key 2).

Time–Current Curve Modifiers (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
103	**1**	**0**	**YES**	**2.00**	**0.10**	**0.01**	**TCC1 Multiplier Value-Phase**	**1.00***
103	**1**	**0**	**YES**	**2.00**	**0.10**	**0.01**	**TCC1 Multiplier Value-Ground**	**1.00***

- Vertically shifts programmed TCC1 by applying a desired multiplier.
- Use with the PHASE/GROUND key to modify phase or ground TCC1.

* Default setting when TCC1 is changed from Access Code 02 (key 2).

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
104	**1**	**0**	**YES**	**42**	**0**	**1**	**TCC1 Minimum Response Time-Phase (cycles)**	**0***
104	**1**	**0**	**YES**	**42**	**0**	**1**	**TCC1 Minimum Response Time-Ground (cycles)**	**0***

- Allows modification of the programmed TCC1 by selecting a minimum response time in a range from 0 to 42 cycles.
- Use with the PHASE/GROUND key to modify phase or ground TCC1.

* Default setting when TCC1 is changed from Access Code 02 (key 2).

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
110	**1**	**0**	**YES**	**--**	**--**	**--**	**Complex TCC2 Setup-Phase (ON/OFF)**	**OFF***
110	**1**	**0**	**YES**	**--**	**--**	**--**	**Complex TCC2 Setup-Ground (ON/OFF)**	**OFF***

- Allows for modification of TCC2.
- Use the PHASE/GROUND key to examine phase and ground.

* Default setting when TCC2 is changed from Access Code 03 (key 3).

Time–Current Curve Modifiers (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
111	**1**	**0**	**YES**	**--**	**--**	**--**	**TCC2 Selection-Phase**	**117**
111	**1**	**0**	**YES**	**--**	**--**	**--**	**TCC2 Selection-Ground**	**135**

- Allows the selection of a programmed, fast or delayed, time–current curve to be modified. In most situations, TCC2 is designated as a delayed or slow curve.
- Use the PHASE/GROUND key to select phase or ground TCC2.
- When TCC characteristics are modified, the readout of Code 111 will indicate a modified curve by prefixing the TCC with a lower case "c".
- Access Codes 111 or 03 can be used to examine TCC2.
- Changes to Access Code 111 automatically update Access Code 03.
- Changes to Access Code 03 automatically update Access Code 111.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
112	**1**	**0**	**YES**	**0.20**	**0.00**	**0.01**	**TCC2 Constant Time Adder-Phase (seconds)**	**0.00***
112	**1**	**0**	**YES**	**0.20**	**0.00**	**0.01**	**TCC2 Constant Time Adder-Ground (seconds)**	**0.00***

- Modifies the programmed TCC2 to delay the time of overcurrent trip.
- Use with the PHASE/GROUND key to modify phase or ground TCC2.

***** Default setting when TCC2 is changed from Access Code 03 (key 3).

Time–Current Curve Modifiers (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
113	**1**	**0**	**YES**	**2.00**	**0.10**	**0.01**	**TCC2 Multiplier Value-Phase**	**1.00***
113	**1**	**0**	**YES**	**2.00**	**0.10**	**0.01**	**TCC2 Multiplier Value-Ground**	**1.00***

- Vertically shifts programmed TCC2 by applying a desired multiplier.
- Use with the PHASE/GROUND key to modify phase or ground TCC2.

* Default setting when TCC2 is changed from Access Code 03 (key 3).

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
114	**1**	**0**	**YES**	**42**	**0**	**1**	**TCC2 Minimum Response Time-Phase (cycles)**	**0***
114	**1**	**0**	**YES**	**42**	**0**	**1**	**TCC2 Minimum Response Time-Ground (cycles)**	**0***

- Allows modification of the programmed TCC2 by selecting a minimum response time in a range from 0 to 42 cycles.
- Use with the PHASE/GROUND key to modify phase or ground TCC2.

* Default setting when TCC2 is changed from Access Code 03 (key 3).

Time–Current Curve Modifiers (cont'd)

Modifications

In order to further enhance control flexibility and to offer an almost unlimited number of time–current curve selections, each TCC programmed into the Form 4C control can be modified vertically with a constant time adder (Access Codes 102 or 112), a multiplier value (Access Codes 103 or 113), or a minimum response time adder (Access Codes 104 or 114). By simple programming, the basic TCC shape can be designed to meet coordination requirements. Modified TCC's display a *c* prefix code when interrogated to let the operator know that the standard TCC is modified. The figures below provide examples of modification to the basic #133 curve.

Constant Time Adders

Constant time adders can be used to modify TCC characteristics. Programmable constant time adders are available from 0 to 0.2 seconds in 0.01 second increments. Refer to Access Codes 102 and 112 for interrogation and programming.

Vertical Translation Multiplier

Each phase and ground TCC can be shifted vertically using vertical multipliers. The available multipliers are 0.10 to 2.0 in increments of 0.01. Refer to Access Code 103 and 113 for interrogation and programming.

