Instruction Book

M-7679
Recloser Control

BECKWITH ELECTRIC ▷ **CO. INC.**

TRADEMARKS

All brand or product names referenced in this document may be trademarks or registered trademarks of their respective holders.

BECKWITH ELECTRIC CO. INC.

Recloser Control M-7679

Next generation Recloser Control and Protection System for Advanced Distribution Grids

Protection and Control

- Over 30 Protection Elements for optimal protection of Power Distribution Systems
- Compatible with Three-Phase Ganged (Std) and Independent Phase Capable Reclosers (Optional)
- Four (std) or Six (optional) Low Energy Analog (LEA) or VT voltage inputs
- Settings Wizard assists in creating file for most common settings
- Recloser Status Monitoring tool displays real time reclosing sequence and fault clearing time
- Comprehensive I/O Matrix provides visual confirmation of enabled functions and selected outputs improving security

Automation/Communications

- Front panel USB and SD Card ports for local programming and data transfer
- One or two optional serial ports (TIA-232, TIA-485 or Serial Fiber)
- Optional single or dual Ethernet ports (copper or fiber) with simultaneous multi-user and multi-protocol support
- Protocols supported include:
  - MODBUS, DNP3.0
  - Optional: IEC61850
- Comprehensive Cyber Security tools to implement NERC CIP requirements, including IPsec and Radius server security
- IEEE 1686 Compliant

IPScom® – *Uncomplicated Software for Complex Power System Applications*

- Integrated Metering, DFR and PQ Visualization Tools
- Search and filtering tools for analysis of SOE, DFR and PQ records
- IPSlogic Programmable Logic

Monitoring

- Power Quality Monitoring up to the 63rd Harmonic including THD and TDD
- PQ Viewer (ITIC Curve)
- Sags, Swell and Sub-Synchronous Transient Detection
- Advanced Data Logging and Load Profile Recorder
- 3500 Event Sequence of Events (SOE) Recorder
- 100 DFR quality records of up to 480 cycles with adjustable sampling rate up to 128 s/c

Flexibility

Two ways to retrofit and upgrade your existing recloser control:

- Beckwith's M-2400 series Adapter Chassis for a direct retrofit of some of the most popular controls in their existing cabinet
- Beckwith's M-2979 Cabinet for replacement of the complete recloser control – plug compatible with multiple vendors

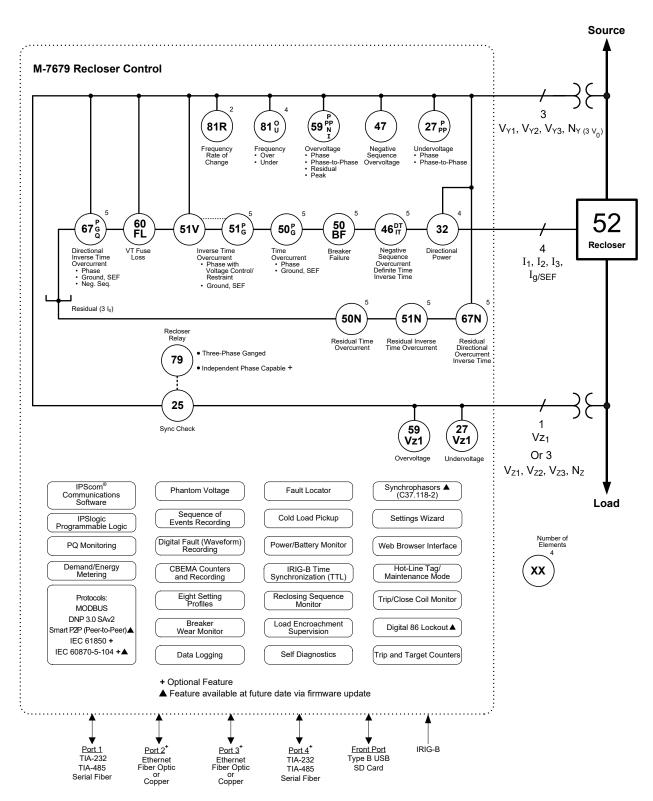*Industry Leader Since 1969*
Made in the USA

Figure 1   M-7679 Recloser Control

Standard Control Features

- Over 30 protection functions
- Horizontal or Vertical Mounting
- 50 Hz or 60 Hz Frequency
- High (90 to 315 Vac/Vdc) or Low (18 to 60 Vdc) Power Supply
- IPScom Communications Software
- IPSlogic Programmable Logic
- Synchrophasors (IEEE C37.118-2)▲
- Load Encroachment Supervision
- Phantom Voltage
- Digital 86 Lockout▲
- I/O Map
- Smart Fuse Coordination▲
- Custom Curve Designer
- Hot-Line Tag
- Fault Locator
- Eight Setting Profiles
- Compare Settings Tool
- Multi-Shot Auto Recloser, Three-Phase Reclose Operation
- Sequence Coordination
- Cold Load Pickup
- Auto Restoration
- Reclosing Sequence Monitor & Recorder
- Recloser/Breaker Wear Monitor
- Power Quality Monitoring
- THD/TDD Monitoring, Alarming and Protection
- ITIC Curve Violation Counters and Recording
- Demand and Energy Metering
- Power Supply Monitor
- Trip/Close Coil Monitor
- Data Logging
- Sequence of Events Recording
- Trip and Target Counters
- Digital Fault (Waveform) Recording
- Fault Event Records
- Self-Diagnostics
- Three Phase Current Inputs plus one Ground or Sensitive Earth Current Input
- Three Phase Voltage Inputs plus one Sync Check Voltage Input
- IRIG-B Time Synchronization (TTL)
- Front Panel USB and SD Card ports

- PORT 1: Rear TIA-232 or TIA-485
- Protocols Included:
  - MODBUS®
  - DNP3.0 SAv2
  - Smart P2P (Peer-To-Peer)▲
- Four User Programmable Digital Inputs
- Four User Programmable Digital Outputs
- Conformal coated circuit boards
- Configurable Front HMI LEDs and Pushbuttons
- 12 Vdc Backup Power Input
- SMTP E-mail server▲
- Web Browser Interface
- IEEE 1686 Standard Compliant Cyber Security
- IPsec (Internet Protocol Security)
- RADIUS Client Capability to manage local and remote access to the control
- Wide Variety of Communications Accessories

Optional Features

- Independent Phase Capable (Triple/ Single) Recloser Operation
- PORT 1 – Fiber Optic Available
- PORT 2 – Rear Ethernet Fiber Optic or Copper
- PORT 3 – Rear Ethernet Fiber Optic or Copper
- PORT 4 – TIA-232, TIA-485, or Fiber Optic
- Optional Protocols in addition to standard MODBUS and DNP3.0 (requires at least one Ethernet Port):
  - Add IEC 61850
  - Add IEC 60870-5-104/101▲
  - Add Combination IEC 61850 and IEC 60870-05-104/101▲
- Expanded I/O – Additional eight digital Inputs and eight digital Outputs for a total of 12 each
- Low Energy Analog (LEA) Inputs per C37.92. Configurations available: 4 LEA, 3LEA + 1VT, or 6LEA.
- M-2032A Battery Charger/Power Supply – please refer to the M-2032A Specification for additional information and ordering options.

▲ Feature available at future date via firmware update / IPScom update

M-7679 Mounting Options

M-2400 Series Adapter Chassis

The M-2400 Series Adapter Chassis and M-7679 Recloser Control provide a direct replacement for the following recloser controls:

- M-2410 replaces the SEL 351R-2
- M-2411 replaces the SEL 351P-3 Panacea
- M-2413 replaces the Cooper Form 6
- M-2418 replaces the Cooper Form 5
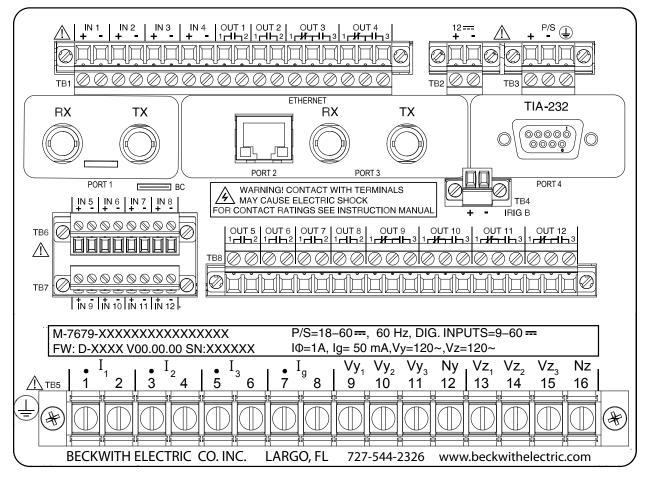
Figure 2   M-2410 Adapter Chassis

Please refer to the M-2410/2411/2413/M-2418 Specification sheets for additional information and ordering options.

M-2979 Recloser Control Cabinet
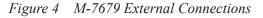
Figure 3   Recloser Control Cabinet

Please see the M-2979 Recloser Control Cabinet Specifications section beginning on page 37.

▲CAUTION: An orange TB3 receptacle indicates that a Low Voltage Power Supply is installed in the unit.

Figure 4   M-7679 External Connections

PROTECTIVE FUNCTIONS

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
	Sync Check			
(25)	Reference Phase	A/B/C	_	_
	Undervoltage Permission			
	Dead Line/Dead Bus	Yes/No	_	_
	Dead Line/Live Bus	Yes/No	_	_
	Live Line/Dead Bus	Yes/No	_	_
	Live Line Minimum Voltage	0.0 to 200.0 V	0.1 V	± 0.2 V or ± 0.5%
	Live Bus Minimum Voltage	0.0 to 200.0 V	0.1 V	± 0.2 V or ± 0.5%
	Sync Check Permission			
	Max/Minimum Time Delay	0.01 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Minimum Voltage	10.0 to 300.0 V	0.01 V	± 0.2 V or ± 0.5%
	Maximum Voltage	10.0 to 300.0 V	0.01 V	± 0.2 V or ± 0.5%
	Angle Difference	0.00° to 90.00°	0.01°	± 0.3°
	Magnitude Difference	0.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Frequency Difference	0.00 to 5.00 Hz	0.01 Hz	± 0.02 Hz or ± 2%
	Undervoltage			
(27)	**Phase Undervoltage (#1 to #4 Steps)**			
	Pickup	10.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Auto Restoration	Enable/Disable		
(27 PP)	**Phase-to-Phase Undervoltage**			
	Pickup	10.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
(27 Vz1)	**Vz1 Undervoltage**			
	Pickup	10.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Bus Side Voltage Supervision			
(27B)	**Bus Side Voltage Supervision**			
	Minimum Closing Voltage	0.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Supervision Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Directional Power (#1 to #4 Steps)			
(32)	Pickup	−3.00 to +3.00 PU	0.01 PU	± 0.02 PU or ± 6%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Power	Real/Reactive		

Each directional power element can be set as overpower or underpower.
The per unit pickup is based on the nominal secondary VT voltage and CT current settings.

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

[†]Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
Negative Sequence Overcurrent (#1 to #5 Steps)				
(46 DT)	**Definite Time**			
	Pickup			
	1 A CT	0.02 to 20.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.10 to 100.00 A	0.01 A	± 0.1 A or ± 3%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
(46 IT)	**Inverse Time**			
	Pickup			
	1 A CT	0.02 to 3.20 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.10 to 16.00 A	0.01 A	± 0.1 A or ± 3%
	Electromechanical Reset Delay	Yes/No		
	Reset Coefficient	0.001 to 30.000 s	0.001 s	± 0.01 s* or ± 1%
	TCC Modifiers Time Adder	0.00 to 30.00 s	0.01 s	± 0.01 s* or ± 1%
	Minimum Response Time Adder	0.00 to 1.00 s	0.01 s	± 0.01 s* or ± 1%
	IEC Curves Family (IEC 60255-151)	Inverse, Very Inverse Extremely Inverse		
	Time Multiplier	0.05 to 1.00	0.01	± 2 cycles or ± 5%
	IEEE Curves (C37.112)	Moderately Inverse Very Inverse Extremely Inverse		
	Time Multiplier	0.10 to 25.00	0.01	± 2 cycles or ± 5%
	US Curves	Moderately Inverse Standard Inverse Very Inverse Extremely Inverse Short Time Inverse		
	Time Multiplier	0.05 to 15.00	0.01	± 2 cycles or ± 5%
	Traditional Recloser Curves	101; 102; 103; 104; 105; 106; 107; 111; 112; 113; 114; 115; 116; 117; 118; 119; 120; 121; 122; 131; 132; 133; 134; 135; 136; 137; 138; 139; 140; 141; 142; 151; 152; 161; 162; 163; 164; 165; 200; 201; 202		
	Time Multiplier	0.10 to 2.00	0.01	± 2 cycles or ± 5%
	Definite Time Time Multiplier	0.10 to 100.00	0.01	± 2 cycles or ± 5%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

[†]Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
	Negative Sequence Overvoltage			
47	Pickup	0.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Breaker Failure			
50 BF	Pickup			
	Phase Current			
	1 A CT	0.02 to 2.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.10 to 10.00 A	0.01 A	± 0.1 A or ± 3%
	Residual/ Ground (Sensitive Ground) Current			
	1 A CT	0.02 to 2.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.10 to 10.00 A	0.01 A	± 0.1 A or ± 3%
	10 mA CT	0.001 to 0.160 A	0.001 A	TBD
	50 mA CT	0.005 to 0.800 A	0.001 A	TBD
	200 mA CT	0.020 to 3.200 A	0.001 A	TBD
	Time Delay	0.01 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Retrip Delay	0.01 to 600.00 s	0.01 s	± 0.01 s* or ± 1%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

[†]Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
	Instantaneous/Definite Time Overcurrent (#1 to #5 Steps)			
50P	**Phase Instantaneous/Definite Time Overcurrent**			
	Pickup			
	1 A CT	0.02 to 20.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.10 to 100.00 A	0.01 A	± 0.1 A or ± 3%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
50 HCL	**High Current Lockout (#1 to #5 Steps)**			
	Phase	Enable/Disable		
	Reference Current			
	1 A CT	0.10 to 100.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.50 to 500.00 A	0.01 A	± 0.1 A or ± 3%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
50N	**Residual Instantaneous/Definite Time Overcurrent**			
	Pickup			
	1 A CT	0.02 to 20.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.10 to 100.00 A	0.01 A	± 0.1 A or ± 3%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
50 HCL	**High Current Lockout (#1 to #5 Steps) with "$3I_0$" HCL Operating Current Reference**			
	Residual/Ground	Enable/Disable		
	Reference Current			
	1 A CT	0.03 to 100.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.15 to 500.00 A	0.01 A	± 0.02 A or ± 3%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
50G	**Ground Instantaneous/Definite Time Overcurrent**			
	Pickup			
	1 A Gnd CT	0.02 to 20.00 A	0.01 A	± 0.02 A or ± 3%
	5 A Gnd CT	0.10 to 100.00 A	0.01 A	± 0.1 A or ± 3%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
50 HCL	**High Current Lockout (#1 to #5 Steps) with "G" HCL Operating Current Reference**			
	Residual/Ground	Enable/Disable		
	Reference Current			
	1 A Gnd CT	0.03 to 100.00 A	0.01 A	± 0.02 A or ± 3%
	5 A Gnd CT	0.15 to 500.00 A	0.01 A	± 0.1 A or ± 3%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
	Inverse Time Overcurrent (#1 to #5 Steps)			
51P	**Phase Inverse Time Overcurrent with Voltage Control/Restraint**			
	Pickup			
	1 A CT	0.02 to 3.20 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.10 to 16.00 A	0.01 A	± 0.1 A or ± 3%
	Load Encroachment Logic	Use/Do Not Use	–	–
	Voltage Control or Voltage Restraint	4.0 to 150.0 %	0.1 %	
51N	**Residual Inverse Time Overcurrent**			
	Pickup			
	1 A CT	0.02 to 3.20 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.10 to 16.00 A	0.01 A	± 0.1 A or ± 3%
51G	**Ground Inverse Time Overcurrent**			
	Pickup			
	1 A Gnd CT	0.02 to 3.20 A	0.01 A	± 0.02 A or ± 3%
	5 A Gnd CT	0.10 to 16.00 A	0.01 A	± 0.1 A or ± 3%
	Electromechanical Reset Delay	Yes/No		
	Reset Coefficient	0.001 to 30.000 s	0.001 s	± 0.01 s* or ± 1%
	TCC Modifiers Time Adder	0.00 to 30.00 s	0.01 s	± 0.01 s* or ± 1%
	Minimum Response Time Adder	0.00 to 1.00 s	0.01 s	± 0.01 s* or ± 1%
	IEC Curves Family (IEC 60255-151)	Inverse, Very Inverse Extremely Inverse		
	Time Multiplier	0.05 to 1.00	0.01	± 2 cycles or ± 5%
	IEEE Curves (C37.112)	Moderately Inverse Very Inverse Extremely Inverse		
	Time Multiplier	0.10 to 25.00	0.01	± 2 cycles or ± 5%
	US Curves	Moderately Inverse Standard Inverse Very Inverse Extremely Inverse Short Time Inverse		
	Time Multiplier	0.05 to 15.00	0.01	± 2 cycles or ± 5%
	Traditional Recloser Curves	101; 102; 103; 104; 105; 106; 107; 111; 112; 113; 114; 115; 116; 117; 118; 119; 120; 121; 122; 131; 132; 133; 134; 135; 136; 137; 138; 139; 140; 141; 142; 151; 152; 161; 162; 163; 164; 165; 200; 201; 202		
	Time Multiplier	0.10 to 2.00	0.01	± 2 cycles or ± 5%
	Definite Time Time Multiplier	0.10 to 100.00	0.01	± 2 cycles or ± 5%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

[†]Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
	Overvoltage			
59	**Phase Overvoltage (#1 to #4 Steps)**			
	Pickup	10.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Auto Restoration	Enable/Disable		
59I	**Peak Overvoltage**			
	Pickup	100 to 150 %	1%	± 3%
	Definite Time	0.01 to 140.00 s	0.01 s	± 0.05 s*
59N	**Residual Overvoltage**			
	Pickup	10.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
59 PP	**Phase-to-Phase Overvoltage**			
	Pickup	10.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
59 Vz1	**Vz1 Overvoltage**			
	Pickup	10.00 to 300.00 V	0.01 V	± 0.2 V or ± 0.5%
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	VT Fuse-Loss Detection			
60 FL	**A VT fuse-loss condition is detected by using the positive and negative sequence components of the voltages and currents.**			
	Time Delay	0.03 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Three Phase VT Fuse Loss Detection	Enable/Disable		

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

[†]Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
	Directional Overcurrent (#1 to #5 Steps)			

(67P) **Phase Directional Overcurrent**

	Operating Current	Phase Current		
	Phase Polarization Voltage	V_1		

(67N) **Residual Directional Overcurrent**

	Operating Current	$3I_O$		
	Phase Polarization Voltage	Vz_1, V_1, V_2, V_O		

(67G) **Ground Directional Overcurrent**

	Operating Current	I_g		
	Phase Polarization Voltage	Vz_1, V_1, V_2, V_O		

(67Q) **Negative Sequence Directional Overcurrent**

	Operating Current	Negative Sequence Current		
	Phase Polarization Voltage	V_2		

Enabled Direction	No-Direction/Directional			
Minimum Polarization Voltage (% of nominal voltage)	2.0 to 10.0 %	0.1%	± 3%	
Action if below	Trip/Block Trip			
Maximum Sensitivity Angle 1	0° to 359°	1°	± 1°	
Maximum Sensitivity Angle 2	5° to 90°	1°	± 1°	
Time Delay	Definite/Inverse	–	–	

Definite Time:
Pickup

1 A CT/Gnd CT	0.05 to 20.00 A	0.01 A	± 0.02 A or ± 3%
5 A CT/Gnd CT	0.25 to 100.00 A	0.01 A	± 0.1 A or ± 3%
Delay	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%

■**NOTE:** Function 67 Inverse Time Delay Specifications continued on next page.