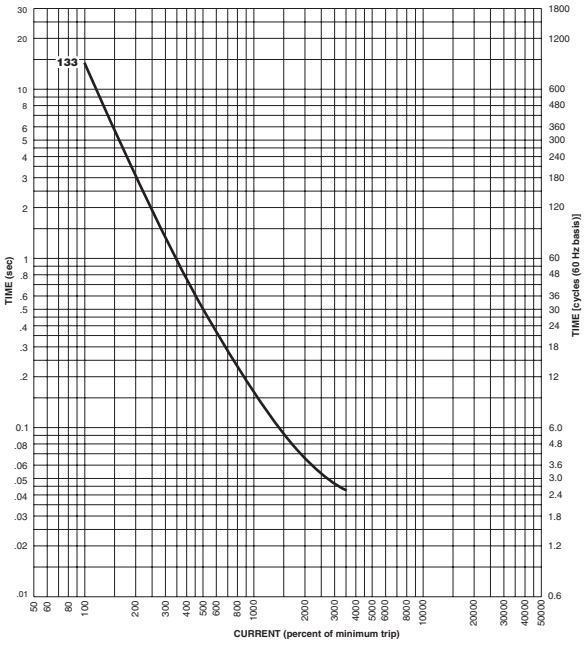


Figure 10.

Basic No. 133 Time–Current Curve (Control Response Time).

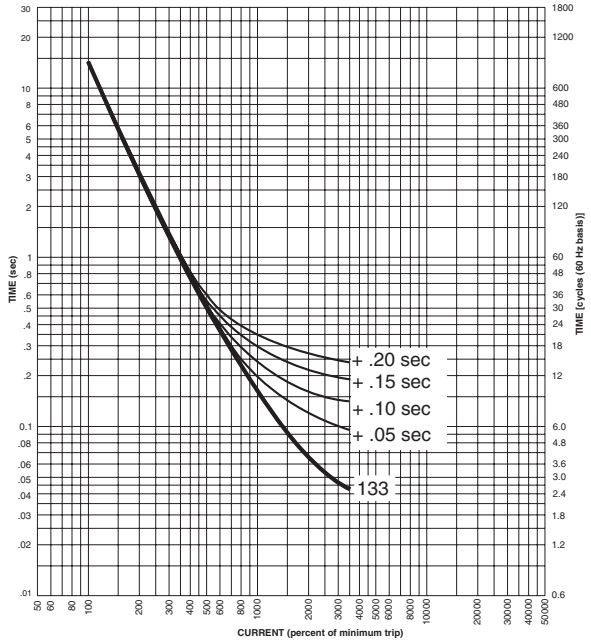


Figure 11.
TCC modification with Constant Time Adder (Control Response Time).

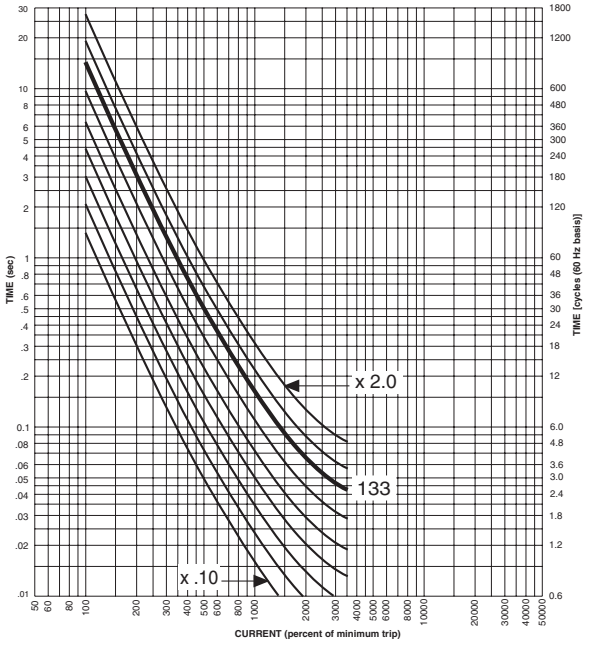


Figure 12.

TCC modification with Vertical Translation Multiplier (Control Response Time).

Time–Current Curve Modifiers (cont'd)

Modifications (cont'd)

Minimum Response Time

The #133 time–current curve can be modified by using a minimum response time setting as shown in Figure 13. The available range of programming minimum time settings is 0 through 42 cycles in 1 cycle increments. Refer to Access Codes 104 and 114 for interrogation and programming.

High-Current Trip

A basic TCC can be modified for high current trip (see Figures 14 and 15). The available range of programmable multipliers is from 1 through 30 times minimum trip in increments of 1. High-current trip also includes trip time delay with an available range of programmable delay times of 1 through 9 cycles in 1 cycle increments. Refer to Access Codes 130 and 134 for interrogation and programming.

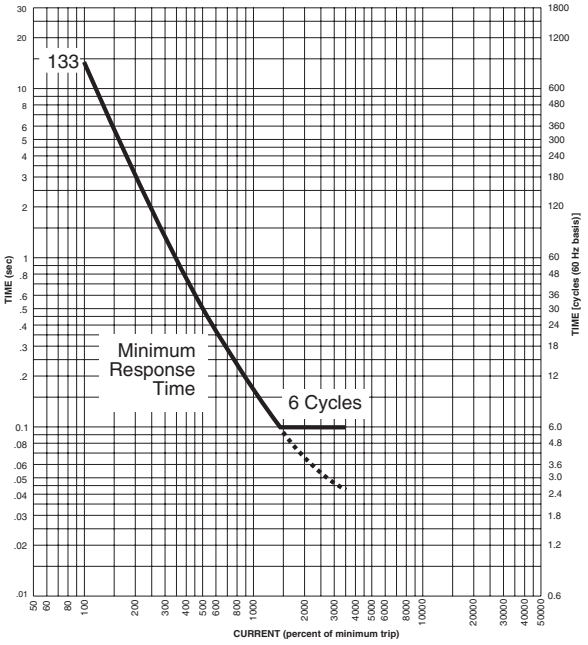


Figure 13.
TCC modification with Minimum Response Time (control response time).

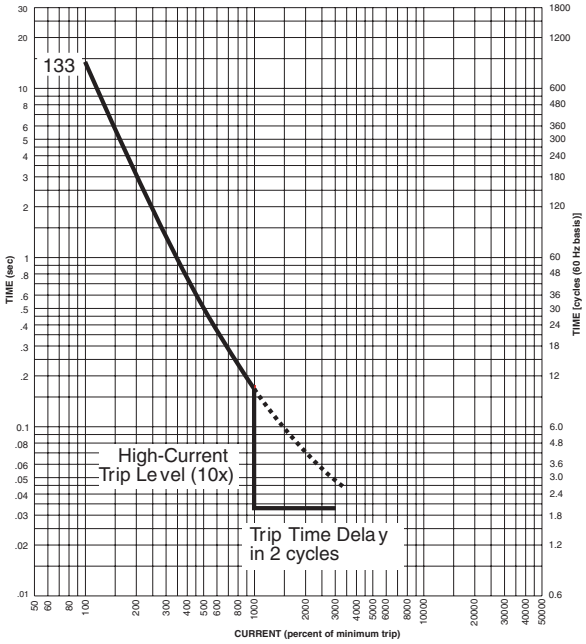
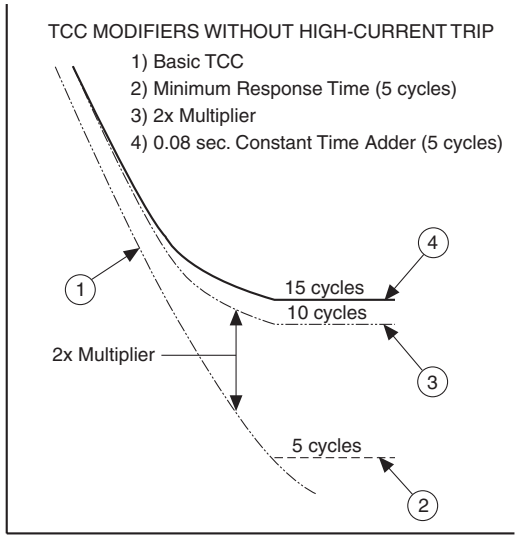


Figure 14.
TCC modification with High-Current Trip (control response time).



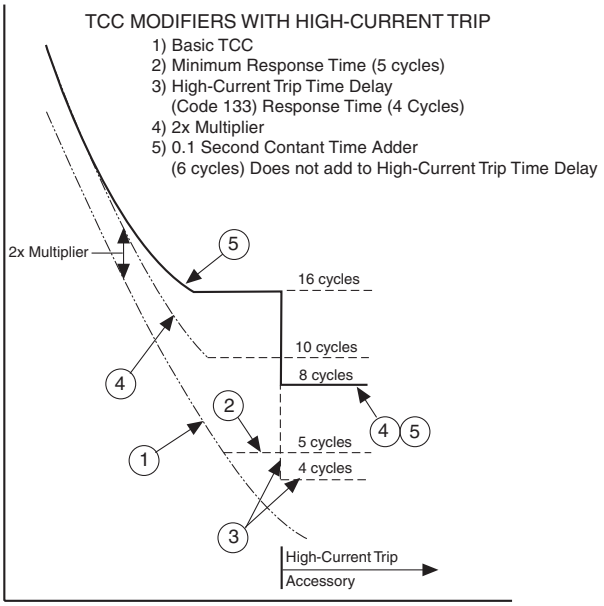


Figure 15.

Modified TCC's with and without the effects of high-current trip and show precedence when more than one modifier is used.

Time–Current Curves (cont'd)

Modifications (cont'd)

High-Current Lockout

Figure 17 shows an example of sequence modification as a result of High-Current Lockout. High-Current Lockout is available in multipliers of 1 to 30 in increments of 1. Refer to Access Codes 140 and 143 for interrogation and programming.

TCC Modification Limits

When modifying time–current curves, caution must be exercised so that the modified curve does not exceed the short-time current limits of the recloser. Consideration should be given to the High-Current Trip and Lockout features when programming very long timing curves with very high minimum trip values.

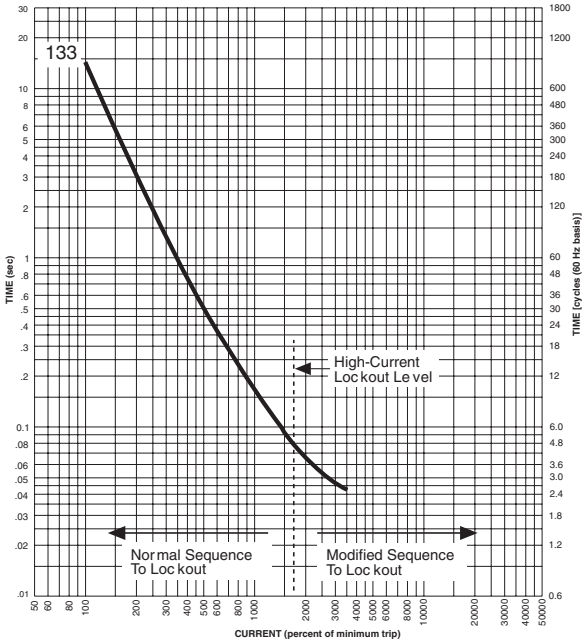


Figure 16.