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

[†]Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
	Directional Instantaneous/Definite Time Overcurrent (Cont'd.)			
	Inverse Time:			
	Pickup			
	1 A CT/Gnd CT	0.02 to 3.20 A	0.01 A	± 0.02 A or ± 3%
	5 A CT/Gnd CT	0.10 to 16.00 A	0.01 A	± 0.1 A or ± 3%
	Electromechanical Reset Delay Yes/No			
	Reset Coefficient	0.001 to 30.000 s	0.001 s	± 0.01 s* or ± 1%
	TCC Modifiers			
	Time Adder	0.00 to 30.00 s	0.01 s	± 0.01 s* or ± 1%
	Minimum Response Time Adder	0.00 to 1.00 s	0.01 s	± 0.01 s* or ± 1%
	IEC Curves Family (IEC 60255-151)	Inverse, Very Inverse Extremely Inverse		
	Time Multiplier	0.05 to 1.00	0.01	± 2 cycles or ± 5%
	IEEE Curves (C37.112)	Moderately Inverse Very Inverse Extremely Inverse		
	Time Multiplier	0.10 to 25.00	0.01	± 2 cycles or ± 5%
	US Curves	Moderately Inverse Standard Inverse Very Inverse Extremely Inverse Short Time Inverse		
	Time Multiplier	0.05 to 15.00	0.01	± 2 cycles or ± 5%
	Traditional Recloser Curves	101; 102; 103; 104; 105; 106; 107; 111; 112; 113; 114; 115; 116; 117; 118; 119; 120; 121; 122; 131; 132; 133; 134; 135; 136; 137; 138; 139; 140; 141; 142; 151; 152; 161; 162; 163; 164; 165; 200; 201; 202		
	Time Multiplier	0.10 to 2.00	0.01	± 2 cycles or ± 5%
	Definite Time			
	Time Multiplier	0.10 to 100.00	0.01	± 2 cycles or ± 5%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

†Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
	Recloser Delay			
(79)	**Three-Phase Ganged or Optional Independent Phase Operation:**			
	Ground Precedence	Yes/No		
	Sequence Coordination Active For Trips	None/1/2/3	–	–
	Maximum Number of Phase Trips	1/2/3/4/5	1	–
	Maximum Number of Ground/Residual Trips	1/2/3/4/5	1	–
	Reset Time after Auto Reclose	1 to 1800 s	1 s	± 0.01 s* or ± 1%
	Reset Time from Lockout	0 to 1800 s	1 s	± 0.01 s* or ± 1%
	Reclose #1, #2, #3, #4 Time Delay for Phase Fault	0.01 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Time Delay for Ground Fault	0.01 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Optional Independent Phase Operation (1 Phase Trip-1 Phase Lockout Mode):			
	Synchronized Phase Sequence	Yes/No		
	Deactivate G/N Functions	Yes/No		
	Trip All Phases for Multi-Phase Faults	Yes/No		
	79 Trip Recloser Sequence			
	Trip #1, #2, #3, #4, #5			
	Function Element 1, 2, 3, 4, 5	50P, 50N, 50G/GS, 46DT, 51P, 51N, 51G/GS, 46 IT, 67P, 67N, 67G/GS, 67Q	–	–
	79 Drive to Lockout			
	Trip Sequence 1, 2, 3, 4, 5	50P HCL, 50G/GS or 50N HCL	–	–
	Protective Function Elements 1, 2, 3, 4	27, 32, 81U/O	–	–
	Supervision			
	Blocking Functions	27 BSVS, 27Vz1, 25 Sync	–	–
	Supervision Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

†Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
Frequency (#1 to #4 Steps)				
81	Pickup	40.00 to 65.00 Hz	0.01 Hz	± 0.02 Hz
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Hysteresis	0.0 to 1.0 Hz	0.1 Hz	
	Undervoltage Block	Enable/Disable		
	Minimum Voltage	1.00 to 180.00 V	0.01 V	
	Minimum Load	Enable/Disable		
	1 A CT	0.00 to 40.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.00 to 200.00 A	0.01 A	± 0.1 A or ± 3%

The pickup accuracy applies at a range of 57 to 63 Hz. Beyond this range the accuracy is ± 0.1 Hz.

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
	Auto Restoration	Enable/Disable		
Rate of Change of Frequency (#1 to #2 Steps)				
81R	Pickup	0.20 to 5.00 Hz/s	0.01 Hz/s	± 0.02 Hz/s
	Definite Time	0.00 to 2.00 s	0.01 s	± 0.01 s* or ± 1%
	Maximum Frequency	40.00 to 70.00 Hz	0.01 Hz	
	Minimum Current			
	1 A CT	0.00 to 20.00 A	0.01 A	± 0.02 A or ± 3%
	5 A CT	0.00 to 100.00 A	0.01 A	± 0.1 A or ± 3%
	Minimum Voltage	0.00 to 300.00 V	0.01 V	
	Pickup Cycle Number	3 to 15	1	
Breaker Monitor				
BM	Pickup	1 to 60000 kA** Cycles	1 kA** Cycles	± 1 kA** Cycles
	Time Delay	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Breaker Open Arc Current Delay	0 to 2000 ms	1 ms	
	Arc Current Cycle	0 to 20 Cycles	1 Cycle	
	Preset Accumulators	0 to 60000 kA** Cycles	1 kA** Cycle	
	Timing Selection Method**	$I^{1.5}T$, IT or I^2T		

(**Timing Selection Method determines unit: kA, $kA^{1.5}$ or kA^2)

The Breaker Monitor feature calculates an estimate of the per-phase wear on the breaker contacts by measuring and integrating the current through the breaker contacts as an arc.

The per-phase values are added to an accumulated total for each phase, and then compared to a user-programmed threshold value. When the threshold is exceeded in any phase, the relay can set a programmable output contact.

The accumulated value for each phase can be displayed.

The Breaker Monitoring feature requires an initiating contact to begin accumulation, and the accumulation begins after the set time delay.

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

†Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
Trip/Close Circuit Monitoring				
(TCM)	Time Delay	0.01 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
(CCM)	Time Delay	0.01 to 600.00 s	0.01 s	± 0.01 s* or ± 1%

Trip Coil and Close Coil input voltages are limited to the specifications in Table 5.

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
Total Harmonic Distortion / Total Demand Distortion				
(THD)	Operating Quantity	Current/Voltage		
	Limit	0.1 to 10.0 %	0.1%	± 2%
	Time Delay	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
(TDD)	Operating Quantity	Current		
	Limit	0.1 to 10.0 %	0.1%	± 2%
	Time Delay	0.00 to 600.00 s	0.01 s	± 0.05 s* or ± 1%

OPTIONAL PROTECTIVE FUNCTIONS

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
	Sensitive Ground Instantaneous/Definite Time Overcurrent (#1 to #5 Steps)			
(50 GS)	Sensitive Ground Pickup			
	10 mA Gnd CT	0.001 to 0.160 A	0.001 A	(TBD)
	50 mA Gnd CT	0.005 to 0.800 A	0.001 A	0.0015 A or ± 3%
	200 mA Gnd CT	0.020 to 2.500 A	0.001 A	(TBD)
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Replaces Standard 50G Ground			
(50 HCL)	**High Current Lockout (#1 to #5 Steps) with "G" HCL Operating Current Reference**			
	Residual/Ground	Enable/Disable		
	Reference Current			
	10 mA Gnd CT	0.001 to 0.160 A	0.001 A	(TBD)
	50 mA Gnd CT	0.005 to 0.800 A	0.001 A	0.0015 A or ± 3%
	200 mA Gnd CT	0.020 to 3.200 A	0.001 A	(TBD)
	Definite Time	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

[†]Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

OPTIONAL PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
Sensitive Ground Inverse Time Overcurrent (#1 to #5 Steps)				
(51 GS)	Sensitive Ground Pickup			
	10 mA Gnd CT	0.001 to 0.160 A	0.001 A	(TBD)
	50 mA Gnd CT	0.005 to 0.800 A	0.001 A	0.0015 A or ± 3%
	200 mA Gnd CT	0.020 to 2.500 A	0.001 A	(TBD)
	Electromechanical Reset Delay Yes/No			
	Reset Coefficient	0.001 to 30.000 s	0.001 s	± 0.01 s* or ± 1%
	TCC Modifiers Time Adder	0.00 to 30.00 s	0.01 s	± 0.01 s* or ± 1%
	Minimum Response Time Adder	0.00 to 1.00 s	0.01 s	± 0.01 s* or ± 1%
	IEC Curves Family (IEC 60255-151)	Inverse, Very Inverse Extremely Inverse		
	Time Multiplier	0.05 to 1.00	0.01	± 2 cycles or ± 5%
	IEEE Curves (C37.112)	Moderately Inverse Very Inverse Extremely Inverse		
	Time Multiplier	0.10 to 25.00	0.01	± 2 cycles or ± 5%
	US Curves	Moderately Inverse Standard Inverse Very Inverse Extremely Inverse Short Time Inverse		
	Time Multiplier	0.05 to 15.00	0.01	± 2 cycles or ± 5%
	Traditional Recloser Curves	101; 102; 103; 104; 105; 106; 107; 111; 112; 113; 114; 115; 116; 117; 118; 119; 120; 121; 122; 131; 132; 133; 134; 135; 136; 137; 138; 139; 140; 141; 142; 151; 152; 161; 162; 163; 164; 165; 200; 201; 202		
	Time Multiplier	0.10 to 2.00	0.01	± 2 cycles or ± 5%
	Definite Time Time Multiplier	0.10 to 100.00	0.01	± 2 cycles or ± 5%

Replaces Standard 51G Ground

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

†Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

OPTIONAL PROTECTIVE FUNCTIONS (*cont.*)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
	Sensitive Ground Directional Overcurrent (#1 to #5 Steps)			
67 GS	Phase Polarization Voltage	Vz_1, V_1, V_2, V_O	–	–
	Enabled Direction	No-Direction/Directional	–	–
	Minimum Polarization Voltage (% of nominal voltage)	2.0 to 10.0 %	0.1%	± 3%
	Action if below	Trip/Block Trip	–	–
	Maximum Sensitivity Angle 1	0° to 359°	1°	± 4°
	Maximum Sensitivity Angle 2	5° to 90°	1°	± 4°
	Time Delay	Definite/Inverse	–	–
	Definite Time:			
	Pickup 10 mA Gnd CT	0.001 to 0.160 A	0.001 A	(TBD)
	Pickup 50 mA Gnd CT	0.005 to 0.800 A	0.001 A	0.0015 A or ± 3%
	Pickup 200 mA Gnd CT	0.020 to 2.500 A	0.001 A	(TBD)
	Delay	0.00 to 600.00 s	0.01 s	± 0.01 s* or ± 1%
	Inverse Time:			
	Electromechanical Reset Delay	Yes/No		
	Reset Coefficient	0.001 to 30.000 s	0.001 s	± 0.01 s* or ± 1%
	TCC Modifiers Time Adder	0.00 to 30.00 s	0.01 s	± 0.01 s* or ± 1%
	Minimum Response Time Adder	0.00 to 1.00 s	0.01 s	± 0.01 s* or ± 1%
	IEC Curves Family (IEC 60255-151)	Inverse, Very Inverse Extremely Inverse		
	Time Multiplier	0.05 to 1.00	0.01	± 2 cycles or ± 5%
	IEEE Curves (C37.112)	Moderately Inverse Very Inverse Extremely Inverse		
	Time Multiplier	0.10 to 25.00	0.01	± 2 cycles or ± 5%
	US Curves	Moderately Inverse Standard Inverse Very Inverse Extremely Inverse Short Time Inverse		
	Time Multiplier	0.05 to 15.00	0.01	± 2 cycles or ± 5%
	Traditional Recloser Curves	101; 102; 103; 104; 105; 106; 107; 111; 112; 113; 114; 115; 116; 117; 118; 119; 120; 121; 122; 131; 132; 133; 134; 135; 136; 137; 138; 139; 140; 141; 142; 151; 152; 161; 162; 163; 164; 165; 200; 201; 202		
	Time Multiplier	0.10 to 2.00	0.01	± 2 cycles or ± 5%
	Definite Time Time Multiplier	0.10 to 100.00	0.01	± 2 cycles or ± 5%

Replaces Standard 67G Function

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

†Select the greater of these accuracy values. For voltage accuracy specified, the range is (20 – 180 V).

Introduction

The M-7679 is a digital, Smart Grid ready, advanced recloser control and protection system that is compatible with most manufacturer's switchgear and suitable for new installations or as a direct, easy-to-install, replacement for older recloser controls. It offers a comprehensive protection package with over 30 individual protection functions and up to eight setting groups for either Three-Phase Ganged or Independent Phase Capable reclosers. The M-7679 features a high accuracy metering system with advanced recording and reporting functions as well as continuous data sampling at 128 samples per cycle.

By configuring various combinations of the slow-, fast-, and time-delay curve elements, the M-7679 Recloser Control can allow as many as five Phase-to-Phase or Phase-to-Ground trips and four total reclosing operations. If required, individual phase or ground reclose intervals are user-settable with time-delays of up to 600 seconds. The settings for the different functions can be accomplished by using the IPScom S-7600 Communications Software or the front panel pushbuttons. For convenience and security, the M-7679 Recloser Control offers an SD card reader. Programming can be done in the office and settings can be loaded using an SD card thus minimizing the time a user needs to spend in front of the control.

Overcurrent Protection

Up to five cumulative fast- and delay-curve operations provide phase and ground overcurrent protection. With a recloser CT ratio of 1000:1, for example, the phase overcurrent protection can have primary currents set as sensitive as 20 A for phase overcurrent and 5 A for ground overcurrent protection.

The M-7679 offers over 50 different time curves plus four user programmable curves to facilitate coordination with other elements in the network. The phase or ground fast- and delay-curves can be set either with the user-designed curves or with the curve selection choices listed in Table 1.

Use traditional Recloser Control curve modifiers to alter fast- and delay-curves (including US or IEC curves):
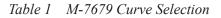
- Constant Time Adder – adds time to curve
- Vertical Multiplier (time dial) – shifts entire curve up or down in time
- Minimum Response Time – delays curve tripping for minimum time
- High Current Lockout – high set lockout maximum
- High Current Trip – closes on bolted fault

Custom Overcurrent Protection

IPSlogic includes algorithms that allow user programmable customization of the overcurrent protection.

The M-7679 Recloser Control supports the following curve selections:

Curve Category	Curve Selection
IEC Curves (IEC 60255-151)	Inverse, Very Inverse, Extremely Inverse
IEEE Curves (IEEE C37.112)	Moderately Inverse, Very Inverse, Extremely Inverse
Traditional Recloser Curves ◼NOTE: (Newer curves are shown with the older curve designations in parentheses)	101 (A); 102 (1); 103 (17); 104 (N); 105 (R); 106 (4); 107 (L); 111 (8*); 112 (15); 113 (8); 114 (5); 115 (P); 116 (D); 117 (B); 118 (M); 119 (14); 120 (Y); 121 (G); 122 (H); 131 (9); 132 (E); 133 (C); 134 (Z); 135 (2); 136 (6); 137 (V); 138 (W); 139 (16); 140 (3); 141 (11); 142 (13); 151 (18); 152 (7); 161 (T); 162 (KP); 163 (F); 164 (J); 165 (KG); 200; 201; 202
US Curves	Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse
Definite Time	Definite Time
User-Designed Programmable Curves	Four Programmable Curves

Table 1   M-7679 Curve Selection

Reclosing Operation

When there is any breaker open operation due to a fault, the relay will close the breaker automatically without user intervention. The Reclosing Operation is achieved using the 79 function in conjunction with overcurrent functions (i.e. 50P, 50G/50GS, 50N, 46DT, 51P, 51G/51GS, 51N, 46IT, 67P, 67N, 67G/GS, 67Q).

The **Reclosing Sequence** is an extension of the single Reclosing Operation. In this instance, when a breaker opens and closes automatically, it will continue until a specified count is reached. Any overcurrent fault will cause a trip after the trip time expires, at which time the 79 function will start the **Reclose Interval**. Both the trip time and Reclose Interval are user settable.

At the end of the Reclose Interval the control will automatically send a close command to the breaker. This process will continue until the maximum number of trips is reached or until the fault clears, whichever occurs first. Once the maximum number of trips is reached, the control will automatically be placed in Lockout and prevent further operation until the unit is reset. The maximum number of trips is user settable. See the Instruction Book for a detailed explanation of the Reclosing function.

Power Quality

Power Quality (PQ) events: sags, swells, voltage and current imbalances; real-time harmonic analysis of current and voltage for each phase, THD, phase voltage loss and variations, and ITIC excursion detection.

Monitoring/Metering

Real-Time Metering – the following measured and calculated values are available in real-time:

- Instantaneous values of the current for three phases, ground or sensitive ground
- Line and phase voltages
- DC battery voltage
- Active, reactive, apparent single- and three-phase power, including directional
- Active energy received and delivered
- Demand metering on per-phase basis
- Reactive energy in quadrants I and III
- Single-phase and three-phase power factor
- Frequency and phase sequence
- Sequence current and voltage magnitudes

Settings Groups

The M-7679 has eight setting groups. Switch setting groups to properly account for prevailing power system conditions. For example if one breaker is dedicated for maintenance you can store the settings for all the feeders and use the appropriate group when that breaker is out of service for maintenance. All the functions shown in Figure 1 (Single Line diagram) are available in each settings group.

Oscillographic Recording

The Oscillograph Recorder provides comprehensive data recording of voltages, currents, and status input/output signals for all monitored waveforms. The Oscillograph recorder stores 100 records of up to 480 cycles each regardless of the sampling rate (at 16, 32, 64, or 128 samples per cycle). Oscillograph data can be downloaded using any communications ports to any Windows™ compatible computer running the IPScom S-7600 Communications Software. Once downloaded, the waveform data can be examined, printed or used in generating reports. The waveform data is also available in COMTRADE file format.

The recorder may be triggered using either the designated protective function element or logic equations. When triggered, the recorder stores pre-trigger data, and then continues to store data for a user-defined post-trigger delay period. The post-trigger delay will range from 5 to 95% of the total record length.

Live Oscillograph

The Live Oscillograph feature allows the user to view in real time the eight channels of oscillography with Power, Power Quality, Phasors and Harmonics.

Sequence of Events

The M-7679 keeps records of the last 3500 Sequence of Events with the following information:

- Pickup, trip, and extinction date and time, and fault duration
- Voltage and current signals for each phase, neutral and sensitive neutral during pre fault, trip and maximum or minimum depending on each case
- Trip cause
- Protection pickup elements that were activated
- Active group
- Fault directionality

Fault Locator

The M-7679 Fault Locator feature can reduce the time required to restore service due to a distribution system fault by providing an accurate estimate of the fault's location, even during periods of high customer load. The control integrates line impedance settings, fault type and fault conditions to calculate the fault location estimation. This feature works without requiring special instrument transformers, pre fault data, or communication to other devices.

Fault Event Records

The M-7679 can record and store up to 3,500 events related to the operation of protection functions, changes in configuration, states of the digital inputs and outputs, pickup and/or operation of protection functions, automated mechanism, statistics, etc.

Front Panel

- LCD display, 2 rows, 20 characters per row, with configurable contrast
- Twelve programmable tricolor front panel LEDs
- Keyboard – 17 pushbuttons (Two dedicated for Trip and Close)
- Six programmable pushbuttons with programmable LEDs
- Nine function pushbuttons

The M-7679 includes Programmable Alarm LEDs to indicate any general overcurrent trip (TRIP), plus additional LEDs to indicate the type of overcurrent trip. The Fast-Curve LED indicates a Fast-Curve Trip.

Recloser/Breaker Wear Monitor

The M-7679 control records the amount of current carried in each phase each time the recloser trips. The control's operational logic employs an algorithm integrating the amount of unfiltered AC current at the time of each trip and the number of operations (close to open) as a method of calculating wear. The control uses this information to establish wear setpoints derived in accordance with IEEE C37.61-1973, and initiates a signal to assert an alarm or modify the recloser operation parameters, such as reducing the total number of reclose operations.

Load Profile Trending (Data Logging Feature)

The M-7679 can store up to 25 parameters in nonvolatile memory (instantaneous, maximum, and minimum with date and time stamping). These parameters include the instantaneous values and energy accumulator groups in time intervals between 1 and 3600 seconds, with 1 second steps. The M-7679 has a storage capacity of up to 3,500 records.

Synchrophasors▲

Synchrophasors improve system operation and reliability allowing operators to closely monitor the distribution network in real time to detect potential cascading voltage collapses before they occur. The M-7679 supports the transmission of synchrophasors acting as a Phasor Measurement Unit (PMU) in compliance with IEEE C37.118-2. Phasor measurements taken at a selectable rate of up to 60 messages or frames per second can be transmitted to a Phasor Data Concentrator for user analysis in a wide-area monitoring and control system.

Phantom Voltage

The M-7679 has the capability to calculate and provide three-phase voltage that is measured without having three voltages physically connected to the terminals of the M-7679. The following VT configurations are supported:

- Phantom Wye
- Phantom Delta
- Open Delta

Phantom WYE is supported for VT connection ONLY. The M-7679 will measure one analog voltage signal on any of the voltage terminals and will then calculate the two remaining corresponding balanced phase voltages.

Example: A voltage signal is applied to the terminal defined as Phase A. The M-7679 will calculate and provide all three balanced Line to Ground phase voltages.

Phantom Delta is also supported in the VT connection ONLY. The measured signal applied to one of the voltage terminals is assumed to be a Line to Line quantity. The M-7679 will then calculate the remaining two corresponding balanced Line to Line voltages.