TCC modification for High-Current Lockout.

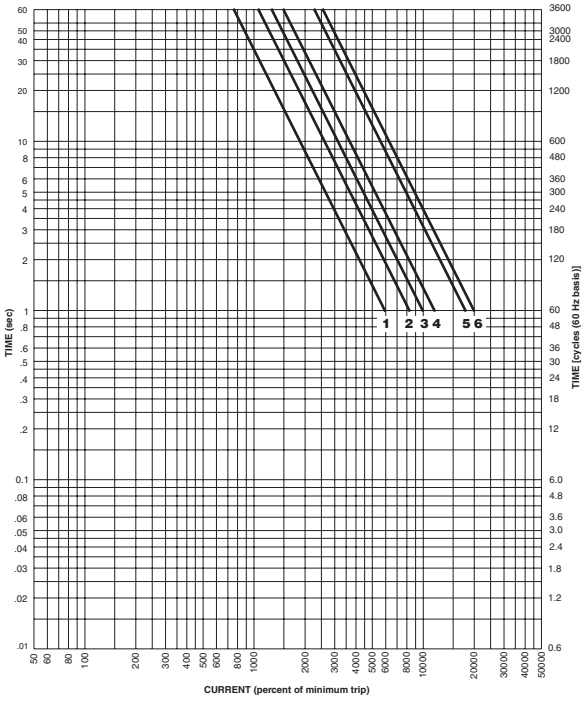


Figure 17.
Maximum recloser limits for TCC modification.

TABLE 7
Maximum Short-Time Recloser Limits

Recloser Type	Maximum Interrupting Rating (sym A)	Curve*
RXE, RVE	6000	1
WVE27, WVE38X	8000	2
WE	10000	3
VWE, VWVE27, VWVE38X	12000	4
VSA12, VSO12	12000	5
VSA16, VSO16	16000	5
VSA20, VSA20A, VSA20B	20000	6

*Curves are recloser short time currents for a single trip operation.

Sensitive Ground/Earth Fault

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
120	**1**	**0**	**YES**	**--**	**--**	**--**	**Sensitive Ground/Earth Fault (ON/OFF)**	**OFF**

- The Sensitive Ground/Earth Fault feature allows the Form 4C control to detect and have the recloser trip after a selectable, definite time, for ground (zero sequence) currents below normal ground minimum trip currents set with Access Code 01 Ground.
- When the Sensitive Ground/Earth Fault feature is ON, the target display (Access Code 30) is altered to distinguish between Sensitive Ground/Earth Fault trips and normal ground fault trips. The ground fault portion of the display will show an *E* for Sensitive Earth Fault operation and *G* for normal ground fault operation.
- Remote indication of targets is also altered when the Sensitive Ground/Earth Fault feature is ON. The remote targets normally indicate phase A, B, or C (alternatively 1, 2, or 3 - see access codes 17, 18, and 19); but with the Sensitive Ground/Earth Fault feature ON, the remote indications are phase, ground and sensitive ground in place of A, B, C (1, 2, or 3), respectively.
- The Sensitive Ground/Earth Fault feature is fully accessible and independently programmable by a digital communication link.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
121	**1**	**0**	**YES**	**100**	**10**	**1**	**Sensitive Ground/Earth Trip Level**	**100**

- Sensitive Ground/Earth Trip Level is set as a percentage of programmed ground minimum trip in the range of 10 to 100% in 1% increments with 3 A* as the minimum allowable trip value.
- Form 4C control logic will prevent changes in the percentage settings that would give a trip value below 3 amps. Under this condition, an LO message will appear in the display. Subsequent changes to the Ground/Earth Minimum Trip setting (Access Code 01 Ground) that cause the Sensitive Ground/Earth Trip to be less than 3 A are not accepted by the control and an LO message is displayed.

* The minimum allowable trip value is dependent on the CT ratio (Access Code 10):

2000:1 ratio, the minimum trip value is 6 A

1000:1 ratio, the minimum trip value is 3 A

500:1 ratio, the minimum trip value is 2 A

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
122	**1**	**0**	**YES**	**100**	**10**	**1**	**Alternate Sensitive Trip Level**	**100**

- Alternate Sensitive Trip Level has the same 3 A limitation as the normal Sensitive Trip Level. By programming the Alternate Sensitive Ground/Earth Trip to 100%, the Sensitive Ground/Earth Trip feature is disabled by the Alternate Minimum Trip Switch on the control front panel, by selecting supervisory alternate minimum trip on the Supervisory I/O accessory, or through digital communications.
- Form 4C control logic will prevent changes in the percentage settings that would give a trip value below 3 A. Under this condition, an LO message appears in the display. Subsequent changes to the Ground/Earth Minimum Trip setting (Access Code 01 Ground) that cause the Sensitive Ground/Earth Trip to be less than 3 A are not accepted by the control, and an LO message is displayed.

Sensitive Ground/Earth Fault (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
123	**1**	**0**	**YES**	**120**	**2**	**1**	**Definite Time to Trip (seconds)**	**120**

- This is the actual time at which the Sensitive Ground/Earth Fault feature will trip.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
124	**1**	**0**	**YES**	**4**	**1**	**1**	**Operations to Lockout**	**4**

- This is the number of trip operations to lockout caused by the Sensitive Ground/Earth Fault feature.
- The setting is independent of the Number of Operations to Lockout (Access Code 05) set for normal phase and earth trip operations.

IMPORTANT: Any combination of Sensitive Ground/Earth Fault and phase and ground operations will not exceed four operations to lockout.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
125	**--**	**0**	**NO**	**--**	**--**	**--**	**Sensitive Ground/Earth Fault Status**	**--**

- Applicable to controls with CPU Firmware versions 9.XX, 12.XX, and 13.XX only.
- Indicates the ON or OFF status of Sensitive Ground/Earth Fault.
- Sensitive Ground/Earth Fault is selected either by the front panel SGF switch or from supervisory control.

High-Current Trip

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
130	**1**	**0**	**YES**	**--**	**--**	**--**	**High-Current Trip - Phase (ON/OFF)**	**OFF**

- High-Current Tripping allows for tripping the recloser with a programmable constant time whenever fault current exceeds a programmed level.
- High-Current Tripping is used to modify the time current curve to allow for increased coordination with primary substation transformer protection or coordination with load side fusing.
- Trips a recloser at any current above the selected fault current level. Levels are set as multiples of the minimum trip (see Access Code 132).
- High-Current Trip-Phase is operable for phase or for phase and ground combined.
- Select High-Current Trip-Phase ON and OFF using the CHANGE key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
131	**1**	**0**	**YES**	**--**	**--**	**--**	**High-Current Trip - Ground (ON/OFF)**	**OFF**

- High-Current Tripping allows for tripping the recloser with a programmable constant time whenever fault current exceeds a programmed level.
- High-Current Tripping is used to modify the time–current curve to allow for increased coordination with primary substation transformer protection or coordination with load side fusing.
- Trips a recloser at any current above the selected fault current level. Levels are set as multiples of the minimum trip (see Access Code 132).
- High-Current Trip-Ground is operable for phase and ground combined. It does not operate for ground only.
- Select High-Current Trip-Ground ON and OFF using the CHANGE key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
132	**1**	**0**	**YES**	**30**	**1**	**--**	**High-Current Trip - Phase (Multiples of Minimum Trip)**	**30**
132	**1**	**0**	**YES**	**30**	**1**	**--**	**High-Current Trip - Ground (Multiples of Minimum Trip)**	**30**

- Sets the operating level (in multiples of minimum trip) at which the recloser will trip when the fault current is above the programmed level.
- Operating levels are separately selectable from 1 to 30, in increments of 1, for phase and ground trip.
- Use the PHASE/GROUND key to examine phase or ground.

High-Current Trip (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
133	**1**	**0**	**YES**	**9**	**1**	**--**	**High-Current Trip - Phase (cycles) (Trip Time Delay)**	**1**
133	**1**	**0**	**YES**	**9**	**1**	**--**	**High-Current Trip - Ground (cycles) (Trip Time Delay)**	**1**

- Time delays are selectable from 1 to 9 cycles, in increments of 1 cycle, based on 60 Hz. For 50 Hz systems, multiply the number of cycles by 0.83.
- The high-current trip time delay should be set faster than the normal time current curve. If the high-current trip is set slower, actual timings will be faster than the high-current trip time programmed.
- Use the PHASE/GROUND key to examine phase or ground.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
134	**1**	**0**	**YES**	**1-2-3-4**	**1**	**--**	**High-Current Trip - Phase (Active Trip Number)**	**0**
134	**1**	**0**	**YES**	**1-2-3-4**	**1**	**--**	**High-Current Trip - Ground (Active Trip Number)**	**0**

- Indicates on which trip operation High-Current Trip is active.
- Trip operations, on which High-Current Trip is active, are customer selectable, via the keyboard, for any combination in sequence (i.e., select 3, 4; or 1 only, 2 only; or 1, 2, 3, 4, etc.) .
- Use the PHASE/GROUND key to examine phase or ground.

High-Current Lockout

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
140	**1**	**0**	**YES**	**--**	**--**	**--**	**High-Current Lockout - Phase (ON/OFF)**	**OFF**

- High-Current Lockout allows for tripping the recloser with a programmable operating sequence whenever fault current exceeds a programmed level.
- High-Current Lockout is used to modify the operating sequence to allow for reduced through-faults on the substation transformer and connected equipment.
- Locks out a recloser at any current level above the selected fault current level. Levels are set as multiples of the minimum trip (Access Code 142)
- High-Current Lockout-Phase is operable for phase only.
- Select High-Current Lockout-Phase ON and OFF using the CHANGE key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
141	**1**	**0**	**YES**	**--**	**--**	**--**	**High-Current Lockout - Ground (ON/OFF)**	**OFF**