Example: Line to Line voltage AB is applied to the Phase A terminal of the unit. The M-7679 will then calculate and provide AB, BC and CA voltages.

Open Delta configuration is also supported in the VT connection ONLY. For example, if two voltage signals with a phase differential of 60 degrees are applied to 2 voltage terminals, with the remaining terminal grounded, the M-7679 will calculate and provide balanced Line to Line voltages AB, BC and CA derived from the two measured voltage signals. The M-7679 assumes proper polarity has been observed. The two measured signals come from Open Delta connected PTs.

Example of Open Delta CA:
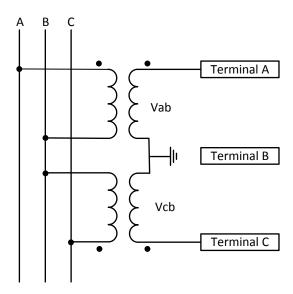
Figure 5   Open Delta CA Example Diagram

▲ Feature available at future date via firmware update

Cyber Security

The M-7679 was designed from the ground up to help customers be NERC and cyber security compliant. The M-7679 meets or exceeds the following standards:

IEEE 1686 Compliant

FIPS180-2, 186-2

IEC 62351-1, -2, -3, -5

ISO/IEC 9798-4

RFC 2104, 3174,3394

IPsec using Internet Key Exchange (IKE) Version 1 and 2, compliant with: RFC 2367, 2393, 2394, 2401, 2402, 2406, 2407, 2408, 2409, 2411, 2412, 3456, 3706, 3947 and 3948

RADIUS Server Support (optional), compliant with: RFC 2865 and 2866

Smart Peer-to-Peer (P2P) Communications▲

Smart P2P Communications is a peer-to-peer communication feature provided that shares operational status among peer devices within its local network. P2P communication can be done via Ethernet communications including multi mode fiber optic link. The transmission distance for fiber optic is dependent on the type of fiber optic used, "Single Mode" or "Multi Mode", and can transmit up to 2,000 meters. Smart P2P Communication can be used to implement pilot transfer schemes or advanced network reconfiguration algorithms.

S-7600 IPScom Communications Software

The S-7600 IPScom Communications Software enables local or remote communication between a Windows™ based computer and the M-7679 Multifunction Recloser Control. It is a Windows application, which allows the user to interact with software modules in different languages. The S-7600 IPScom Communications Software makes efficient use of object-oriented programming, achieving a smooth and scalable design, and has an open data structure that allows maintenance and the incorporation of new functions.

The S-7600 IPScom Communications Software is a Windows application that provides an easy graphical interface to program and monitor the M-7679. The S-7600 Software provides a simple function programming interface, plus an easy-to-use settings wizard.

Smart Flash SD Card Slot

Allows the user to perform the following functions locally without needing a laptop in field.

- Load Setpoints
- Save Setpoints
- Save Data Log
- Save Sequence of Events
- Save Oscillograph Records
- Clone Save

- Clone Load
- Firmware Update
- Save Metering Data
- Save Wake Screen Data
- Physical Security Key
- Bootloader Update

Cold Load Pickup

The M-7679 Cold Load Pickup feature provides the user with the ability to automatically adjust the M-7679 Overcurrent protection elements to consider the duration of a loss of load and the recloser response to the loss of load. The Cold Load Pickup feature can tailor the recloser settings to allow the return of the load without tripping. The Cold Load Pickup feature continuously monitors recloser parameters to ascertain when the non-Cold Load Pickup settings can be restored.

Selective Load Shedding Provides Improved System Response and Service Reliability

Modernizing existing recloser apparatus by retrofitting with the M-7679 provides improvements to system response and service reliability. The Recloser Control can be set up to recognize critical loads and help stabilize system loading. Including underfrequency elements as components of the Recloser Control scheme allows segmenting the feeder to sustain maximum load and respond to system conditions during power transients. Recloser programming allow as much as six levels of frequency and time settings to coordinate with other devices during a power loss.

General Specifications

Power Supplies

The M-7679 Recloser Control provides a choice of two main power supply input ranges; a low voltage range of 18 to 60 Vdc and a high range of 90 to 280 Vac or 90 to 315 Vdc.

The M-7679 also features a backup power supply input of 11 to 14 Vdc, that allows continued operation in case of main power supply loss.

▲ **CAUTION:** An orange TB3 receptacle indicates that a Low Voltage Power Supply is installed in the unit.

Power Supply	Range	Burden
24/48 Vdc	18-60 Vdc	12 VA
125/220 Vdc/Vac (Optional)	90-280 Vac 90-315 Vdc	15 VA

Table 2   Power Supply Specifications

AC Voltage Inputs

Voltage	Nominal	Maximum Continuous	Max Short Duration
Line to Neutral	120 Vac	300 Vac	600 Vac for 10 s
Low Energy Analog	4 Vac	12 Vac	300 Vac for 10 s

Table 3   AC Voltage Input Specifications

AC Current Inputs

AC Current	I Nominal	I Continuous	I Short duration
Phase Current	1 A/5 A	3 A/15 A	100 A/500 A for 1 second
Ground Current	1 A/5 A	3 A/15 A	100 A/500 A for 1 second
Sensitive Earth Fault (SEF)	10 mA/50 mA/200 mA	0.3 A/1.5 A/6 A	100 A for 1 second

Table 4   AC Current Input Specifications

Digital Inputs (Opto-Isolated)

The M-7679 includes four programmable inputs with capability for expansion up to twelve. These inputs must be externally wetted. The M-7679 offers two voltage ranges.

■ **NOTE:** Hardware prior to Serial Number 500 only supports a low voltage range of 24–48 Vdc with a minimum Turn-on Voltage of 18 Vdc. Please refer to the unit label "DIG. INPUTS" for the applicable range.

Wetting Voltage	
Input	Pickup Range
Low	9 – 60 Vdc
High	90 – 300 Vdc

Table 5   Digital Input Specifications

Output Contacts

The M-7679 includes four output contacts expandable to twelve. Any of the protective functions can be individually programmed to activate any one or more of the four Programmable Output Contacts (OUT1 through OUT4). Any output contact can also be selected as pulsed or latched. IPSlogic can also be used to activate output relay contact.

The optional expanded I/O includes an additional eight Programmable Output Contacts (OUT5 through OUT12). These contacts are configurable only using IPScom Communications Software.

The output contacts are all rated per IEEE C37.90 (See Tests and Standards section for details).

Operation Frequency and Phase Rotation

Frequency: 60 Hz or 50 Hz

Tracking: 42 to 65 Hz

Phase Rotation: ABC or ACB

Communications Ports

The unused communications ports can be disabled through software to comply with cyber security requirements.

Front – USB Port – Type B, Version 1.1 (Local Programming), SD Card

Rear – Communication Ports:

- Port 1 (standard) – Serial TIA-232, TIA-485, Fiber, or none
- Port 2/Port 3 (optional) – One or two Ethernet Ports, RJ45 10/100 BASE-T or Fiber 100 BASE-FX
- Port 4 (optional) – Serial TIA-232, TIA-485, Fiber, or none
- Ethernet Ports are auto-detect, auto-negotiable 10/100 Mbps, with support for multi-user rights for up to six concurrent users

Time Synchronization Port:

- IRIG - B (B000)
- Input – Demodulated
- Input level – TTL
- Isolation – 1,500 Vdc

Protocols

Serial Ports – MODBUS®, DNP3.0

Ethernet Ports – MODBUS over TCP/IP and UDP, DNP3.0 over TCP/IP and UDP; IEC 61850, SmartP2P (Peer to Peer)▲, IEC 60870-5-104/101▲ (optional)

Self-Diagnostics

The Recloser Control includes several self-diagnostic functions and routines that detect possible hardware failures. It also includes a manual test mode that is used to check if the LEDs, Inputs, Outputs, Display, and Keyboard are working properly.

▲ Feature available at future date via firmware update

System Setup

Figure 6   IPScom System Setup Screen (Shown: Voltage Input Option X4, Three-Phase Ganged)

Figure 7   IPScom System Setup Screen (Shown: Voltage Input Option H6, Independent Phase Capable)

System Setup (Cont'd.)

Figure 8   IPScom System Setup – Inputs Screen (with Extended I/O)

Figure 9   IPScom System Setup – Vurtual Inputs Screen
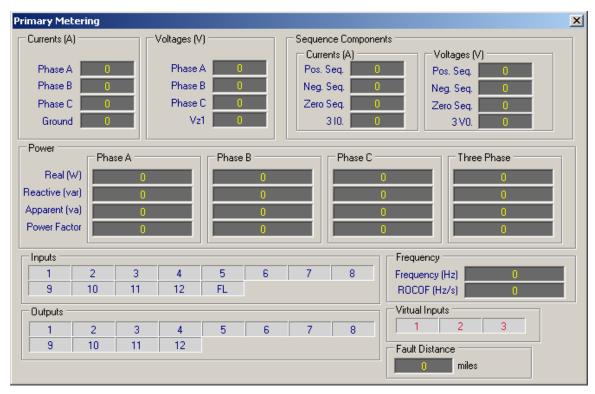
System Setup (Cont'd.)

Figure 10   IPScom System Setup – Outputs Screen (with Extended I/O)

Figure 11   IPScom System Setup – User Lines Screen

■**NOTE:** Secondary Metering Screen is identical.

Figure 12   IPScom Primary Metering Screen (Voltage Input Option X4, L4, H4 or VT)

■**NOTE:** Secondary Metering Screen is identical.
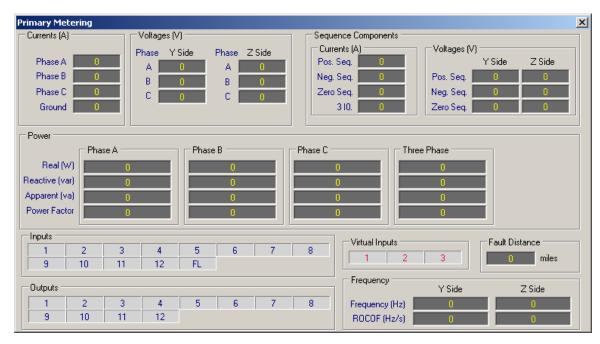
Figure 13   IPScom Primary Metering Screen (Voltage Input Option X6, L6 or H6)
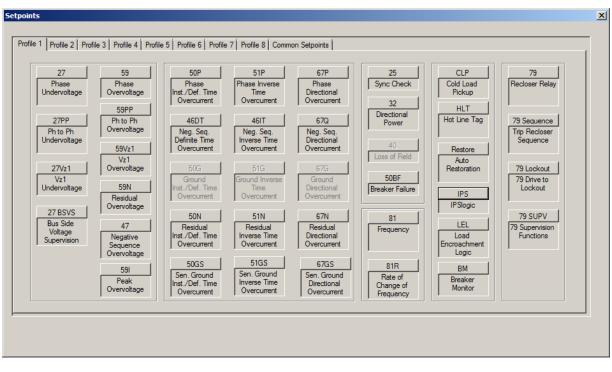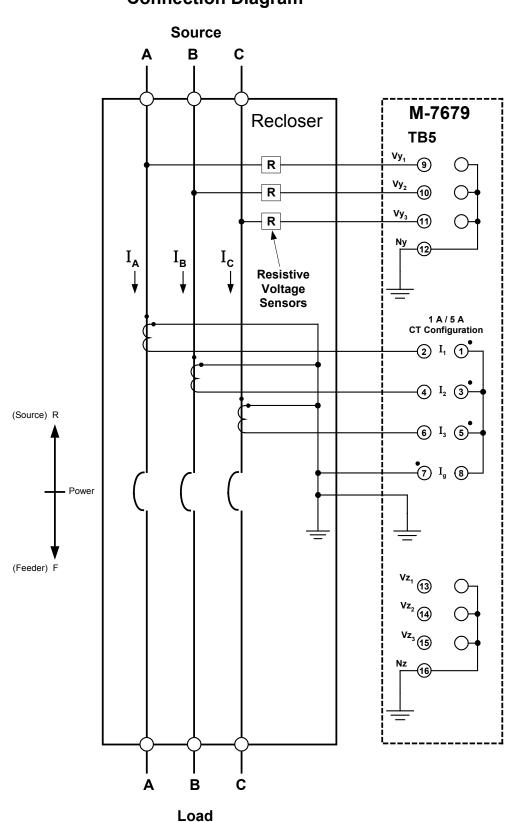
Figure 14   IPScom Setpoints Screen

Figure 15   IPScom Example Setpoint Screen: 27 Phase Undervoltage

Figure 16   IPScom Smart Button Programming Screen

**M-7679 Typical
Connection Diagram**

Source

Figure 17   M-7679 Three-Line Connection Diagram

Tests and Standards

The M-7679 Recloser Control complies with the following tests and standards:

Voltage Withstand

Dielectric Withstand
IEC 60255-27   2,000 Vac

Impulse Voltage
IEC 60255-27   +/- 5,000 V-pk

Insulation Resistance
IEC 60255-27   > 5 G Ω

Electrical Environment

Surge Withstand Capability
IEEE C37.90.1   +/- 2.5 kV Oscillatory
IEEE C37.90.1   +/- 4 kV Fast Transient Burst

1 MHz Oscillatory Immunity
IEC 61000-4-18   +/- 2.5 kV Common Mode
IEC 61000-4-18   +/- 2.5 kV Differential Mode

Electrostatic Discharge Test
IEEE C37.90.3   (+/- 8 kV) - Point Contact Discharge
IEEE C37.90.3   (+/- 15 kV) - Air Discharge
IEC 61000-4-2   (+/- 8 kV) - Point Contact Discharge
IEC 61000-4-2   (+/- 15 kV) - Air Discharge

Radiated Field Immunity
IEEE C37.90.2   35 V/m - 80 to 1000 MHz
IEC 61000-4-3   35 V/m - 80 to 1000 MHz

Fast Transient Disturbance Test
IEC 61000-4-4   +/-4 kV, 5 kHz

Surge Immunity
IEC 61000-4-5   +/- 4 kV Common Mode
IEC 61000-4-5   +/- 1 kV Differential Mode

Voltage Interruption Immunity
IEC 61000-4-11   (5 cycles AC / 50 ms DC)

Output Contacts

IEEE C37.90   30 A make for 0.2 seconds at 250 Vdc Resistive

8 A carry at 120 Vac, 50/60 Hz

6 A break at 120 Vac, 50/60 Hz

0.5 A break at 48 Vdc, 24 VA

0.3 A break at 125 Vdc, 37.5 VA

0.2 A break at 250 Vdc, 50 VA

Atmospheric Environment

Temperature

■ **NOTE**: The LCD display's visible temperature range is –20° C to +70° C.

IEC 60068-2-1   Cold, -40° C (-40° F) (operating)

IEC 60068-2-2   Dry Heat, +85° C (+185° F) (operating)

IEC 60068-2-78   Damp Heat, +40° C (+104° F) @ 95% rh (operating)

IEC 60068-2-30   Damp Heat condensation cycle, +25° C, +55° C (+131° F) @ 95% rh (operating)

Mechanical Environment

IEC 60255-21-1   Vibration response Class 1 (0.5 g)

Vibration endurance Class 1 (1 g)

IEC 60255-21-2   Shock response Class 1 (5 g)

Shock Withstand Class 1 (15 g)

Bump Endurance Class 1 (10 g)

IP Protection Degree

IEC 60529   IP 50, Dust Protected

External Connections

The possible connections for the M-7679 are shown in Figure 4.

Physical

5 Unit Height and 1/3 rack of 19"

Size: Vertical: 6.0" wide x 8.0" high x 6.22" deep (15.2 cm x 20.3 cm x 15.8 cm)

Horizontal: 9.47" wide x 5.20" high x 6.22" deep (24.1 cm x 13.21 cm x 15.8 cm)

Approximate Weight: 3.5 lbs (1.6 kg)

Approximate Shipping Weight: 5 lbs (2.27 kg)

Recommended Storage Parameters

Temperature: 5° C to 40° C

Humidity: Maximum relative humidity 80% for temperatures up to 31° C, decreasing to 31° C linearly to 50% relative humidity at 40°C.

Environment: Storage area to be free of dust, corrosive gases, flammable materials, dew, percolating water, rain and solar radiation.

Warranty

The M-7679 Digital Recloser Control is covered by a ten-year warranty from date of shipment.

Specification subject to change without notice.
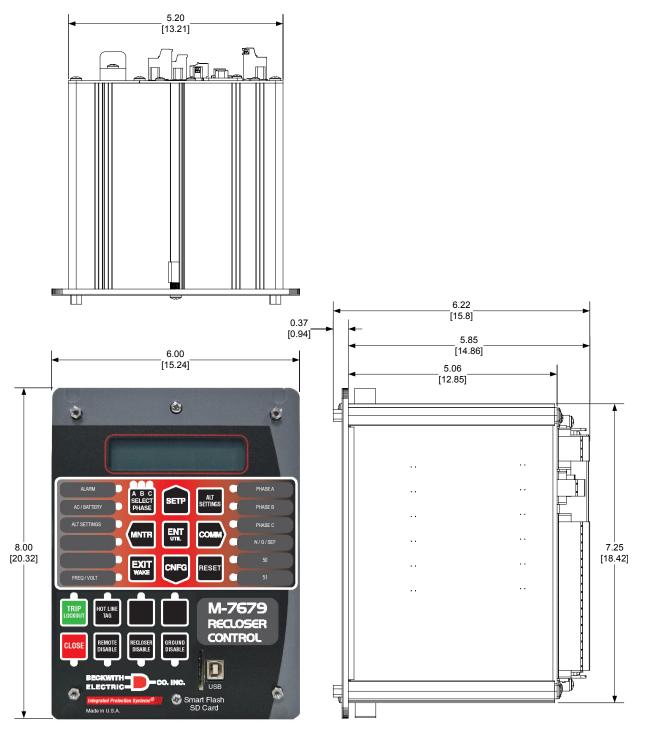
Figure 18   M-7679 Vertical Model External Dimensions
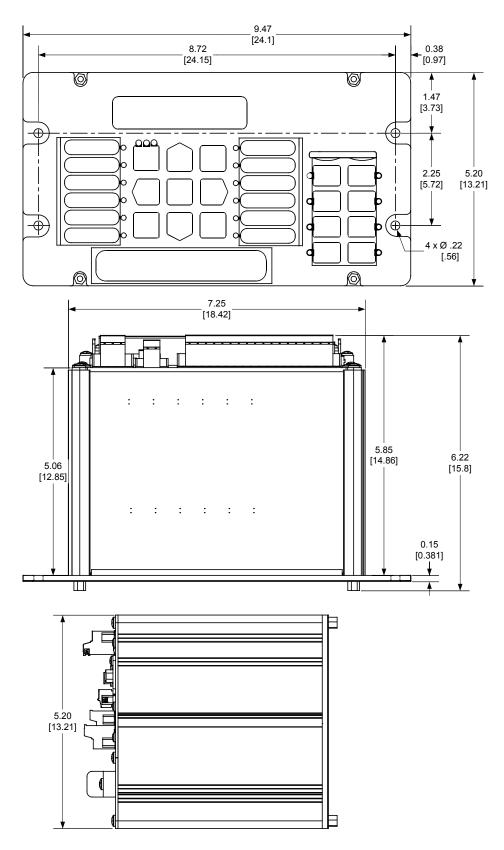
Figure 19   M-7679 Horizontal Model External Dimensions

M-2979 Recloser Control Cabinet

Cabinet houses Beckwith's M-7679 Recloser Control in complete recloser control replacement applications.

- Provides easy direct replacement of recloser controls for Cooper, G&W, Elastimold, SEL, ABB, Whip & Bourne, Joslyn, and Tavrida reclosers
- Eliminates the need for expensive rewiring of I/O signals accepting existing connector plugs for Power, Control, Voltages and Currents with the same pin sequence
- Accepts the existing communications connections for Serial TIA-232, TIA-485, Fiber Optic and IRIG-B
- Simplifies upgrading communications to optional true embedded Ethernet ports in the M-7679 Recloser Control allowing for multi-user, multi-protocol access to the advanced metering, PQ and DFR information collected by the control
- Includes an on board smart 24 V battery charger with 12 V and 24 V outputs

Figure 20   M-2979 Recloser Control Cabinet

M-2979 Recloser Control Cabinet (Cont'd.)