- High-Current Lockout allows for tripping the recloser with a programmable operating sequence whenever fault current exceeds a programmed level.
- High-Current Lockout is used to modify the operating sequence to allow for reduced through-faults on the substation transformer and connected equipment.
- Locks out a recloser at any current above the selected fault current level. Levels are set as multiples of the minimum trip (Access Code 132).
- High-Current Lockout is operable for phase and ground combined. It does not operate for ground only.
- Select High-Current Lockout-Ground ON and OFF using the CHANGE key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
142	**1**	**0**	**YES**	**30**	**1**	**1**	**High-Current Lockout - Phase (Multiples of Minimum Trip)**	**30**
142	**1**	**0**	**YES**	**30**	**1**	**1**	**High-Current Lockout - Ground (Multiples of Minimum Trip)**	**30**

- Sets the operating level (in multiples of minimum trip) at which the operating sequence is modified when the fault current is above the programmed level.
- Operating levels are separately selectable from 1 to 30, in increments of 1, for phase and ground trip.
- Use the PHASE/GROUND key to examine phase or ground.

High-Current Lockout (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
143	**1**	**0**	**YES**	**4**	**1**	**--**	**High-Current Lockout - Phase (Active Trip Number)**	**4**
143	**1**	**0**	**YES**	**4**	**1**	**--**	**High-Current Lockout - Ground (Active Trip Number)**	**4**

- Indicates on which trip operation the high-current lockout is active.
- Use PHASE/GROUND key to examine phase and ground.

Clock

When the Form 4C control is first energized, the clock default date is January 1, 2001 (1/1/2001). The clock must be set to the proper date and time for the events to be properly recorded. (Refer to *Setting The Control Clock* section of this manual.)

IMPORTANT: Overcurrent protection is independent of the clock and will respond correctly regardless of the clock status.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
153	**0**	**0**	**NO**	**2088**	**1989**	**1**	**Set Time Clock - Year**	**2001**

- Enter the four digits of the current year.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
154	**0**	**0**	**YES**	**12.31**	**1.01**	**1.1**	**Set Time Clock - Month . Day**	**1.01**

- Enter the month to the left and the day to the right of the decimal point.
- If the number of the day is a single digit, the digit must be preceded by a zero.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
155	**0**	**0**	**YES**	**23:59**	**0:0**	**0:01**	**Set Time Clock - Hour : Minute**	**1:01**

- Enter the hour and minutes based on 24-hour notation.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
156	**0**	**0**	**YES**	**:59**	**:00**	**:01**	**Set Time Clock - Seconds**	**:00**

- If the number of seconds is a single digit, the digit is preceded by a zero.

Event Recorder

The Event Recorder provides detailed, time-related data for system analysis. Event recorder data will indicate time-tagged current values for eighteen different event types. The event types (Access Code 162) identify the fault history for numerous applications in operation and analysis of the distribution feeder.

Below is sample data from the event recorder. The access codes are referenced under the appropriate heading.

TABLE 8
Event Recorder Sample Data

Event # (161)	Event Type (162)	Month.Day (163)	Hour:Min (164)	Second (165)	CURRENT (kA)			
					Ground (166)	Phase Bushing 1-2 (167)	Phase Bushing 3-4 (168)	Phase Bushing 5-6 (169)
1	2	2.17	14:20	:40	0.02	0.16	0.15	0.17
2	1	2.17	14:20	:08	2.80	0.16	0.15	2.80
3	1	2.17	14:20	:06	2.80	0.16	0.15	2.80
4	3	2.08	10:24	:15	0.00	0.00	0.00	0.00
5	1	2.08	9:21	:12	1.30	0.13	1.30	0.14
6	1	2.08	9:21	:07	1.30	0.13	1.30	0.14
7	1	2.08	9:21	:05	1.30	0.13	1.30	0.14
8	1	2.08	9:21	:03	1.30	0.13	1.30	0.14
9	2	2.03	14:40	:49	0.02	0.15	0.15	0.16
10	1	2.03	14:40	:16	2.40	2.40	0.15	0.16
11	1	2.03	14:40	:14	2.40	2.40	0.15	0.16
12	2	2.03	14:38	:40	0.02	0.15	0.15	0.17
13	1	2.03	14:37	:08	2.80	0.16	0.15	2.80

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
160	**Reset 1**	**0**	**NO**	**50**	**1**	**1**	**No. of Events Since Last Reset**	**--**

- Feature is enabled or disabled per Access Code 23 (ON/OFF).
- Displays the number of events that have occurred since the last time Access Code 160 was reset to zero.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
161	**0**	**0**	**NO**	**50**	**1**	**1**	**Event Number**	**--**

- Upon entry of Access Code 161, Event 1 will appear. For a specific event, press the CHANGE key and enter the event number.
- Key-in the event number for direct event interrogation.
- The Form 4C control stores the 50 most recent events.
- Data for a specific event is accessed using the SCROLL key.

Event Recorder (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
162	**--**	**0**	**YES**	**--**	**--**	**--**	**Event Type**	**--**

- Access Code 162 identifies the type of event indicated by the event number of Access Code 161.
- Access Code 162 can only be accessed from Access Code 161 using the SCROLL key.