The M-2979 Recloser Control Cabinet, when combined with the M-7679 Recloser Control, provides convenient direct replacement of the control and cabinet for the following reclosers:

- Cooper/Traditional Electronic
- Cooper NOVA with Control Power Interface
- G&W Viper ST/LT
- Cooper NOVA STS & TS
- ABB Gridshield
- Tavrida OSM

- Cooper NOVA with Auxiliary Input Power
- G&W Viper S
- Elastimold MVR
- ABB OVR3 & VR-3S
- Joslyn TriMod 600R
- Whip & Bourne GVR

Application

The M-2979 includes the capability to change out the Recloser Control and Cabinet as one component. The M-2979 Recloser Cabinet and M-7679 Recloser Control combination includes all the required interface connections and external communications capabilities that are necessary to replace an existing recloser control. The M-2979 Recloser Control Cabinet meets or exceeds NEMA 250, IEC 60529 and IEEE C37.60. Each M-2979 Recloser Cabinet can be configured with the optional support equipment to match the existing recloser control application and environment or supplied completely empty.

Figure 21   M-2979 Recloser Control Cabinet Interior

M-2979 Recloser Control Cabinet (Cont'd.)

Construction

Available Cabinet Materials

- Aluminum (5052-H32 .090" thickness)
- Stainless Steel (Optional) (Type 316, 14 gauge)

Finish

- Polyester powder coat, exterior and interior color ANSI 70 Gray

Standard Features

- Metallic enclosures are all welded seam construction, ground smooth
- NEMA 3RX rated
- Single exterior gasketed door with:
    - Quarter turn 3 point latch with pad-locking handle (includes hole for 3/8" max lock hasp)
    - Large open angle > 120°
    - Hold open device
    - Integral document holder
    - Nameplate on inside of door
- Stainless steel hardware and hinges
- External ground stud
- Vented at bottom and upper back (fine mesh screens)
- All cabinet penetrations are sealed to prevent moisture and insect ingress
- Each cabinet includes the applicable connector layout in the bottom that replicates the specific recloser control cabinet being replaced. Also provides penetrations for options and future customer added accessories. Connector mounting hardware is only accessible from inside of cabinet.
- Two lifting eyes, 1.5" diameter holes, attached to sides of cabinet
- Interior swing panel with:
    - Flush mounted recloser control
    - Aluminum construction with class 3 chromate finish
    - Thumb latches
    - Ground strap
    - 120 Vac duplex, 3-wire, 15 A polarized GFI convenience receptacle (on 120 Vac and 240 Vac supply only)
- Pole mounting bracket that includes:
    - 5/8" maximum bolt diameter with keyway at top
    - 5/8" bolt diameter slot at bottom
    - 3 pole banding slots
- 35 mm DIN rail mounted Terminal Blocks

M-2979 Recloser Control Cabinet (Cont'd.)

Cabinet to Recloser Interface

- Main Control and Measurement
  - 14 Pin Cannon receptacle (Cooper Traditional/G&W Viper S)
  - 14 Pin Cannon receptacle with 2 Pin LV closing receptacle (Cooper Traditional, NOVA/G&W Viper S)
  - 14 Pin Cannon receptacle with 2 Pin LV closing receptacle and 6 Pin Dead Line (G&W Viper S)
  - 19 Pin Cannon receptacle (Cooper NOVA, G&W Viper S)
  - 24 Pin rectangular receptacle (ABB OVR3/VR-3S)
  - 24 Pin rectangular receptacle (Whip & Bourne GVR)
  - 26 Pin Cannon receptacle (Cooper NOVA TS/STS)
  - 32 Pin Cannon receptacle (G&W Viper ST/LT, Elastimold MVR)
  - 42 Pin rectangular receptacle (G&W Viper ST/LT, Tavrida OSM)

- Voltage Sensing
  - Direct Wiring
  - 4 Pin Cannon receptacle
  - 8 Pin Cannon receptacle (Threaded for 120 V)
  - 8 Pin Cannon receptacle (Quick Lock for LEAs)

- Power Supply
  - Direct Wired 1 Source
  - Direct Wired 2 Sources with AC Transfer Switch
  - 2 Pin Socket 1 Source
  - 3 Pin Socket 1 Source
  - Two, 2 Pin Sockets (2 Sources) with AC Transfer Switch
  - Two, 3 Pin Sockets (2 Sources) with AC Transfer Switch

M-2979 Recloser Control Cabinet (Cont'd.)

M-2032A Battery Charger

The M-2032A is designed to charge a 24 V sealed lead-acid battery. It includes an internal circuit to prevent overcharging of the battery and extend it's life. The charger feature of the M-2032A will not operate if it does not detect a minimum battery voltage of 21 Vdc.

- Provides 24 Vdc power to any Recloser Control configured with Low Voltage power supply
- Charges one 24 Vdc battery which upon AC power interruption can be used as temporary power (UPS) supply
- Accepts AC or DC power input from 105 to 285 V (50 or 60 Hz)
- Output:
    – 13.8 Vdc (+/- .5 V) @ 1 A for auxiliary equipment or 12 V controls regulated

    – 24 Vdc (+/- .5 V) @ 1 A for Beckwith Recloser Controls or auxiliary equipment

    – BATT Out – Battery Charge for 24 V Lead Acid Batteries, 1 A charge rate max

- Burden of less than 100 VA
- Transient suppressed, input and output
- Substation hardened -40° C to +85° C
- Conformal coated

Battery Charger Transient Protection

Surge Withstand Capability:

IEEE C37.90.1 ±2.5 kV Oscillatory, ±4 kV Fast Transient Burst

IEEE C37.90.1-1989 ±2.5 kV Oscillatory, ±5 kV Fast Transient

High Voltage – All M-2032A input terminals will withstand 1500 Vac RMS to chassis or instrument ground for one minute with a leakage current not to exceed 25 mA, for all terminals to ground. Input and output circuits are electrically isolated from each other, from other circuits and from ground.

Battery Charger Environmental

Temperature Range – -40° C to +85° C

Humidity – Operational to a maximum of 95% relative humidity.

Battery

- 24 Vdc (9 Ahr or 12 Ahr)
- Sealed lead acid

M-2979 Recloser Control Cabinet (Cont'd.)

Optional Equipment/Accessories

- Intrusion detection door contact

- Universal radio shelf

- Fold out out shelf for laptop rest

- Communications ready package

    – Fused DC power, 12 Vdc nominal

    – Radio equipment mounting

    – Polyphaser

    – Antenna and Type N external connector

    – Antenna cable lead with connectors

- Recloser control test switches mounted on the interior swing panel include:

    – Sensing currents

    – Sensing voltages

    – Trip and Close outputs

- Pole Mount Bracket Extension (B-1687) allows for mounting of the cabinet on any existing hole pattern from 20" to 40"

- 50 Watt, 120 Vac Heater with automatic thermostat (available on 120 Vac and 240 Vac supply only)

- Control cable locking devices, vandal resistant

- AC transfer switch

- Lightning Protection (For installations with external antennas) options include:

    – DSXL PolyPhaser Lightning Arrestor 700MHz - 2.7GHz N Female protected side, N Female Bulkhead antenna side.

    – AL-LSXM PolyPhaser Lightning Arrestor 2 GHz to 6 GHz N Female protected side, N Female Bulkhead antenna side.

    – SMA male to N male antenna cable to connect lightning protection to a radio for cabinet mount.

    – TNC male to N male antenna cable to connect lightning protection to a radio for cabinet mount.

    – N male to N male antenna cable to connect lightning protection to a radio for cabinet mount (48").

- Antennas:

    – Laird FG9023, 902 MHz to 928 MHz, 3 dBi gain, fiberglass Omnidirectional antenna, N Female connector.

    – FM2, antenna Pole Mount Bracket for Laird fiberglass antennas.

    – Laird TRAB9023NP, 902 MHz to 928 MHz, 3 dBi gain, Omnidirectional Phantom antenna, N Female bulkhead connector.

    – Laird TRAB806/17103P, Multi Band, 806 MHz to 2.5 GHz, 3 dBi gain, Omnidirectional Phantom antenna, N Female bulkhead connector.

    – SMA male to N male antenna cable to connect antennas with an integrated bulkhead to a radio for cabinet mount (48").

    – TNC male to N male antenna cable to connect antennas with an integrated bulkhead to a radio for cabinet mount (48").

    – N male to N male antenna cable to connect lightning protection to a radio for cabinet mount (48").

M-2979 Recloser Control Cabinet (Cont'd.)

Optional Equipment/Accessories (Cont.'d)

- Radio Options Include:

  2 Way VHF (154 MHz) radio

  – Radius

  2 Way (130 MHz - 3.7 GHz) radio modems:

  – SilverSpring Networks SSN ebridge and sbridge

  – MDS INET 900 AP

  – MDS INET II

  – MDS SD9

  – MDS X710

  – MDS SD4

  – MDS 9810

  – MDS TransNET

  – MDS Mercury 3650 and 900

  – MDS entraNET 900 and 2400

  – CellNet Series III

  Digital Cellular Modems:

  – Sixnet BT series Mobility Pro/Industrial Pro Gateways

  – Multitech Multimodem series routers and modems

  – AirLink Raven II, X, XE, XT

  – Telemetrics DNP RTMII

  – Zywan 3G/GPRS/GSM Cellular Modem

- Radio, Factory Installation:

  – Radio mounted and installed to M-2979

  – Customer supplied radio mounted and installed to M-2979A

- RS-232 Radio Comm Cable - 6' length.

- RS-232 Radio Comm Cable - 6' length (Male to Female null modem).

- Ethernet Radio Comm Cable - 6' length.

- DB9 to DB25 - RS-232 Cable Converter

- 1/2" HEYCO Liquid Tight Cordgrip to secure cable coming into cabinet.

- 25 foot N male to N male LMR-400 antenna extension cable

- AC Transfer Switch

- Surge Arrester for VT inputs

- Test Switches

- VT Fuses

- Cable Tray

M-2979 Recloser Control Cabinet (Cont'd.)

Physical

Aluminum (5052-H32), .090" thickness

Size: 28.78" high x 17.75" wide x 14.11" deep (73.1 cm x 45.01 cm x 35.84 cm)

Approximate Weight with M-7679: 30.4 lbs (13.79 kg)

Approximate Shipping Weight with M-7679: 36.4 lbs (16.51 kg)

Stainless Steel (316), 14 gauge

Size: 28.78" high x 17.75" wide x 14.11" deep (73.1 cm x 45.01 cm x 35.84 cm)

Approximate Weight with M-7679: 45.4 lbs (20.59 kg)

Approximate Shipping Weight with M-7679: 51.4 lbs (23.32 kg)

■ **NOTE:** Add approximately 7.5 lbs (3.4 kg) when equipped with Battery Backup option.

Warranty

The M-2979 Recloser Control Cabinet is covered by a five year warranty from date of shipment. Third party mounted options will carry their respective manufacturer's warranty, passed along through Beckwith Electric.

Trademarks

All brand or product names referenced in this document may be trademarks or registered trademarks of their respective holders.

Specification subject to change without notice. Beckwith Electric Co., Inc. has approved only the English version of this document.

M-2979 Recloser Control Cabinet (Cont'd.)
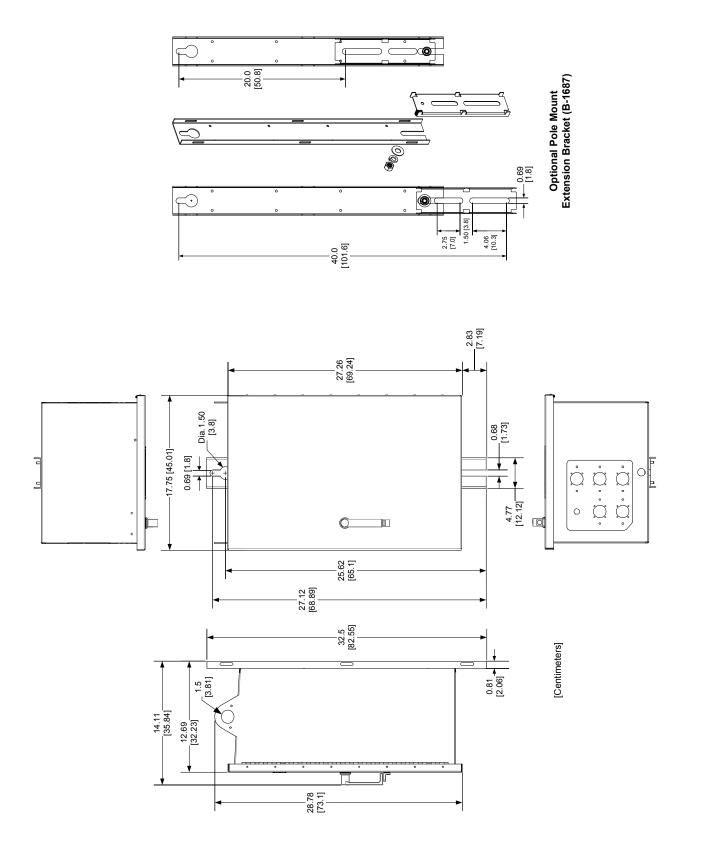
Figure 22   M-2979 Recloser Control Cabinet Dimensional Drawing

BECKWITH ELECTRIC CO., INC.
6190 - 118th Avenue North • Largo, Florida 33773-3724 U.S.A.
PHONE (727) 544-2326 • FAX (727) 546-0121
marketing@beckwithelectric.com
www.beckwithelectric.com
ISO 9001:2008

800-7679-SP-09   08/16

WARNING

DANGEROUS VOLTAGES, capable of causing death or serious injury, are present on the external terminals and inside the equipment. Use extreme caution and follow all safety rules when handling, testing or adjusting the equipment. However, these internal voltage levels are no greater than the voltages applied to the external terminals.

DANGER! HIGH VOLTAGE

– This sign warns that the area is connected to a dangerous high voltage, and you must never touch it.

PERSONNEL SAFETY PRECAUTIONS

The following general rules and other specific warnings throughout the manual must be followed during application, test or repair of this equipment. Failure to do so will violate standards for safety in the design, manufacture, and intended use of the product. Qualified personnel should be the only ones who operate and maintain this equipment. Beckwith Electric Co., Inc. assumes no liability for the customer's failure to comply with these requirements.

– This sign means that you should refer to the corresponding section of the operation manual for important information before proceeding.

Always Ground the Equipment

To avoid possible shock hazard, the chassis must be connected to an electrical ground. When servicing equipment in a test area, the Protective Earth Terminal must be attached to a separate ground securely by use of a tool, since it is not grounded by external connectors.

Do NOT operate in an explosive environment

Do not operate this equipment in the presence of flammable or explosive gases or fumes. To do so would risk a possible fire or explosion.

Keep away from live circuits

Operating personnel must not remove the cover or expose the printed circuit board while power is applied. In no case may components be replaced with power applied. In some instances, dangerous voltages may exist even when power is disconnected. To avoid electrical shock, always disconnect power and discharge circuits before working on the unit.

Exercise care during installation, operation, & maintenance procedures

The equipment described in this manual contains voltages high enough to cause serious injury or death. Only qualified personnel should install, operate, test, and maintain this equipment. Be sure that all personnel safety procedures are carefully followed. Exercise due care when operating or servicing alone.

Do not modify equipment

Do not perform any unauthorized modifications on this instrument. Return of the unit to a Beckwith Electric repair facility is preferred. If authorized modifications are to be attempted, be sure to follow replacement procedures carefully to assure that safety features are maintained.

PRODUCT CAUTIONS

Before attempting any test, calibration, or maintenance procedure, personnel must be completely familiar with the particular circuitry of this unit, and have an adequate understanding of field effect devices. If a component is found to be defective, always follow replacement procedures carefully to that assure safety features are maintained. Always replace components with those of equal or better quality as shown in the Parts List of the Instruction Book.

Avoid static charge

This unit contains MOS circuitry, which can be damaged by improper test or rework procedures. Care should be taken to avoid static charge on work surfaces and service personnel.

Use caution when measuring resistances

Any attempt to measure resistances between points on the printed circuit board, unless otherwise noted in the Instruction Book, is likely to cause damage to the unit.

TABLE OF CONTENTS
M-7679 Recloser Control
Instruction Book

Chapter 2   Operation (Cont'd.)

Chapter 2 Operation (Cont'd.)

Chapter 3 IPScom®

Chapter 3   IPScom (Cont'd.)

Chapter 3   IPScom (Cont'd.)

Chapter 4   System Setup

Chapter 4   System Setup (Cont'd.)

Chapter 4   System Setup (Cont'd.)

Chapter 5   Setpoints (Cont'd.)

Chapter 5   Setpoints (Cont'd.)

Chapter 5   Setpoints (Cont'd.)

Chapter 5 Setpoints (Cont'd.)

Chapter 6   Installation

Chapter 7   Testing

Appendix D   Cyber Security (Cont'd.)

Appendix E   Self-test Error Codes

Appendix F   Battery Charger

Appendix G   Appendix – S-1100 Remote Ethernet File Update Utility

800-7679-IB-09   08/16

1 Introduction

1.1 Instruction Book Contents

This instruction book includes seven Chapters and eight Appendices.

Chapter 1: Introduction

Chapter One summarizes the devices' capabilities, introduces the instruction book contents and provides an overview of the M-7679 Recloser Control.

Chapter 2: Operation

Chapter Two provides the necessary instructions regarding operation of the M-7679. Manual operation of the M-7679 is accomplished by utilizing the unit's front panel controls and indicators, or through the S-7600 IPScom Communications and Oscillographic Analysis Software.

Chapter 3: IPScom

Chapter Three provides a description of each element of the S-7600 IPScom Communications Software. The IPScom menu structure and commands are described in detail for each feature and function.

Chapter 4: System Setup

Chapter Four is designed for the person(s) responsible for the direct setting and configuration of the system. It describes the procedures for entering all required data into the M-7679. Included in this chapter are functional and connection diagrams for a typical application for the system. It also illustrates the definition of system quantities and equipment characteristics required by the M-7679.

Chapter 5: Setpoints

Describes the individual function settings and the Setpoint configuration process for the unit (choosing active functions), output contact assignment and input blocking designation.

Chapter 6: Installation

The person or group responsible for the installation of the M-7679 will find herein all mechanical information required for physical installation, equipment ratings, and all external connections in this chapter. For reference, the Three-Line Connection Diagrams are repeated from **Chapter 4, System Setup**. Additional tests which may be desirable at the time of installation are described in **Chapter 7, Testing**.

Chapter 7: Testing

This chapter provides step-by-step test procedures for each function, as well as diagnostic mode and auto-calibration procedures.

Appendix A: HMI Menu Flow

This Appendix includes the M-7679 HMI Flow diagrams to aid the user in navigating the menu system.

Appendix B: Recloser Control Configuration Worksheet

This Appendix contains a copy of the Recloser Control Input/Output Configuration Table and is provided to define and record the blocking inputs and output configuration for the recloser.

Appendix C: DNP Configuration Editor

This Appendix includes the DNP Configuration Editor features and functions.

Appendix D: Cyber Security

This Appendix includes comprehensive setup procedures to implement a NERC/CIP compliant security system.

Appendix E: Self-Test Error Codes

This Appendix lists all the error codes and their definitions.

Appendix F: Battery Charger

This Appendix includes the M-2032A Battery Charger features and functions.

Appendix G: S-1100 Remote Ethernet File Update Utility

This Appendix includes the S-1100 Remote Ethernet File Utility (REFU) features and functions.

Appendix H: Index

This Appendix includes the Index for the M-7679 Instruction Book.

1.2   General Overview of M-7679 Recloser Control

The M-7679 is a digital, Smart Grid ready, advanced Recloser Control and Protection System that is compatible with most manufacturer's switchgear and suitable for new installations or as a direct, easy-to-install, replacement for older recloser controls. It offers a comprehensive protection package with individual protection functions as shown in Table 1-1, with up to eight setting groups for either Three-Phase Ganged or Independent Phase Capable reclosers.

The Recloser Control Front Panel includes the following features:

- LCD display, 2 rows, 20 characters per row, with configurable contrast
- Twelve programmable tricolor front panel LEDs
- Keyboard – 17 pushbuttons (Two dedicated for Trip and Close)
- Six programmable pushbuttons with programmable LEDs
- Nine function pushbuttons

The M-7679 Recloser Control, communication module and auxiliary equipment is housed in a NEMA 3RX cabinet.

The M-7679 features a high accuracy metering system with advanced recording and reporting functions as well as continuous data sampling at 128 samples per cycle.

By configuring various combinations of the slow–, fast–, and time-delay curve elements, the M-7679 Recloser Control can allow as many as five trips and four total reclosing operations. If required, individual reclose intervals are user-settable with time-delays of up to 600 seconds. The settings for the different functions can be accomplished by using the IPScom S-7600 Communication Software or the front panel pushbuttons.

The M-7679 includes Programmable Alarm LEDs to indicate any general overcurrent trip (TRIP), plus additional LEDs to indicate the type of overcurrent trip. The Fast-Curve LED indicates a Fast-Curve Trip.

For convenience and safety, the M-7679 Recloser Control offers an SD card reader. Programming can be done in the office and settings can be loaded using an SD card thus minimizing the time a user needs to spend in front of the control.

FUNCTION	DESCRIPTION
25	Sync Check
27	Phase Undervoltage
27PP	Phase-to-Phase Undervoltage
27Vz1	Vz1 Undervoltage
27BSVS	Bus Side Voltage Supervision
32	Directional Power
46DT	Negative-Sequence Definite Time Overcurrent
46IT	Negative-Sequence Inverse Time Overcurrent
47	Negative-Sequence Overvoltage
50BF	Breaker Failure
50P	Phase Instantaneous/Definite Time Overcurrent
50G	Ground Instantaneous/Definite Time Overcurrent
50N	Residual Instantaneous/Definite Time Overcurrent
51P	Phase Inverse Time Overcurrent with Voltage Control/Restraint
51N	Residual Inverse Time Overcurrent
51G	Ground Inverse Time Overcurrent
59	Phase Overvoltage
59PP	Phase-to-Phase Overvoltage
59I	Peak Overvoltage
59N	Residual Overvoltage
59Vz1	Vz1 Overvoltage
60FL	VT Fuse Loss Detection

FUNCTION	DESCRIPTION
67P	Phase Directional Overcurrent
67N	Residual Directional Overcurrent
67G	Ground Directional Overcurrent
67Q	Negative-Sequence Directional Overcurrent
81	Frequency
81R	Rate-of-Change of Frequency
BM	Breaker Monitor
CLP	Cold Load Pickup
HLT	Hot Line Tag
Restore	Auto Restoration
PSBC	IED Power Supply/Battery Charger Monitor
TCM/CCM	Trip/Close Circuit Monitoring
THD/TDD	Total Harmonic Distortion/Total Demand Distortion
Recloser Functions	
79	Auto Reclose
79 Sequence	Trip Recloser Sequence
79 Lockout	Drive to Lockout
79 SUPV	Supervision Functions
Optional Protective Functions **(with 200 mA, 50 mA or 10 mA Ground CT option)**	
50GS	Sensitive Ground Instantaneous/Definite Time Overcurrent
51GS	Sensitive Ground Inverse Time Overcurrent
67GS	Sensitive Ground Directional Overcurrent

Table 1-1   M-7679 Device Functions

Communication Ports

The M-7679 includes five physical communication ports. The unused communications ports can be disabled through software to comply with cyber security requirements.

- Front – USB Port, Type B, Version 1.1. This port is used to locally set and interrogate the control using a portable computer.
- Port 1, (standard) located on the rear of the control can be either a Serial TIA-232, TIA-485, Fiber, or none.
- Port 2/Port 3, (optional) located on the rear of the control can be either a RJ45 Ethernet 10/100 BASE-T or Fiber Ethernet 100 BASE-FX.

  Ethernet Ports are auto-detect, auto-negotiable 10/100Mbps, with support for multi-user rights for up to six concurrent users.

- Port 4, (optional) located on the rear of the control can be either a Serial TIA-232, TIA-485, Fiber, or none.

Time Synchronization Port:

- IRIG - B (B000)
- Input – Demodulated
- Input level – TTL
- Isolation – 1,500 Vdc

Communications Protocols

USB Port – MODBUS RTU

Rear Serial Ports – DNP 3.0 level 2 slave, MODBUS RTU and Smart P2P (Peer-to-Peer)

Optional Ethernet Ports – DNP 3.0 over TCP/IP and UDP, and MODBUS over TCP, IEC 61850 (optional) plus Smart P2P

Time Sync: SNTP

Detailed information regarding the use of the control communications ports is provided in **Chapter 3, IPScom**.

S-7600 IPScom Communications Software

The S-7600 IPScom Communications Software enables local or remote communication between a Windows™ based computer and the M-7679 Recloser Control. The S-7600 IPScom Communications Software makes efficient use of object-oriented programming, achieving a smooth and scalable design, and has an open data structure that allows maintenance and the incorporation of new functions.

The S-7600 IPScom Communications Software is a Windows application that provides an easy graphical interface to program and monitor the M-7679. The S-7600 Software provides simple setup programming in the easy-to-use Recloser Wizard.

See **Chapter 3, IPScom** for an overview of IPScom features.

1.3   Accessories

M-2979 Recloser Control Cabinet

The M-2979 Recloser Control Cabinet is an aluminum polyester powder coated, welded seam construction, single gasketed door, NEMA 3RX rated cabinet. See the M-7679 Specification for detailed features and options.

M-24xx Recloser Control Adapter Chassis

The M-24xx series of Recloser Control Adapter Chassis are tailored to provide direct drop in replacement of recloser controls. The unique wiring/control harnesses and connectors match existing recloser control configurations.

2 Operation

■ **CYBER SECURITY NOTE:**
When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

The purpose of this chapter is to describe the steps that are necessary to interrogate the M-7679 utilizing either the front panel HMI or a Windows™ based computer running IPScom S-7600 Communications Software through any of the available communications ports. These instructions assume that the following conditions exist:

- The unit is energized from an appropriate power supply (Green Alarm LED is illuminated).

    See **Chapter 6**, **Installation**, Section 6.3 External Connections, for power supply connection details.

- For Windows based computer communications, IPScom is installed on the host computer.

    See **Chapter 3**, **IPScom S-7600**, Section 3.2 Installing IPScom, if IPScom is not installed.

- Initial computer communication has been established with the unit.

    If this is the first attempt to establish communications with the unit, then see **Chapter 3**, **IPScom S-7600**, Section 3.3 Communications Using Direct USB Connection.

2.0   Operations Quick Index

2.1   Front Panel Controls and Indicators Overview

The front-panel user interface consists of an LCD display, dedicated/programmable pushbuttons, and dedicated/programmable tri-color LEDs.

DISPLAY

A two row, by 20 character per row Liquid Crystal Display (LCD) with configurable contrast is provided on the Recloser Control front panel (Figure 2-1). The display normally displays the user lines and remains so until the **SETP**, **CNFG**, **MNTR**, **COMM**, or **ENT UTIL** pushbutton is depressed or a recloser cycling message is displayed.
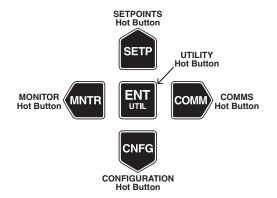
NAVIGATION PUSHBUTTONS

The Navigation pushbuttons provide the means to navigate through the HMI menu screens and also to effect changes to settings.

They are used to enter new values by incrementing or decrementing the displayed value. The new value is not stored until the **ENT** pushbutton is pressed a second time. The navigation pushbuttons also provide direct access "Hot Buttons" to HMI menu headers.

Pressing the applicable pushbutton will display the heading corresponding to the "Hot Button" label contained in the pushbutton (Figure 2-1).

The "Hot Buttons" directly access the menu headers and can only be selected from either the user lines or the cycling display. While the **EXIT** pushbutton is not a Hot Button, it provides the means to navigate back to upper level menus and also "Wakes" the recloser.

In addition to the navigational/hot buttons the recloser control front panel also includes dedicated pushbuttons that activate recloser features. The pushbutton locations are stated as a function of the front panel index presented in Figure 2-2.

The dedicated pushbuttons (non programmable) include:

- Select Phase (S1)
- Alt Settings (S3)
- RESET (S9)

Default/preassigned programmable pushbuttons include:

- TRIP Lockout (S10)
- HOT LINE TAG (S11)
- CLOSE (S14)
- REMOTE DISABLE (S15)
- RECLOSER DISABLE (S16)
- GROUND DISABLE (S17)

The above default/preassigned pushbuttons, and pushbuttons S12 and S13 can be programmed by the user subject to the programming limitations stated in the IPScom, Setup/Configuration/Buttons feature.

SELECT PHASE Pushbutton (S1)

Three-Phase Ganged Mode

If the recloser control operates in Three-Phase Ganged Mode "all three phases operate at the same time", then the **SELECT PHASE** pushbutton is not operable when performing TRIP or CLOSE command operations originating from the front panel pushbuttons. In this mode, LEDs 7,8 and 9 will illuminate red when the recloser is closed and green when the recloser is open. However, if a "Trip Close Error" is detected, then LEDs 7,8 and 9 will be extinguished.

Independent Phase Mode

In an Independent Phase Capable recloser type configuration where each phase operates independently, in order to manually TRIP or CLOSE the recloser from the front panel pushbuttons, the user must first press the **SELECT PHASE** button. The selection sequence for the **SELECT PHASE** pushbutton is as follows:

- First Press – Causes the control to be ready to TRIP or CLOSE all three phases simultaneously (LED 7, 8 and 9 illuminate).
- Second Press – Phase A Only (LED 7)
- Third Press – Phase B Only (LED 8)
- Fourth Press – Phase C Only (LED 9)
- Fifth Press – Phase A, B and C (LEDs 7, 8 and 9)

When selected, the Phase(s) LED will flash Red or Green corresponding to its current status. The LED will illuminate GREEN if the breaker status is TRIP or RED if the breaker status is CLOSE. If the breaker status can not be determined, or there was a failure to TRIP, a failure to CLOSE, or interrupter failure, then LEDs 7, 8 and 9 will alternately flash Red and Green.

TRIP LOCKOUT (S10)

The **TRIP LOCKOUT** pushbutton is a pre-programmed pushbutton that retains its ability to be reprogrammed. When it is pressed, a trip command is initiated which activates the dedicated TRIP Output contact based on its configuration and the Lockout condition is set. If there is a time delay enabled on the TRIP output, then LED 16 will flash green. The flash rate is once per second. LED 16 will remain illuminated (solid) green once the contact is fired, only if the 52b contact is energized. LED 16 will flash amber when an Overcurrent Element 50/51 is picked up and timing to trip. LED 16 will also illuminate solid red when the recloser is in lockout state. There is a 2 second delay when this LED changes from green to red. LED 16 will extinguish when a Trip Close Error is detected.

When the control is powered down when it is in a Lockout condition, the control will remember the Lockout condition when power is restored to the control and will also send a TRIP command to the breaker.

CLOSE (S14)

■**NOTE:** If a Trip Close Error is active, then both Local Manual and Remote Manual Close operations are blocked.

The **CLOSE** pushbutton is a pre-programmed pushbutton that retains its ability to be reprogrammed. When it is pressed it initiates a Close command which activates the dedicated Close Output contact based on its configuration. If there is a time delay enabled on the Close output, then LED 20 will flash red. The flash rate is once per second. LED 20 will remain illuminated (solid) red once the contact is fired, only if the 52a contact is energized. LED 20 will extinguish when a Trip Close Error is detected.

GROUND DISABLE (S17)

The **GROUND DISABLE** pushbutton is a pre-programmed pushbutton that retains its ability to be reprogrammed. When pressed, this pushbutton deactivates all enabled Ground and Neutral protective functions. LED 23 will illuminate amber indicating the enabled Ground and Neutral protective functions have been deactivated. Pressing this pushbutton when GROUND DISABLE is active will reinstate all enabled Ground and Neutral protective functions. LED 23 will extinguish. When the recloser control is powered up, the state of this pushbutton is that GROUND DISABLE feature is not active and all enabled Ground and Neutral protective functions are active. LED 23 is extinguished.

RECLOSER DISABLE (S16)

The **RECLOSER DISABLE** pushbutton is a pre-programmed pushbutton that retains its ability to be reprogrammed. When pressed, this pushbutton deactivates an enabled 79 Recloser function. LED 22 will illuminate amber indicating the enabled 79 Recloser function has been deactivated. Pressing this pushbutton when RECLOSER DISABLE is active will reinstate an enabled 79 Recloser function. LED 22 will extinguish. When the recloser control is powered up, the state of this pushbutton is that RECLOSER DISABLE feature is not active, and enabled 79 Recloser functions are active. LED 22 is extinguished.

REMOTE DISABLE (S15)

The **REMOTE DISABLE** pushbutton is a pre-programmed pushbutton that retains its ability to be reprogrammed. When pressed, this pushbutton disables all remotely initiated operations and LED 21 illuminates in amber. Remote operations include any operation initiated through communication with the recloser. When the recloser control is powered up, the state of this pushbutton is that the REMOTE DISABLE feature is not active, and remote operations are enabled. LED 21 is extinguished.

HOT LINE TAG (S11)

The **HOT LINE TAG** pushbutton is a pre-programmed pushbutton that retains its ability to be reprogrammed.

When the **HOT LINE TAG** pushbutton is pressed, the Hot Line Tag feature will become active and inhibit all Close operations, regardless of the source of the Close command. LED 17 will illuminate amber indicating Hot Line Tag is active.

The state of the **HOT LINE TAG** pushbutton is non-volatile. If a main power interruption to the recloser control occurs, the recloser control will remember the HOT LINE TAG state at the time of the power interruption. When power is reinstated, the HOT LINE TAG status prior to the power interruption will be reinstated.

Hot Line Tagging can only be disabled by the same source that enabled it, either from the control front panel or remotely.

ALTERNATE SETTINGS (S3)

When the Alternate Settings pushbutton is pressed for greater than 0.5 seconds the recloser control will display the Profile Switching menu. The user can then switch the active profile to any of the 8 available profiles. LED 4 will illuminate amber indicating Alternate Settings are active.

RESET/LAMP TEST (S9)

The **RESET/LAMP TEST** pushbutton is a dedicated pushbutton and can not be programmed to actuate another feature or function. When pressed (for at least 3 seconds) it Resets the latched signals and LEDs. This pushbutton also performs a test of the LEDs by turning them all on simultaneously for 2 seconds after the pushbutton is depressed. All LEDs will illuminate amber for these 2 seconds.

LEDS

LED locations are presented in Figure 2-2. LEDs can be illuminated as Red, Green or Amber. The LEDs can be selected to latch (illuminate) on a particular color: Red, Green or Amber. This selection is available through IPScom's LED configuration utility. By default LEDs 10, 11, 12 are latched on RED. RED indicates overcurrent function timeout. Only LEDs 2, 3, 4, 5, 6, 13, 14, and 15 are programmable for latching. The latch condition is resettable by using the reset command either on the front panel, or remotely through communications. The latch condition is non-volatile and in case of a main power interruption to the recloser control, the recloser control will remember the latch state at the time the power interruption occurred.

■**NOTE:** Functions 32 and 67 do not have LEDs configured by default. These can be programmed through IPScom's Custom LED configuration utility.

ALARM LED (LED 1)

The ALARM LED will illuminate green at power up when all the self-diagnostic tests have passed. If any of the tests fails, the led flashes red. The LED will flash green to indicate that the health of the recloser control is good. Any anomaly causes the LED to flash red. Any conditions that trigger the alarm condition will be displayed on the LCD display. This LED configuration is fixed except for limited customization of the alarm list.

Alarm conditions that will cause the Alarm LED to illuminate and flash red include:

- Any DSP problem
- Runtime setpoints checksum mismatch
- Memory test failure
- Any alarm conditions configured by the user though software
- AC power supply failure
- Battery charger failure
- Battery failure or trouble
- Clock not set
- Control circuit interrupted
- Interrupter mechanism problem
- Recloser Closed and failed to Trip
- Recloser Open and failed to Close
- Indeterminate recloser state

When the ALARM LED is flashing red, recloser control protection will be disabled when any of the following conditions are met:

- SF6 Gas Pressure
- Trip Close
- EEprom Setpoints Checksum
- Flash Not Formatted
- AC Power/Battery Status
- DSP Watchdog
- EEprom Calibration Check
- Max Breaker Operation
- Internal Battery Failure

AC/BATTERY (LED 2)

The AC element of the AC/BATTERY LED illuminates amber when 120 Vac power supply voltage is less than minimum level at the recloser control terminals.

The BATTERY element of the AC/BATTERY LED illuminates red when the battery is not healthy. Either the battery voltage is low; it cannot take a charge, or failed the latest load test.

The AC/BATTERY LED will illuminate green if all of the following conditions exist:

- The 120 Vac power supply voltage is greater than minimum level at the recloser control terminals.
- Battery voltage is not low
- Battery can be charged
- Battery has not failed the latest load test

When there is no battery charger connection, this LED can be programmed with the Power Supply OK status. The Power Supply OK illuminates green as long as the input voltage is between the high and low reference voltage setpoints of the power supply settings.

ALT SETTINGS (LED 3)

When any settings group is active other than the primary group, the LED will illuminate amber, otherwise it will be extinguished.

Unassigned (LEDs 4 and 5)

LEDs 4 and 5 are unassigned and can be user programmed utilizing the LEDs Utility found under the Setup/Configuration menu drop down in IPScom. See Chapter 3 for more information.

FREQ/VOLT (LED 6)

The FREQ/VOLT LED illuminates green when a 81 Element (not 81R) has caused a trip signal. The FREQ/VOLT LED will illuminate red when a 27 or 59 Element has caused a trip signal.

SELECT PHASE (LED 7, 8, 9)

Refer to the SELECT PHASE pushbutton (S1).

PHASE A, B, C (LED 10, 11, 12)

Each PHASE LED illuminates red when a trip signal is issued when the respective phase current exceeds its minimum trip setting. While the phase element is timing to trip, the respective LED will illuminate amber. If the element resets before tripping, the respective LED will extinguish. The PHASE LEDs are fixed and can not be reprogrammed.

N/G/SEF (LED 13)

The N/G/SEF LED illuminates red when a trip signal is issued when the Ground or Sensitive Earth Fault or Neutral current exceeds its minimum trip setting. While the Ground or Sensitive Earth Fault or Neutral current element is timing to trip, the LED will illuminate amber. If the element resets before tripping, the respective LED will extinguish. The N/G/SEF LED is fixed and can not be reprogrammed.

50 (LED 14)

The 50 LED will illuminate red when a 50 Element has caused a trip signal.

51 (LED 15)

The 51 LED will illuminate red when a 51 Element has caused a trip signal.
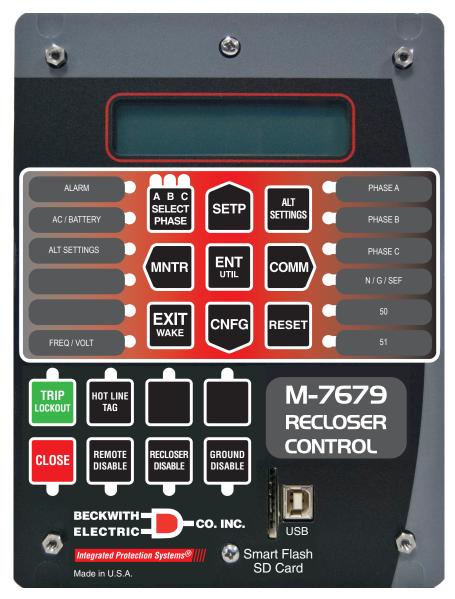
Figure 2-1   M-7679 Front Panel
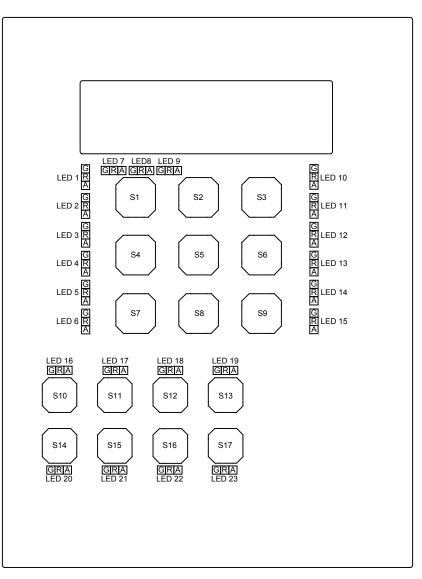
Figure 2-2   Pushbutton and LED Location Index

HMI MENU STRUCTURE

The HMI menu structure (Appendix A) consists of three levels; Header, Sub-Header and Data/Data Entry. From the header level the user can navigate to the adjacent headers with the **LEFT** and **RIGHT** pushbuttons (Figure 2-2), go to the sub-header level by pressing **ENT** or **DOWN** pushbutton, or clear the screen by pressing the **EXIT** pushbutton.