***** Available only to control firmware versions that have these features.

Event Type:

1 - Overcurrent Trip
2 - Reset
3 - Close (Manual Control Switch)
4 - Close (Supervisory)
5 - Lockout (Manual Control Switch)
6 - Lockout (Remote)
7 - Lockout (Supervisory)
8 - Trip (Supervisory or Manual)
9 - Loss of ac Power (2-minute minimum)
10 - Restoration of ac Power (.03 seconds)
11 - Sequence Coordination
12 - Sensitive Ground/Earth Fault Trip
13 - Close Retry Lockout
14* - Fault Target (Switch Mode)
15* - Switch Mode
16* - Recloser Mode
17 - Recloser Manual Lockout (yellow handle is down)
18* - Attempt To Close When Hot Line Tag Is Active
19* Unknown Event (DOS)
Inconsistent State Lockout (CCI Interface software)
20 Alternate Minimum Trip is ON
21 Alternate Minimum Trip is OFF

*Code 19 - An Event Type 19 is logged in the event recorder when the inconsistent state handler notices a recloser tripped status and the F4C microprocessor control did not issue a trip command. The F4C interface software program interprets an Event Type 19 as an unknown event and has no effect on recloser operation. The following can generate an Event Type 19:

Signal Duration - Remote Lockout connections, terminals 3 and 4, on the F4C Standard I/O circuit board require a minimum signal duration of approximately 1/4 second. The minimum signal duration insures that inputs will be picked up within the CPU scan window. An input to terminals 3 and 4 will result in a direct trip output to the recloser. If the Remote Lockout signal is less than 1/4 second, the recloser may still trip, although the F4C CPU may not know why the recloser tripped and generate an Event Type 19. The same applies for the Supervisory Lockout input when the control is in supervisory mode.

Code 17 - When the yellow handle is pulled down and then pushed back up, a Code 17, followed by a Code 19, will be logged.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
163	**--**	**0**	**YES**	**--**	**--**	**--**	**Month . Day**	**--**

- Access Code 163 identifies the month and day of the event indicated by Access Code 161.
- Access Code 163 can only be accessed from Access Code 161 using the SCROLL key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
164	**--**	**0**	**YES**	**--**	**--**	**--**	**Hour : Minute**	**--**

- Access Code 164 identifies the hour and minute of the event indicated by Access Code 161.
- Access Code 164 can only be accessed from Access Code 161 using the SCROLL key.

Event Recorder (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
165	**--**	**0**	**YES**	**--**	**--**	**--**	**Second**	**--**

- Access Code 165 identifies the second of the event indicated by Access Code 161.
- Access Code 165 can only be accessed from Access Code 161 using the SCROLL key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
166	**--**	**0**	**YES**	**--**	**--**	**--**	**Ground Current (kA)**	**--**

- Access Code 166 identifies the ground current of the event indicated by Access Code 161.
- Access Code 166 can only be accessed from Access Code 161 using the SCROLL key.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
167	**--**	**0**	**YES**	**--**	**--**	**--**	**Phase Bushing1-2 Current (kA)**	**--**
168	**--**	**0**	**YES**	**--**	**--**	**--**	**Phase Bushing 3-4 Current (kA)**	**--**
169	**--**	**0**	**YES**	**--**	**--**	**--**	**Phase Bushing 5-6 Current (kA)**	**--**

- Access Codes 167 through 169 identify the current through the three phases of the event indicated by Access Code 161.
- Current values are in rms kiloamperes. Current range is from 0 kA to 30 times programmed minimum trip value. If the fault exceeds 30 times minimum trip, an over-range message (-1) will be displayed.
- Access Codes 167 through 169 can only be accessed from Access Code 161 using the SCROLL key.

Duty Cycle Monitor

The Duty Cycle Monitor provides keyboard accessible duty cycle information

- The Duty Cycle measures and records duty for each individual phase in non-volatile memory.
- The recloser duty is measured and stored on the basis of *Current$^{1.5}$ x Number of Operations* for Each Phase (ANSI C37.61).
- Readout is based on a percentage of total duty cycle for each phase.
- Duty record can be adjusted or reset if recloser is changed-out, serviced, etc.
- Feature is enabled and disabled via Access Code 24 (ON/OFF) through Security Level 1.
- Readout does not require security access.
- Information is also accessible via Digital Communications.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
170	**1**	**0**	**NO**	**9999**	**1**	**1**	**100% Interrupter Duty Factor**	**97**

- Use CHANGE key to enter value.
- Duty factor is value listed in *100% Duty Cycle Factor* column x 10^5.

Using the table below, select the appropriate recloser interrupting duty cycle factor and enter that value using Access Code 170.

TABLE 9
Interrupter Duty Factor

Recloser Type	Interrupting Rating (RMS Sym A)	100% Duty Cycle Factor	Recloser Type	Interrupting Rating (RMS Sym A)	100% Duty Cycle Factor
RXE, RVE	6000 A	97	VSA20 VSA20A VSA20B	20000 A	2248
WE	12000A @ 4.8 kV	257			
WE	10000A @ 14.4 kV	196			
VWE VWVE27 VWVE38X	12000 A	1045	VSO12	12000 A	1045
			VSO16	16000 A	1608
WVE27	8000 A	140	NOVA15 NOVA27 NOVA38	12000 A	1111
WVE38X	8000 A	140			
VSA12	12000 A	1045			
VSA16	16000 A	1608			

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
171	**1**	**0**	**YES**	**999.9**	**0**	**0.1**	**Bushing 1-2 Phase Interrupter Duty (%)**	**0**
172	**1**	**0**	**YES**	**999.9**	**0**	**0.1**	**Bushing 3-4 Phase Interrupter Duty (%)**	**0**
173	**1**	**0**	**YES**	**999.9**	**0**	**0.1**	**Bushing 5-6 Phase Interrupter Duty (%)**	**0**

- Information is accessible via the keyboard or Digital Communications.
- Use CHANGE key to enter value or reset to zero.
- A new recloser, not in service, has 0% interrupting duty cycle. As the recloser is used, the duty cycle increases. When the interrupting duty reaches 100%, the interrupter contacts should be examined and replaced.

Load Profile Monitor

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
180	**0**	**0**	**NO**	**96**	**1**	**1**	**Load Profile - Reading Number**	**--**

- Data is accessible through the keyboard or Digital Communications.
- From the keyboard, Access Codes 181 through 185 are accessible from Access Code 180 using the SCROLL key.
- Data is read and recorded in 15-minute intervals and stored in memory for the most recent 24 hours for a total of 96 readings.
- Indicates the rms demand current for each phase and ground.
- No security code is required for readout.

IMPORTANT: Load Profile Data will be lost if power to the Form 4C control is lost. Load Profile data will also be lost when the control resets after a change to a TCC Group (Access Code 70) or Line Frequency (Access Code 71).

TABLE 10
Load Profile Monitor Sample Data

Reading (180)	Hr:Min (181)	Ground Current (182)	Phase Current Bushing 1-2 (A) (183)	Phase Current Bushing 3-4 (A) (184)	Phase Current Bushing 5-6 (A) (185)
1	15:30	2	258	261	262
2	15:15	0	260	257	259
3	15:00	2	253	251	255
4	14:45	1	261	255	257
5	14:30	1	257	248	257

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
181	**--**	**0**	**YES**	**--**	**--**	**--**	**Time - Hour and Minute**	**--**

- Indicates the hour and minute of a specific phase rms demand current profile.

Load Profile Monitor (Cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
182	**--**	**0**	**YES**	**--**	**--**	**--**	**Ground Current (A)**	**--**

- Indicates the rms demand current profile for Ground Current.

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
183	**--**	**0**	**YES**	**--**	**--**	**--**	**Phase Bushing 1-2 Current (A)**	**--**
184	**--**	**0**	**YES**	**--**	**--**	**--**	**Phase Bushing 3-4 Current (A)**	**--**
185	**--**	**0**	**YES**	**--**	**--**	**--**	**Phase Bushing 5-6 Current (A)**	**--**

- Indicates the rms demand current profile for the three Phase Currents.

Switch Mode

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
190	**2**	**0**	**YES**	**--**	**--**	**--**	**Switch Mode Active TCC Selection (TCC1/TCC2)**	**2**

- Applicable to controls with CPU Firmware versions 8.XX, 11.XX, and 12.XX only.
- Indicates whether TCC1 - phase and ground or TCC2 -phase and ground is active when the control is in the Switch Mode. (Reference Access Codes 02 and 03.)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
191	**2**	**0**	**YES**	**1600**	**50**	**1**	**Switch Mode Minimum Target Sensing - Phase**	**100**
191	**2**	**0**	**YES**	**800**	**5**	**1**	**Switch Mode Minimum Target Sensing - Ground**	**50**

- Applicable to controls with CPU Firmware versions 8.XX, 11.XX, and 12.XX only.
- Minimum target sensing is a threshold value at which a system overcurrent is detected.
- Minimum target sensing is set for both phases and ground through a range of settings based on the recloser's CT ratio.
  CT ratio 500:1 allows a range from 25 to 800 A phase and 2 to 400 A ground.
  CT ratio 1000:1 allows a range from 50 to 1600 A phase and 5 to 800 A ground.
  CT ratio 2000:1 allows a range from 100 to 2400 A phase and 10 to 1600 A ground.
- All values are adjusted in increments of 1.
- The control accepts only the values within the limits preset in the control. Attempts to enter other values results in a LO/HI message.
- Use the PHASE/GROUND key to select phase and ground.

Switch Mode (cont'd)

	Security			Limits				
Access Code	Write	Read	Scroll	High	Low	Incr	Parameter	Factory Settings
192	**2**	**0**	**YES**	**1600**	**50**	**1**	**Switch Mode Alternate Minimum Target Sensing - Phase**	**100**
192	**2**	**0**	**YES**	**800**	**5**	**1**	**Switch Mode Alternate Minimum Target Sensing - Ground**	**50**

- Applicable to controls with CPU Firmware versions 8.XX, 11.XX, and 12.XX only.
- Alternate minimum target sensing is set for both phase and ground through a range of settings based on the recloser's CT ratio.

  CT ratio 500:1 allows a range from 25 to 800 A phase and 2 to 400 A ground.

  CT ratio 1000:1 allows a range from 50 to 1600 A phase and 5 to 800 A ground.

  CT ratio 2000:1 allows a range from 100 to 2400 A phase and 10 to 1600 A ground.
- All values are adjusted in increments of one.
- The control accepts only the values within the limits preset in the control. Attempts to enter other values results in a LO/HI message.
- Use the PHASE/GROUND key to select phase and ground.

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