From the sub-header level, the user can navigate to the adjacent sub-headers with the **LEFT** and **RIGHT** pushbuttons, return to the header level by pressing the **EXIT** or **UP** pushbuttons, or enter the data/data entry level by pressing **ENT** or **DOWN**. Once in the data/data entry screens, the user can navigate through the list with the **UP** and **DOWN** pushbuttons. In this level the list wraps around. To exit the level, the user can press **EXIT** to return to the corresponding sub-header, or use the **LEFT** and **RIGHT** pushbuttons to go to the adjacent sub-header level. To enter data, reset parameters or access data screens, press **ENT**.
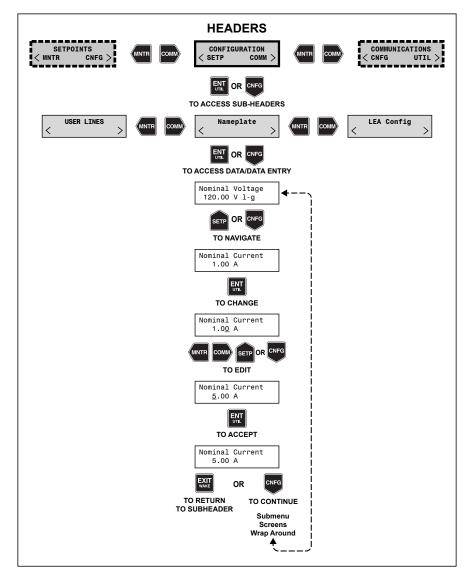
Figure 2-3   HMI Menu Structure and Navigation Example

ENT Pushbutton

The **ENT** pushbutton is a hot button for the "Utility Menu". It is also used to perform the following functions:

- Enter the "edit" mode of a screen
- Store a setpoint or condition in memory
- Enter the sub-header or data level
- Reset certain monitoring screens

EXIT Pushbutton

The **EXIT** pushbutton is a hot button for a unit "wakeup", which starts cycling through a series of user selectable metering information screens. The user can move up and down the automatic cycling using the **UP** and **DOWN** pushbuttons. The screens for the wakeup sequence can be enabled or disabled from the IPScom S-7600 Communications Software (See Section 4.1 Unit Setup).

The **EXIT** pushbutton is also used to perform the following functions:

- Exit a level to the next higher level
- Cancel data entry
- Clear the screen when at the header level

Data Entry Screens

Data entry screens are of three types:

- Alphanumeric – the **LEFT** and **RIGHT** pushbuttons advance the cursor to the digit to be edited and the **UP** and **DOWN** pushbuttons change the value
- List – the **UP** and **DOWN** pushbuttons change the data
- Bit Mask – the **LEFT** and **RIGHT** pushbuttons move the cursor to the bit and the up and down pushbuttons change the value

For all screens the **ENT** pushbutton saves the value and **EXIT** pushbutton cancels the operation. An "underscore" beneath the far left or far right character or digit indicates the user is in the **EDIT** mode.

Power Up Screens

Each time the control is powered up, it will briefly display a series of screens that include:

- Initializing
- Loading Configuration
- Loading DSP
- User Lines

LCD Screen Contrast

The LCD screen contrast can be set/reset from the control front panel through the HMI menu item at any time. The LCD Screen Contrast adjustment menu item is located in the Communication/HMI menu.

"EDIT" Mode Prompt

An underscore beneath the far left or far right character or digit is enabled by initially pressing **ENT**. This prompt indicates that the user can change a setting using the **UP** or **DOWN** pushbuttons to increment or decrement the settings. Values have factory preset increments, such as 0.1 volt or 1 second. Press **ENT** the second time to execute the setting change.

Smart Flash SD Card Slot

The Smart Flash SD Card Slot allows the user to:

- Load and Save Setpoints
- Save Datalog/Datalog Range
- Save Sequence of Events Record/Range
- Save Oscillograph
- Clone Save/Clone Load
- Load and Save DNP Configuration
- Save Metering Data
- Update Firmware
- Update Bootloader

The steps necessary to perform these actions are described later in this chapter.

2.2   Operation (HMI/IPScom)

MESSAGE SCREENS (HMI)

Default Message Screen

When the M-7679 is energized and unattended, the User Logo lines are displayed along with any System Alarm messages.

Wakeup Message Screens

If **EXIT WAKE** is selected, the display will initiate a cycling display of any parameters selected in the IPScom Wakeup Dialog screen (Figure 3-76).

The Wakeup cycling can be frozen by selecting either the **UP** or **DOWN** pushbutton once, which will continuously display the wakeup screen being displayed at that moment. Utilize the **UP**/**DOWN** arrow pushbuttons to advance to the next parameter. Press the **EXIT** pushbutton to return to the User Lines screen.

Fault Recorder Event Message

In the event of a fault, the HMI will display a message alert that a fault has occurred with the timestamp of the most recent event, similar to the following:

```
Fault occurred
01/20/16  08:36:19.54
```

The screen will then cycle through the following parameters:

- Fault occurred/Time Stamp
- Input Status
- Output Status
- Function Pickup
- Function Timeout
- Voltages
- Currents

To clear the cycling display, press the **RESET** pushbutton.

Custom Messages

The user has the option to display up to eight custom messages.in the HMI top menu main screen. The messages are enabled utilizing the IPSlogic feature of IPScom (see Chapter 5 Setpoints). Once enabled, the user may edit the message text from the IPScom Setup/Setpoints/IPSlogic dialog screen.

CYBER SECURITY

NERC/CIP Compliant Cyber Security

To provide NERC/CIP compliance, the M-7679 offers enhanced Cyber Security utilizing User Name/Password authorization. When this cyber security is enabled, access to the control is restricted to authorized users. Access to specific HMI menus is determined by the User Permissions assigned by the Security Administrator. See **Appendix D, Cyber Security** for detailed information.

OSCILLOGRAPH RECORDER

Trigger Oscillograph Recorder

To manually trigger the Oscillograph recorder from IPScom perform the following:

1. Start IPScom, then establish communications with the target control.
2. Select **Setup/Oscillograph/Trigger** from the IPScom toolbar. IPScom will display an Oscillograph Trigger confirmation screen (Figure 2-4).

Figure 2-4   Manual Oscillograph Trigger Confirmation Screen

3. Select "YES". IPScom will display an "Oscillograph was triggered successfully" confirmation screen (Figure 2-5).

Figure 2-5   Oscillograph Recorder Successfully Triggered Confirmation Screen

4. Select "OK". IPScom will return to the Main screen.

Retrieve Oscillograph Record

Oscillograph data must be retrieved from the control in a Comtrade file (*.cfg) in order to be viewed. The included BecoPlot Oscillograph Analysis Software program (Utility/BecoPlot) or any Comtrade reader is required to view the downloaded oscillograph files.

To retrieve Oscillograph data perform the following:

1. Start IPScom, then establish communications with the target control.
2. Select **Setup/Oscillograph/Retrieve** from the IPScom toolbar. IPScom will display a "Retrieve Oscillograph Record" dialog screen (Figure 2-6).

Figure 2-6   Retrieve Oscillograph Record Dialog Screen

3. Select the desired oscillograph record(s), then select "Retrieve". IPScom will display a Retrieve Oscillograph Record "Save As" dialog screen (Figure 2-8).

   Selecting "Auto Save" displays a popup window allowing all available records to be selected (Figure 2-7). Select "Yes" to allow IPScom to automatically select and save all records to the same location, rather than displaying the "Save As" screen for each selected record.

Figure 2-7   Retrieve Oscillograph Record Auto Save Popup Screen

Figure 2-8   Retrieve Oscillograph Record (Save As) Dialog Screen

4. Select the desired location for the downloaded record(s). Select "Save". IPScom will display a Download Oscillograph Record status screen (Figure 2-9).

Figure 2-9   Download Oscillograph Record Status Screen

When the oscillograph record has been downloaded, IPScom will display the following confirmation screen.

Figure 2-10   Oscillograph Data Records Were Retrieved Confirmation Screen

5. Select "OK". IPScom will return to the Main screen.

Clear Oscillograph Records (IPScom)

To Clear all Oscillograph records in the recloser control perform the following:

1. Start IPScom, then establish communications with the target recloser.

2. Select **Setup/Oscillograph/Clear** from the IPScom toolbar. IPScom will display a Clear Oscillograph Record confirmation screen (Figure 2-11).

Figure 2-11   Clear Oscillograph Record Confirmation Screen

3. Select "Yes", IPScom will display a confirmation dialog screen (Figure 2-12).

Figure 2-12   Oscillograph Records Cleared Successfully Confirmation Screen

4. Select "OK". IPScom will return to the Main screen.

SEQUENCE OF EVENTS

Retrieve Sequence of Events Record

IPScom can be utilized to download and view the Sequence of Events (*.soe) format file contents.

To retrieve Sequence of Events data perform the following:

1. Start IPScom, then establish communications with the target recloser.

2. Select **Setup/Sequence of Events/Retrieve** from the IPScom toolbar. IPScom will display a Retrieve Sequence of Events Record "Save As" dialog screen (Figure 2-13).

Figure 2-13   Retrieve Sequence of Events Record (Save As) Dialog Screen

3. Select a folder to save the file to and the desired file name, then select "Save". IPScom will display a Download SOE Record status screen (Figure 2-14).
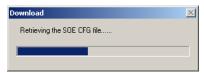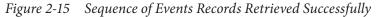
Figure 2-14   Download Sequence of Events Record Status Screen

When the Sequence of Events record has been downloaded, IPScom will briefly display a confirmation screen (Figure 2-15), followed by the Open Viewer prompt screen (Figure 2-16).

Figure 2-15   Sequence of Events Records Retrieved Successfully

Figure 2-16   Sequence of Events Open Viewer Prompt Screen

4. Select "Yes" to open the file in the Sequence of Events Viewer. Select "No" to return to the main screen.

View Sequence of Events From IPScom

The Sequence of Events Viewer allows the user to view detailed Sequence of Events Record parameters.

■**NOTE:** Sequence of Events is monitored at a fixed period of 1 cycle.

1. Start IPScom, then select **Utility/Data Analysis/SOE Viewer/Sequence of Events Viewer** from the IPScom toolbar. IPScom will display a "Sequence of Events Viewer" dialog screen (Figure 2-17).

2. Select "Open" and navigate to the folder containing the desired Sequence of Events file(s).

3. The viewer displays all events in the selected file. Double-click any event to display the "Sequence of Events Detailed Record" (Figure 2-18) with the following captured basic parameters:

   - Active Profile
   - Current (A, B, C, N)
   - Voltage (A, B, C, N)
   - Voltage (Pos., Neg., Zero)
   - Current (Pos., Neg., Zero)
   - Real Power (A, B, C, 3Ph)
   - Reactive Power (A, B, C, 3Ph)
   - Power Factor (A, B, C, 3Ph)
   - Apparent Power (A, B, C, 3Ph)

   - Frequency
   - Frequency Change
   - ITIC Events (VA, VB, VC)*
   - Operation Counters
   - Control Status
   - Pickup Status
   - Timeout Status
   - Voltage Harmonics
   - Current Harmonics

   *A more detailed view of the ITIC data is available in the Power Quality Viewer (Figure 2-19).

■**NOTE:** Up to four Sequence of Events Detailed Record Screens can be opened at
one time.

The Sequence of Events Detailed Record screen includes the following information:

- **Control Status** – Control features that were active at the time the Sequence
  of Event capture was initiated.
- **Pickup Status** – Pickup signal(s) that triggered the SOE Recorder.
- **Timeout Status** – Timeout signal(s) that triggered the SOE Recorder.
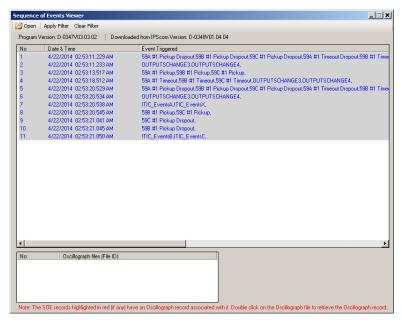
Figure 2-17   Sequence of Events Viewer Dialog Screen

Figure 2-18   Sequence of Events Detailed Record Dialog Screen

View Power Quality Events From IPScom

The PQ Events Viewer allows the user to view detailed ITIC Event parameters from the Sequence of Events Record.

To view ITIC Events records perform the following:

1. Start IPScom, then select **Utility/Data Analysis/SOE Viewer/PQ Viewer** from the IPScom toolbar. IPScom will display the "PQ Events Viewer" dialog screen (Figure 2-19).

2. Select "Open" and navigate to the folder containing the Sequence of Events file.

3. Select the Sequence of Events record to display the captured ITIC parameters. Hovering over a plotted point will display the details of the event in the "Event Data" portion of the screen. Select the "PQ Table Form" tab to view the ITIC event parameters in a Table format (Figure 2-20).
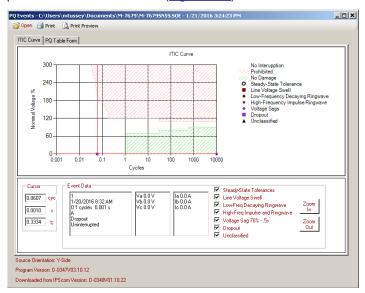
Figure 2-19   PQ Events Viewer Graphic Format Screen

Figure 2-20   PQ Events Viewer Table Format Screen

Clear Sequence of Events Records

To Clear Sequence of Events records from the control perform the following:

1. Start IPScom, then establish communications with the target recloser.

2. Select **Setup/Sequence of Events/Clear** from the IPScom toolbar. IPScom will display a Clear Sequence of Events Record confirmation screen (Figure 2-21).

Figure 2-21   Clear Sequence of Events Record Confirmation Screen

3. Select "Yes". IPScom will display a "Sequence of Events records cleared successfully" confirmation screen (Figure 2-22).

Figure 2-22   Sequence of Events Record Cleared Successfully Confirmation Screen

4. Select "OK". IPScom will return to the Main screen.

DATA LOGGING

Retrieve Data Logging Data From IPScom

1. Start IPScom, then establish communications with the target control.

2. Select **Setup/Data Logging/Retrieve** from the IPScom toolbar. IPScom will briefly display a "Retrieving Directory" status screen followed by a Data Log "Save As" dialog screen (Figure 2-23).

Figure 2-23   Data Log Retrieve "Save As" Dialog Screen

3. Select a folder to save the file to and the desired file name, then select "Save". IPScom will display the following (.csv) file prompt screen (Figure 2-24). Select "Yes" to have IPScom automatically create a (.csv) copy of the Data Log to the selected folder.

Figure 2-24   Save Data Log File as ".CSV" Copy Prompt Screen

4. IPScom will display a Download status screen. When the Data Log download is complete IPScom will display the following confirmation screen.

Figure 2-25   Data Log Records Were Retrieved Confirmation Screen

5. IPScom will automatically open BecoPlot to view the Data Log record.

Clear All Data Log Records From IPScom

1. Start IPScom, then establish communications with the target recloser.

2. Select **Setup/Data Logging/Clear** from the IPScom toolbar. IPScom will display a Clear Data Log Record confirmation screen (Figure 2-26).

Figure 2-26   Clear All Data Log Records Confirmation Screen

3. Select "Yes". IPScom will display a "Data Log records were cleared" confirmation screen (Figure 2-27).

Figure 2-27   Data Log Records Cleared Successfully Confirmation Screen

4. Select "OK". IPScom will return to the Main screen.

MONITOR

Accessing the HMI Monitor Screens

1. Press [MNTR]. The menu will advance to "MONITOR".

```
        MONITOR
❮UTIL            SETP❯
```

2. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
     Primary Metering
❮                    ❯
```

3. Press [MNTR] or [COMM] as necessary to navigate to the desired Monitor Sub-Header screen:

```
     Secondary Metering
❮                    ❯
```

```
     Frequency Metering
❮                    ❯
```

```
     Fault Location
❮                    ❯
```

```
         Status
❮                    ❯
```

```
     Fault Indication
❮                    ❯
```

```
        Harmonics
❮                    ❯
```

```
     Battery Charger
❮                    ❯
```

4. Press [CNFG] as necessary to view specific parameters within the selected Monitor Sub-Header as shown in the following list.

Control Front Panel Monitor Screens

The HMI categories/parameters for Monitoring are:

PRIMARY METERING

Current and Voltages

Va, Vb, Vc, Vz1 Volts

Ia, Ib, Ic Amps

In/Ig Amps

Seq Components

V1, V2, Vo Volts

I1, I2, Io Amps

Power

Watts (A, B, C, 3 Phase)

VArs (A, B, C, 3 Phase)

VA (A, B, C, 3 Phase)

SECONDARY METERING

Current and Voltages

– Phase

Va, Vb, Vc, Vz1 Degrees

Ia, Ib, Ic Degrees

In/Ig Degrees

– Magnitude

Va, Vb, Vc, Vz1 Volts

Ia, Ib, Ic Amps

In/Ig Amps

Seq Components

V1, V2, Vo Volts

I1,I2, Io Amps

Power and Demand

Demand Voltage (A, B, C, S)

Demand Current (A, B, C, G)

Present Watts (A, B, C)

Present VArs (A, B, C)

Present VA (A, B, C)

Present Power (3 phase)

Present Power Factor (A, B, C, 3PH)

Demand History

– Phase A, B, C

Min/Max Va (Vb, Vc)

Min/Max Ia (Ib, Ic)

Min/Max Pa (Pb, Pc)

Min/Max Qa (Qb, Qc)

Min/Max Sa (Sb, Sc)

Demand History (Cont.'d)

– Three Phase

Min/Max P

Min/Max Q

Min/Max S

Demand History Reset

– Ground/Neutral

Min/Max Vz1

Min/Max Ig

Energy Metering

KWatt Hours Forward (A, B, C)

Lagging KVAr Hours (A, B, C)

KWatt Hours Reverse (A, B, C)

Leading KVAr Hours (A, B, C)

Energy Meter Reset

FREQUENCY METERING

Frequency (Hz)

Rate of Change of Frequency (Hz/s)

FAULT LOCATION

Fault Distance (miles)

Fault Type

STATUS

Input Status

Output Status

Power Supply Voltage

Counters

FAULT INDICATION

View Fault Records

HARMONICS

Voltage % THD (A, B, C)

Current % THD (A, B, C)

Current % TDD (A, B, C)

Voltage Harmonics (A, B, C)

Current Harmonics (A, B, C)

BATTERY CHARGER

Battery Status

Battery Voltage (V)

Charging Current (A)

Accessing the IPScom Monitor Screens

The Monitor sub-menu screens, when connected to a recloser, display parameter values consistent with the capabilities of the communication system.

Monitor/Primary and Secondary Metering

To access the Primary or Secondary Metering parameters utilizing IPScom, select **Monitor/ Primary (or Secondary) Metering** from the IPScom Main Screen drop down menu. IPScom will display the applicable Metering screen (Figure 2-28 or Figure 2-29) which includes Metering data for Currents, Voltages, Sequence Components, Power and Frequency. Also included is the Status of Inputs, Outputs, Virtual Inputs and Fault Distance.

■ **NOTE:** Secondary Metering Screens are identical.
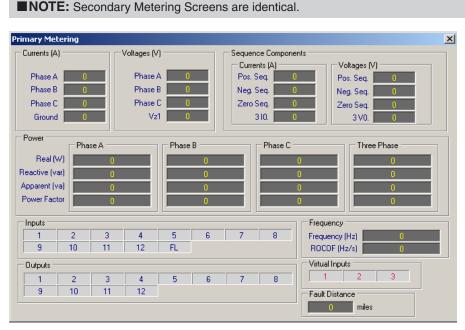
Figure 2-28   IPScom Primary Metering Screen (Voltage Input Option X4, L4, H4 or VT)
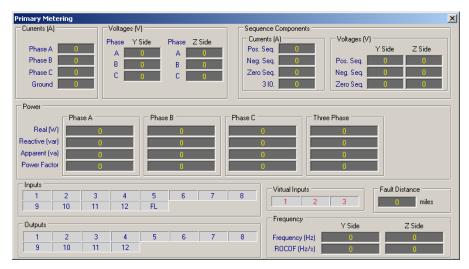
Figure 2-29   IPScom Primary Metering Screen (Voltage Input Option X6, L6 or H6)

Monitor/Function Status

Function Status Monitoring is available to the user from the IPScom Monitor/Function status drop down menu on the Main Menu Bar. The Function Status screen (Figure 2-30) presents a realtime graphic representation of the Recloser Control Protective Function pickup and trip status as well as those Inputs and Outputs that are activated.

Figure 2-30   Function Status Screen

Monitor/Recloser Monitoring

Recloser Status Function 79 (Figure 2-31) can be monitored in real time. Breaker Status Phase A, B, and C, Recloser Settings and Reclose Status Phase A, B, and C are displayed.

- Breaker Status (Phase A, B, C)   • Supervision
- Settings   • Reset from Lockout Timer
- Reclose Status (Phase A, B, C)   • Timing Status (Trips 1 through 5)
- Fault Type

The screen contains a Breaker Status/Time Graph which displays displays real time Breaker Status relative to Time since a fault has occurred (Ground or Phase) on Cold Load Pickups. Trip Time, Reclose Time, and Reset Time are displayed as a function of the Timing Option selection.

The Recloser Status screen also includes a "Refresh" Selection. The Refresh selection refreshes the "Settings" and "Reclose Status" displays to reflect the current 79 Function settings in the event that the Active Settings Profile has changed.

Figure 2-31   Recloser Status Monitoring Screen (Three-Phase Ganged)

Figure 2-32   Recloser Status Monitoring Screen (Independent Phase)

Monitor/Demand Metering

To access the Demand Metering screen from IPScom, select **Monitor/Demand Metering**. IPScom will display the Demand Metering screen (Figure 2-33). The Demand Metering screen, when connected to a control, displays parameter values consistent with the capabilities of the communication system. All Demand History and Energy Metering Values include the date and time at which each occurred.

The **Demand Interval** applies to the Demand Present and the Demand History parameters. The Demand Interval can be set to 15, 30, and 60 minutes.

The **Max Demand Load Current (I_L)** setting is an element of the Total Demand Distortion calculation and is applied when the Total Demand Distortion function is enabled.

■**NOTE:** Selecting "**UTC**" at the bottom of the screen displays the Date/Time in Universal Time Code format. Display either Primary or Secondary values using the "**Toggle**" selection.

Figure 2-33   Demand Metering Screen

Monitor/Harmonics

To access the Harmonic Analysis screen from IPScom, select **Monitor/Harmonics**. IPScom will display the Harmonic Analysis screen (Figure 2-34).
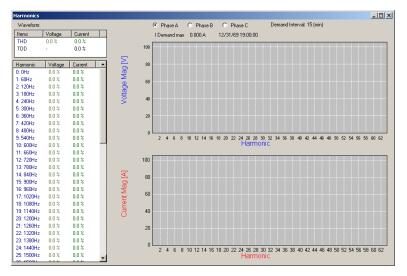
Figure 2-34   Harmonic Analysis Screen

WEB BROWSER INTERFACE

This feature allows the user to monitor the M-7679 from a web browser. The HTTP protocol must be enabled to use this feature. The HTTP protocol can be enabled from either the HMI (*COMM>Comm Ports Security>Protocol Access>HTTP*) or IPScom (*Communication>Setup>Comm Port Security>Protocol Access*) as shown below.

Figure 2-35   Communication, Comm Port Security, Protocol Access Dialog Screen

Accessing the M-7679 utilizing a Web Browser

Enter the IP address of the target unit to display the M-7679 landing page (Figure 2-36).

Figure 2-36   M-7679 Web Browser Landing Page

Select the "M-7679 Monitor" link from the top black toolbar to display the available monitoring selections (Figure 2-37).

Figure 2-37   M-7679 Web Browser Monitor Page

Select the Monitoring screen to be displayed from either the red link or the dropdown menu. An example of the Primary Metering screen is shown in Figure 2-38.

Figure 2-38   Web Browser Primary Metering Screen Example

Select the "Help" link from the top black toolbar to display Figure 2-39 which contains links to support information available on the Beckwith Electric website.
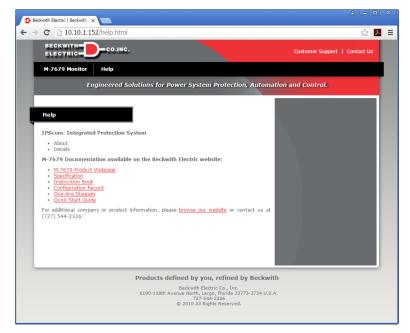
Figure 2-39   Web Browser Help Screen

REMOTE CONTROL

The Remote Control menu item located in the **Utility** dropdown menu displays the applicable Remote Control screen (Figure 2-40). Remote Control allows the user to remotely open or close the recloser in either Three-Phase Ganged or Independent Phase modes. The feature allows the user to "Trip Lockout" and "Close" all phases in Three-Phase Ganged mode or individual phases in Independent Phase mode. "Reset" and "Disable Hot Line Tag" commands can be initiated as well. See "Utility/Remote Control" on page 3–57 for detailed information.

Figure 2-40   Three-Phase Ganged or Independent Phase Remote Control Dialog Screen

Remotely Setting/Overriding Control Outputs

> ■**NOTE:** Recloser Control Outputs "Enable Remote Control" setting for the desired Output(s) must be enabled to remotely set/override the Output(s).

> ▲**CAUTION:** Setting or Overriding Control Outputs remotely can adversely affect Recloser Operation.

The following operations can be performed from the IPScom "Remote Output Control" dialog screen Figure 2-41:

- Energize or De-energize Output 1 or 2
- Energize or De-energize Outputs 3 and 4 (also 5 – 12 for Expanded I/O units)
- Reset Latched Outputs 3 and 4 (also 5 – 12 for Expanded I/O units)
- Force Output Reset of all Outputs

To remotely Set or Override a Control Output from IPScom perform the following:

1. Start IPScom, then establish communications with the target recloser.
2. Select **Utility/Remote Output Control** from the IPScom toolbar. IPScom will display the Remote Output Control dialog screen (Figure 2-41).
3. Select the desired Output Contact(s) to be set/overridden.
4. Select the desired setting or override:

   – Energize   – Force Output Reset

   – De-energize   – Reset Latched Outpu

   IPScom will display a confirmation screen for the specific selection. If "Force Output Reset" was selected, then the Force Output Reset selection will change to a "Red" indication which means that all Output Contacts are de-energized. Also, the Output Contact selections will be grayed out.

5. Select "Yes" to implement the selected Setting or Override.

Figure 2-41   Remote Output Control Dialog Screen

SEND AN IEC 61850 CONFIGURATION FILE

To Send an IEC 61850 Configuration file proceed as follows:

1. Start the IPScom Communications Software on the PC.
2. Connect to the M-7679 control.
3. Select **Communication/Setup/Protocol/IEC 61850/Send CID File**. IPScom will display the "Open" dialog screen with a default file extension of "*.cid".
4. Select the desired Configuration file, then select "Open". IPScom will display the "Upload" status screen (Figure 2-42) while the Configuration file is sent.

Figure 2-42   IEC Configuration File Upload Status Screen

5. When the file has been successfully sent to the control, IPScom will display the File Sent Successfully confirmation screen (Figure 2-43).

Figure 2-43   IEC Configuration File Sent Successfully Confirmation

Retrieve an IEC 61850 Configuration File

To Retrieve an IEC 61850 Configuration file proceed as follows:

1. Start the IPScom Communications Software on the PC.
2. Connect to the M-7679 control.
3. Select **Communication/Setup/Protocol/IEC 61850/Retrieve CID File**. IPScom will briefly display a "Retrieving Directory" screen and then display the "Save As" dialog screen with a default file extension of "*.cid".
4. Name the Configuration file, then select "Save". IPScom will display the "Download" status screen (Figure 2-44) while the Configuration file is transferred.

Figure 2-44   IEC Configuration File Download Status

5. When the file has been successfully downloaded from the control, IPScom will display the File Retrieved Successfully confirmation screen (Figure 2-45).
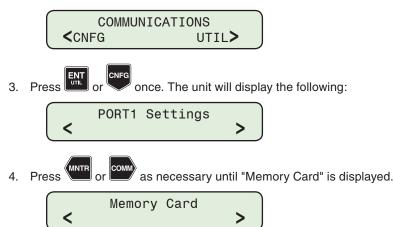
Figure 2-45   IEC Configuration File Retrieved Successfully Confirmation

SMART FLASH SD CARD

Accessing the Smart Flash SD Card Screens (HMI)

1. Verify that a (FAT) formatted Smart Flash SD Card is inserted into the Smart Flash SD Card slot.

2. Press [COMM]. The menu will advance to "COMMUNICATIONS".

```
      COMMUNICATIONS
   ❮CNFG          UTIL❯
```

3. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
      PORT1 Settings
   ❮                  ❯
```

4. Press [MNTR] or [COMM] as necessary until "Memory Card" is displayed.

```
       Memory Card
   ❮                  ❯
```
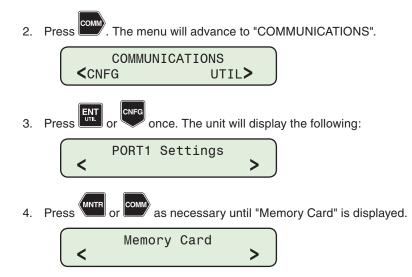
The Memory Card can now be utilized to:

- Load Setpoints
- Save Setpoints
- Save Datalog/Datalog Range
- Save Sequence of Events Record/Range
- Save Oscillograph
- Save Trip Sequence Event Record
- Clone Save/Clone Load
- Save Metering Data
- Firmware Update
- Bootloader Update

Loading Setpoints from a Smart Flash SD Card

The Setpoints file consists of the specific setpoint settings for ALL 8 Profiles. Loading a setpoint file from an SD Card overwrites the existing setpoint file. Care must be taken to ensure the correct file has been selected for loading onto the control. Setpoint changes are immediately acted on by the control and may cause undesired control operation.

1. Insert the Smart Flash SD Card (that includes the setpoints file) into the control as previously described.

2. Press [COMM]. The menu will advance to "COMMUNICATIONS".

```
      COMMUNICATIONS
   ❮CNFG          UTIL❯
```

3. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
      PORT1 Settings
   ❮                  ❯
```

4. Press [MNTR] or [COMM] as necessary until "Memory Card" is displayed.

```
       Memory Card
   ❮                  ❯
```

5. Press [CNFG] as necessary to navigate to the "Load Setpoints" menu item.

```
Load Setpoints
Press ENT to begin
```

6. Press [ENT UTIL]. The control will prompt the user to select the file to be loaded.

■**NOTE:** If an arrow is displayed on either end of the bottom display line, additional setpoint files are available for selection.

```
Enter file name:
m7679  →
```

7. Utilize [MNTR] or [COMM] to select the desired setpoint file (*.spf).

▲**CAUTION:** Setpoint changes are immediately acted upon by the control and may cause undesired control operation.

8. Press [ENT UTIL]. The unit will display the following sequence of screens:

```
Load Setpoints
Loading file...
```

```
Load Setpoints
Processing file...
```

```
Load Setpoints
File loaded
```

The new setpoints are now available to the control.

9. Press [ENT UTIL] or [EXIT WAKE] to return to the "Load Setpoints" screen.

Saving Files Utilizing a Smart Flash SD Card

The steps to Save Setpoint files are described as follows. The steps are similar to save any of the following data files:

- Datalog
- Datalog Range
- Sequence of Events Record
- SOE Record Range
- Oscillograph
- Metering Data
- Trip Sequence Event Record
- Clone Save

Clone Save

The Clone Save feature provides the user with the capability to save all of a control's settings to a Smart Flash SD Card with the exception of the control's serial number. See the detailed steps for performing a **Clone Load** later in this Chapter.

Saving Setpoints to a Smart Flash SD Card

The setpoints file consists of the specific setpoint settings for ALL 8 Profiles. Saving the control setpoint file to an SD Card allows the user to open the saved file in IPScom and then edit specific profiles while retaining any existing setpoint information for the profiles which are NOT changing. This edited file can then be saved onto an SD Card and reloaded onto the control. Setpoint changes are immediately acted on by the control and may cause undesired control operation.
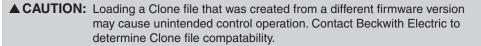
1. Insert the target Smart Flash SD Card (that has adequate space available) into the control as previously described.

2. Press [COMM]. The menu will advance to "COMMUNICATIONS".

```
        COMMUNICATIONS
   ‹CNFG           UTIL›
```

3. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
        PORT1 Settings
   ‹                    ›
```

4. Press [MNTR] or [COMM] as necessary until "Memory Card" is displayed.

```
         Memory Card
   ‹                    ›
```

5. Press [CNFG] as necessary to navigate to the "Save Setpoints" menu item.

```
   Save Setpoints
   Press ENT to begin
```

6. Press [ENT UTIL]. The control will prompt for a file name to be entered.

```
   Enter file name:
   m7679
```

7. Utilize the arrow pushbuttons to enter the desired file name.

8. Press [ENT UTIL]. The unit will display the following sequence of screens:

```
   Save Setpoints
   Saving file...
```

```
   Save Setpoints
   File saved
```

9. Press [ENT UTIL] or [EXIT WAKE] to return to the "Save Setpoints" screen.

Clone Load from a Smart Flash SD Card

The Clone Load feature provides the user with the capability to load a control Clone file with all the cloned control's settings to another control with the exception of the serial number.

> ▲ **CAUTION:** Loading a Clone file that was created from a different firmware version may cause unintended control operation. Contact Beckwith Electric to determine Clone file compatability.

1. Insert the Smart Flash SD Card (that includes the Clone file) into the control as previously described.

2. Press [COMM]. The menu will advance to "COMMUNICATIONS".

```
      COMMUNICATIONS
  <CNFG           UTIL>
```

3. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
      PORT1 Settings
  <                    >
```

4. Press [MNTR] or [COMM] as necessary until "Memory Card" is displayed.

```
      Memory Card
  <                    >
```

5. Press [CNFG] as necessary to navigate to the "Clone Load" menu item.

```
  Clone Load
  Press ENT to begin
```

6. Press [ENT UTIL]. The control will display the following:

```
          SN1.cln
      MM/DD/YY  HH:MM
```

7. Utilize [MNTR] or [COMM] to navigate to the the desired Clone file.

8. Press [ENT UTIL]. The unit will display the following:

```
  Clone All Settings?
  YES
```

The user may choose to clone **ALL** settings, including Communications and User Lines; or to clone **ONLY** the Communications or User Lines settings.

    a. To Clone **ALL** settings including Communications and User Lines, select **YES**.

    b. To Clone **ONLY** Communications or User Lines settings, select **NO**. The following sequence of screens will be displayed:

```
  Clone Comms?
  YES
```

```
  Clone User Lines?
  YES
```
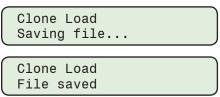
    c. Select **YES** or **NO** as desired.

9. Press [ENT UTIL]. The control will display the following:

```
Check Config Match?
YES
```
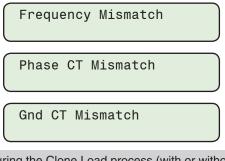
The user may choose to perform a configuration match check which verifies the compatibility of the clone file with the unit configuration. The user may also load the Clone file without the configuration match check. Select **YES** or **NO** as desired, then press **ENT**.

   a. If **YES** was selected, the unit will perform an internal configuration match check. If the control configuration matches the clone file, the unit will proceed with the Clone Load process.

   b. If **NO** was selected, the unit will load the Clone file without performing a configuration match.

   c. The unit will display the following sequence of screens:

```
Clone Load
 Saving file...
```

```
Clone Load
 File saved
```

   d. If **YES** was selected and the the control configuration does not match the clone file, the control will display one or more of the following error messages and the Clone Load process will cease:

```
Frequency Mismatch
```

```
Phase CT Mismatch
```

```
Gnd CT Mismatch
```

■**NOTE:** During the Clone Load process (with or without the "Check Config Match" selected, the following error messages may be displayed when applicable:

Clone file loaded with a setpoint out of range:

```
Loaded, range error
```

Clone file loaded which has generated an eeprom error:

```
Loaded, eeprom error
```

Clone file loaded, but the file is corrupt:

```
Loaded signature error
```

SD Card error, clone file cannot be read:

```
File read error
```

Press [ENT UTIL] or [EXIT WAKE] to return to the "Clone Load" screen.

Firmware Update from a Smart Flash SD Card

1. Insert the Smart Flash SD Card (that contains the firmware update file) into the control as previously described.

2. Press [COMM]. The menu will advance to "COMMUNICATIONS".

```
        COMMUNICATIONS
    ❮CNFG           UTIL❯
```

3. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
        PORT1 Settings
    ❮                    ❯
```

4. Press [MNTR] or [COMM] as necessary until "Memory Card" is displayed.

```
        Memory Card
    ❮                    ❯
```

5. Press [CNFG] as necessary to navigate to the "Firmware Update" menu item.

```
    Firmware Update
    Press ENT to begin
```

6. Press [ENT/UTIL]. The unit will display the following sequence of screens:

```
    Firmware Update
    Loading file...
```

```
    Update Process
    In Progress...
```

```
    Updating Firmware
    Please wait...
```

```
    ATTENTION! Rebooting
    in 29 seconds
```

The unit display will "countdown" to reboot and then display the initialization screens.

After a firmware update the control setpoints and configuration are unaffected. IPScom commmunication with the control will need to be reestablished.

Bootloader Update from a Smart Flash SD Card

The Bootloader is a program that runs self-tests and then loads the main application firmware on the M-7679. Besides loading the main application firmware and performing self-tests when booting up, the bootloader program will take over during boot up when there is no valid application firmware found and also when forced to run by a special HMI interface command. The Bootloader does not have any control protective functionalities, only communication and local HMI functionalities.

To update the Bootloader from a Smart Flash SD Card proceed as follows:

1. Insert the Smart Flash SD Card (that includes the Bootloader Update file) into the control as previously described.

2. Press [COMM]. The menu will advance to "COMMUNICATIONS".

```
         COMMUNICATIONS
    ❮CNFG            UTIL❯
```

3. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
        PORT1 Settings
    ❮                  ❯
```

4. Press [MNTR] or [COMM] as necessary until "Memory Card" is displayed.

```
         Memory Card
    ❮                  ❯
```

5. Press [CNFG] as necessary to navigate to the "Bootloader Update" menu item.

```
    Bootloader Update
    Press ENT to begin
```

6. Press [ENT/UTIL]. The unit will display the following:

```
    Do Not Remove Power!
    Press ENT to begin
```

7. Press [ENT/UTIL]. The unit will display the following sequence of screens:

```
    Do Not Remove Power!
    Loading file...
```

```
    Do Not Remove Power!
    Updating...
```

```
    Updating Bootloader
    Please Wait...
```

```
    ATTENTION! Rebooting
    in XX Seconds
```

After 30 seconds the unit will reboot with the new bootloader file.

Formatting an SD Card in FAT32

▲ **CAUTION:** The contents of the SD Card will be erased when performing this procedure.

1. Select the computer (or My Computer) from the Windows™ "Start" menu.
2. Right click on the SD Card icon and select Format.
3. Select "FAT32" in the File Format box and check "Quick Format" in the Format Options.
4. Click OK. The SD Card will be formatted and Windows will prompt when completed.

SD Card Key Generator

The SD Card Key Generator feature allows a User Name and Password to be saved to an SD Card. The SD Card with Key Generated User Name and Password can be inserted into the SD Card slot on the unit and all security privileges (from the HMI) will be available to the user.

1. Start IPScom.
2. Select Utility/SD Card Key Generator. IPScom will display the "SD Card Key Generator" dialog screen (Figure 2-46).

Figure 2-46   SD Card Key Generator Dialog Screen

3. Enter the desired User Name and Password.
4. Select "Generate". IPScom will display the "Save SD Key" dialog screen (Figure 2-47).
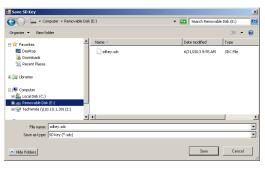
Figure 2-47   Save SD Key Dialog Screen

■ **NOTE:** The file name cannot be changed. It must be "sdkey.sdc".

5. Select the location of the SD Card, then select "Save". IPScom will briefly display the "SD Card Key Saved" confirmation screen (Figure 2-48) and then return to the main screen.

Figure 2-48   SD Card Key Saved Confirmation Screen

Stop

Figure 2-51   E-mail Support User Information Dialog Screen

> ■**NOTE:** Supplying User Information, though recommended, is not
> required to use the E-mail Support feature.

4. Determine if User Information is to be included in the Support Request E-mail and proceed as follows:

    • If no User Information is to be included in the Support Request E-mail, then select "Exit".

    • If User Information is to be included in the support request, then enter the User Information and a brief description of the support issue, then select "Save" to create a "Description.txt" file which will be included with the downloaded support files.

    IPScom will create a "M-7679 Support Files" folder on the desktop and then display the "E-mail Support Files Downloaded" confirmation screen (Figure 2-52). Any errors during the retrieve of the support files are logged into a "Errorlog.txt" file and the file is included in this folder.
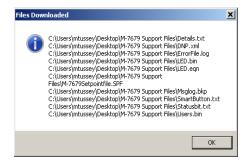
Figure 2-52   E-mail Support Files Downloaded Confirmation Screen

5. Select "OK".

    If Microsoft® Outlook® is the default E-mail program, the files are automatically attached to a New E-mail (Figure 2-54).

    If Outlook is not the default E-mail program, IPScom will display the following message screen (Figure 2-53) prompting the user to send the support files located in the "M-7679 Support Files" folder on the desktop to support@beckwithelectric.com.
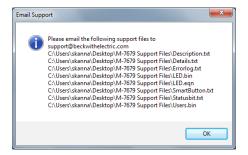
Figure 2-53   E-mail Support without Outlook Message Screen
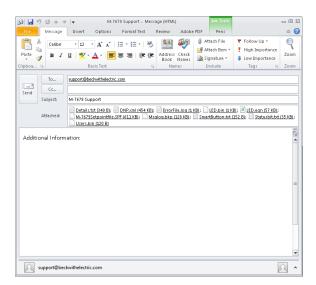
Figure 2-54   E-mail Support with Outlook Screen

COMPARING SETPOINT FILES

Comparing Setpoint Files does not require IPScom to be connected to a recloser control as long as the files to be compared are present on the PC. To compare two setpoint files proceed as follows:

1. Start IPScom.

2. From the IPScom menu bar select **File/Compare** and select either ".sup Files" or for legacy setpoint files, select ".spf Files".

   IPScom will display an "Open – File to Edit or Newer File" dialog screen with a default file extension of either ".sup" or ".spf".

3. Navigate to the desired "File to Edit or Newer File" location.

4. Select the desired file and then select Open. IPScom will display an "Open – Reference File or Older File" dialog screen with a default file extension of either ".sup" or ".spf".

5. Navigate to the desired Reference File location.

6. Select the desired Reference File and then select Open. IPScom will perform a comparison of the selected files and display the results (Figure 2-55).

The IPScom File Compare results dialog screen includes the following features:

- Print/Print Preview
- Edit the newer file settings from the File Compare dialog screen by selecting the feature header which jumps to the feature settings screen and allows the changes to be saved into the newer Setpoint File.
- Save allows any changes to be saved into the newer Control File or legacy Setpoint File.
- "Options/Show if Equal" selection allows the user to also display those settings that are the same in both files.

Figure 2-55   IPScom Setpoint File Compare Results Dialog Screen

This Page Left Intentionally Blank

3 IPScom

■ **CYBER SECURITY NOTE:**

When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

This chapter is designed for the person or group responsible for the operation and setup of the M-7679. The S-7600 IPScom Communications Software can be used to successfully communicate system settings and operational commands to the M-7679 as well as access the extensive monitoring and status reporting features. This chapter provides a general overview of each IPScom menu selection and command in the same order as they are displayed in the software program. Those IPScom features and functions that are covered in other sections of this Instruction Book will be noted and referenced.

3.0   Availability

IPScom S-7600 Communications Software is available on CD-ROM or from www.beckwithelectric.com. Also included on the CD-ROM is the companion Instruction Book in *.pdf format.

3.1   Hardware Requirements

IPScom will run on any computer that provides at least the following:

- Windows 2000®, Windows XP®, Windows Vista®, Windows 7® or Windows 10®
- One USB (serial) port

Hardware Required for Direct USB (Serial) Communication

To use IPScom to communicate with a Beckwith Electric M-7679 Recloser Control using a direct USB (serial) connection, a USB cable is required.

3.2   Installing IPScom

The IPScom S-7600 installation program has been written to overwrite previous versions of IPScom unless stated otherwise in the IPScom installation and installed "Read Me" file.

IPScom runs on Windows 2000®, Windows XP®, Windows Vista®, Windows 7® or Windows 10® operating system. Familiarity with Windows™ is important in using IPScom.

IPScom will be installed on the host PC's hard disk. While it does not require special installation procedures, an installation utility has been provided to make the process easier.

> ■**NOTE:** The installer must have Administrator rights on the computer that IPScom is being installed on.

Digital Signature

For enhanced Cyber Security and to be fully NERC CIP compliant, the IPScom installation program file (.exe) is digitally signed. This verification ensures that IPScom is signed by Beckwith Electric Co., Inc. Any changes to the software once it has been signed will invalidate the digital signature.

To verify the digital signature, access the "Properties" window by right-clicking the (.exe) file. If the version is signed, the Properties window will display an additional tab as shown in Figure 3-1. If the version is unsigned, the Properties window will be similar to Figure 3-2.
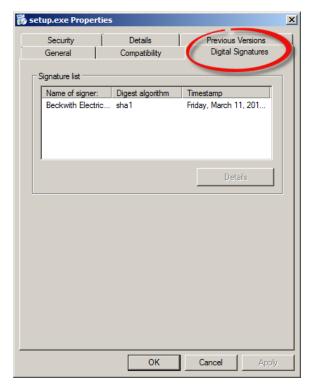
Figure 3-1   File "Properties" Digital Signature Tab – Signed Installation Program

Figure 3-2   File "Properties" Unsigned Installation Program
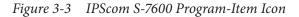
To install IPScom:

1. Insert the IPScom software into your CD-ROM drive.
2. Select "Run" from the "Start Menu".
3. In the "Run" dialog box, initiate software installation by typing **D:\Setup.exe** (or other drive designator:\Setup.exe, depending on the letter designation for the CD-ROM drive).
4. The Installation Wizard will prompt the user through the installation process. After installation, the IPScom program icon is placed on the desktop (Figure 3-3).

Starting IPScom

Select the IPScom program-item icon from the Becoware group in the Program Manager, or select IPScom from the program list using the "Start" Menu. The IPScom Main Screen will be displayed (Figure 3-12).

Figure 3-3   IPScom S-7600 Program-Item Icon

3.3   Communications Using Direct USB Connection

When the control is connected to the PC utilizing a USB cable, Windows will enumerate the control as a serial com device and will assign an unused COM Port to the control.

Direct Communication Using USB (Serial) Connection

■**NOTE:** The M-7679 and IPScom S-7600 Communications Software are shipped from the factory with the same default communication parameters. Therefore it may not be necessary to setup communication parameters for initial local communications. Default communication parameters are contained in the individual sections.

1. Ensure the following conditions exist:
   - IPScom is installed on the host computer
   - The recloser control is energized

2. Plug the USB cable into the host computer USB port.

3. Plug the USB cable into the USB port on the control. The host computer will interrogate the control to determine the type of hardware device it is.

4. Start the IPScom program, IPScom will display the IPScom "Main" dialog screen (Figure 3-12).

5. Select "Communication/USB" from the "Communication" drop-down menu.

IPScom will display the USB Port dialog screen (Figure 3-4).

Figure 3-4   USB Port Connection Dialog Screen

6. Ensure that the correct USB device is displayed.

7. Select "Connect". If Cyber Security is disabled, IPScom will attempt to connect to the target control.

8. If IPScom returns a "Cannot Connect" error screen (Figure 3-5), then repeat Steps 6, and 7.

Figure 3-5   Cannot Connect Error Screen

9. If Cyber Security is enabled, IPScom will display the "Log On" dialog screen (Figure 3-6).

Figure 3-6   Log On User Name and Password Dialog Screen

10. Enter a valid User Name and Password and select "Log On". IPScom will attempt to connect to the target control.

11. If IPScom returns a "User Access Permissions Denied" error screen (Figure 3-7), then repeat Steps 7, 9 and 10.

Figure 3-7   User Access Permissions Denied Error Screen

12. If Cyber Security is disabled, or a valid User ID/Password was entered, then IPScom will briefly display an "Access Granted" screen followed by the "Connected through USB" confirmation screen (Figure 3-8). IPScom will display the connected version of the IPScom Main Screen (Figure 3-14).

Figure 3-8   Connected through USB Confirmation Screen

3.4   TIA-232 and TIA-485 Communications

To use IPScom S-7600 Communications Software to interrogate, set, or monitor the M-7679 Recloser Control using a TIA-232 or TIA-485 connection the following conditions must be met:

- The control is physically connected to a TIA-232 or TIA-485 network consistent with the hardware and connection requirements.
- IPScom software communication parameters and device parameters must match the control's default TIA-232 or TIA-485 settings and the selected/ default device parameters.

Elements of the control's TIA-232 or TIA-485 Port communication parameters include the following (default settings):

- Baud Rate (9600 bps)
- Sync Time (2 mS)
- Parity (None)
- Stop Bits (1)

Default device parameters that are at the default settings or have been configured locally at the control include (default settings):

- Device Address (1)
- Protocol (MODBUS)
- Echo Cancel (fiber optic) (None)

Communication Using TIA-232 or TIA-485 Connection

1. Ensure the following conditions exist:
   - The control is physically connected to the TIA-232 or TIA-485 network
   - IPScom is installed on the host computer
   - The control is energized

2. Start the IPScom program. IPScom will display the IPScom "Main" dialog screen (Figure 3-12).

3. Select "Communication/Com Port" from the "Communication" drop-down menu.

IPScom will display the Serial Port dialog screen (Figure 3-20).

4. Ensure that the correct COM port is displayed.

5. Ensure that both the Device and Comm settings are consistent with the control's default values.

6. Select "Connect". IPScom will attempt to connect to the target control.

7. If Cyber Security is enabled, enter a valid User Name and Password (Figure 3-6) and then select "Log On".

8. If IPScom returns a "Cannot Connect Error" screen (Figure 3-5) or a "Permissions Denied" error screen (Figure 3-7), then repeat the applicable steps.

9. If a valid User ID/Password was entered, then IPScom will display the "Successfully Connected through Serial" dialog screen (Figure 3-9). Select "OK", IPScom will display the connected version of the IPScom Main Screen (Figure 3-14).

Figure 3-9   Connected through Serial Confirmation Screen

3.5   Ethernet Communications

The optional Ethernet Port can be purchased as either a RJ-45 (10/100 Base-T) interface or Fiber Optic through ST connector (100 Base-Fx) for Ethernet communication to the M-7679. The port supports up to eight concurrent connections. The maximum number of allowed DNP connections is five. The maximum number of MODBUS connections is eight. The port supports DHCP protocol and also allows manual configuration of the Ethernet port. MODBUS protocol "Port Number" and DNP Protocol "Port Number" are always configured manually regardless of DHCP Enable/Disable option.

■ **NOTE:** IPScom can be used through the Ethernet port and may be considered a MODBUS connection for the purpose of determining how many concurrent connections are allowed.

■ **NOTE:** Using Fiber Ethernet requires the Auto Negotiate setting in the control be set to Disable to operate correctly.

Communication Using Ethernet Connection

1. Ensure the following conditions exist:
   • The control is physically connected to the Ethernet network
   • IPScom is installed on the host computer
   • The control is energized

2. Start the IPScom program. IPScom will display the IPScom "Main" dialog screen (Figure 3-12).

3. Select **Communication/TCP/IP** from the **Communication** drop-down menu. IPScom will display the TCP/IP Connection Dialog Screen (Figure 3-21).

4. Enter the Device and TCP/IP parameters for the target control or select from the Address Book.

5. Select "Connect". IPScom will attempt to connect to the target control.

6. If Cyber Security is enabled, enter a valid User Name and Password (Figure 3-6) and then select "Log On".

7. If IPScom returns a "Cannot Connect Error" screen (Figure 3-5) or a "Permissions Denied" error screen (Figure 3-7), then repeat the applicable steps.

8. If a valid User ID/Password was entered, then IPScom will briefly display the "You are now connected" confirmation screen (Figure 3-10) and then display the connected version of the IPScom Main Screen (Figure 3-14).

You are now connected.

Figure 3-10   Connected through Ethernet Confirmation Screen

If the control is to be connected to a network that does not support DHCP protocol, then the following information must be obtained from the Network Administrator, to be entered locally at the control or remotely utilizing IPScom:

- IP Address
- Net Mask
- Gateway (may be necessary)

■**NOTE:** The DNP and MODBUS Port addresses can not be set to the same value.

Also, if the network MODBUS Port address is not "502" or the DNP Port address is not "20000", then the MODBUS Port and DNP Port settings must be set.

Port 1, TIA-232, TIA-485, (2Wire), or Fiber Optic (ST or Vpin) Cable

Beckwith Recloser Control

Recloser

USB Cable

Printer

Computer Running IPScom S-7600 Communications Software
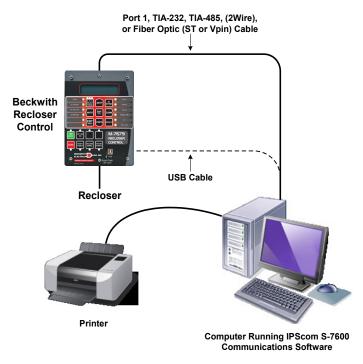
Figure 3-11   Direct Connection Diagram

3.6   Overview of Operation

The IPScom installation and establishing initial local communications are covered in **3.2 Installing IPScom**. Once installed, the IPScom program icon is available from the Program Manager and IPScom can be run like any other Windows™ program. (The installation utility places IPScom in a Program Manager group named Becoware.)

Selecting the IPScom Program from the Becoware Folder or selecting the IPScom Program Icon (Figure 3-3) from the Desktop will open the program and display the IPScom Main Screen (Figure 3-12).

Figure 3-12, represents the IPScom Main Screen menu structure. IPScom Main Screen "File Mode" menu structure and IPScom Main Screen "Connected" menu structure are presented in Figure 3-13 and Figure 3-14 respectively.

■**NOTE:** If communication is not established to the unit and no file is open, items relating to settings and monitoring are disabled. If not connected but a file is open, monitoring screens are displayed without data.

When in File Mode with a named file open the file name and path to the file are displayed in the top menu bar.

The IPScom Main Screen "**Connected**" (Figure 3-14) also displays:

Top Menu Bar – the type of Connection that is in effect

Bottom Menu Bar:

- Fault Type
- Fault Distance
- Error Messages
- Firmware Version
- Unit Serial Number
- Active Profile
- Date and Time
- Connection Status
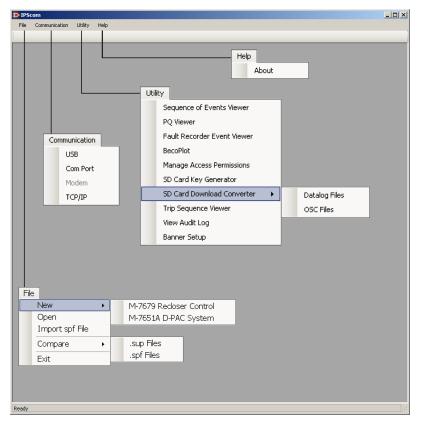
Figure 3-12   IPScom Main Screen Menu Selections
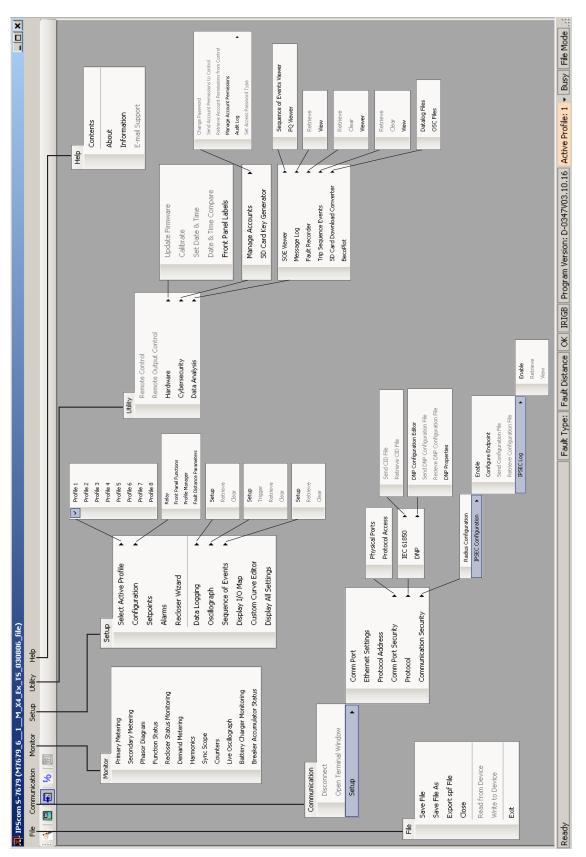
*Figure 3-13   IPScom Main Screen Menu Selections (**File Mode**)*
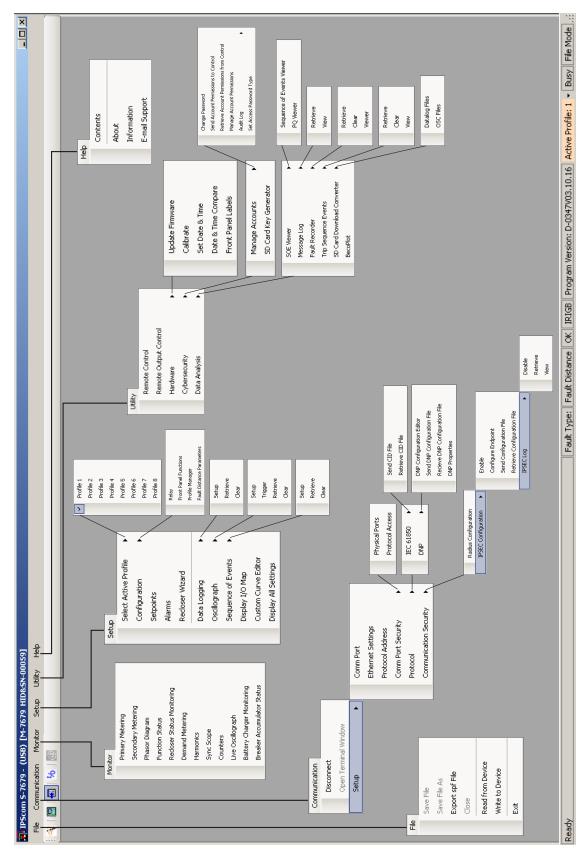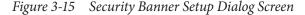
*Figure 3-14   IPScom Main Screen Menu Selections (**Connected**)*

Main Screen/Utility/Banner Setup

IPScom includes a Security Banner feature located in the Main Screen Utility menu dropdown. The Security Banner feature, when enabled, provides the user with the ability to display a user defined Banner when connecting to a control. The Security Banner will be displayed when connecting to a control and requires the user to acknowledge the contents of the Banner before proceeding to connect/login. The Security Banner is a function of IPScom and is not a setting that resides on the control.

Figure 3-15   Security Banner Setup Dialog Screen

Figure 3-16   Security Banner Message Screen

M-7679 System Errors Displayed in IPScom

IPScom polls the M-7679 for System Errors, Fault Type, Fault Distance, the Time and the Active Profile. When an error occurs or if an error exists when connecting to the M-7679, IPScom will display a message screen describing the errors (Figure 3-17). It will also flash a red warning indicator in the status bar with the error code. The description of the error code can be accessed at any time by double-clicking the flashing indicator. The Fault Type, Fault Distance and the Active Profile are also displayed in the status bar.

Figure 3-17   System Errors Message Screen

The following are the errors that can be reported/displayed:

- Trip Close Error – occurs if the 52A and 52B contacts are in the same state.
- Battery Status Error – occurs if the battery is not present, fails the load test, or is not charging.
- EEprom Setpoint Checksum Error – occurs if the checksum is bad.
- DSP Watchdog Error – occurs if the DSP is not running correctly.
- Gas Pressure Error – occurs if the input for the gas pressure is high.
- EEprom Calibration Checksum Error – occurs if the checksum is bad.
- DSP Failure Error – occurs if the DSP fails.
- Flash Not Formatted Error – occurs if the internal flash drive is not formatted.
- Max Breaker Operations Error – occurs when the Breaker Operation Limit setting has been exceeded.

- Internal Battery Failure – occurs when the internal battery that provides back up power to the non-volatile memory has failed.
- Battery Charger Communication Failed – occurs when the Battery Charger is enabled and the control cannot establish communication with the Battery Charger.

When a critical error occurs or if a critical error exists when connecting to the M-7679, IPScom will display a warning message and prompt the user to e-mail the support files to Beckwith Electric. The following are the errors that generate the Warning screen (Figure 3-18):

- Setpoints Checksum Error – occurs if the checksum is bad.
- Calibration Checksum Error – occurs if the checksum is bad.

Refer to "E-mail Support from IPScom" in Chapter 2 for detailed instructions for utilizing the E-mail Support feature.
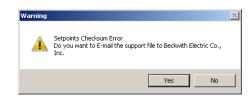
Figure 3-18   Warning Setpoints Checksum Error

FILE MENU

The File Menu feature of IPScom utilizes a Control File (*.sup) that consists of the following subset of files to capture the control setup and configuration:

- version.txt (the version of the firmware)
- m7679.spf (setpoints)
- led.eqn (led map file)
- ledmap.bin (binary file for LEDs)
- ipslogic.xml (IPSlogic map file)
- ipslogic.bin (binary file for IPSlogic)
- statusbits.txt (inputs used for the two map files)
- wakeupconfig.txt (wake list)
- SmartButton.txt (custom button file)

When IPScom is launched a file can either be created "New" or opened "Open". For a new file, temporary working files are copied from default files. When an existing file is opened, the temporary working files are extracted from the opened file.

File Not Open or Not Connected Mode

The File drop down menu when IPScom is not connected to a control, or a file is not open provides the following features:

- **New** – Choose "M-7679 Recloser Relay" to open the New File Dialog Screen to allow the user to select the Firmware Version, Nominal Frequency, Secondary CT Rating, Extended I/O, Independent Phase Capable Option, Ground CT Rating, the Voltage Input Option, and the IEC 61850 option (Figure 3-19).

  As these parameters are entered, IPScom will automatically update the "Smart String" displayed at the bottom of this window. This Smart String represents the Model Number of the control. This Smart String is then displayed in the IPScom title bar in File mode.

  When creating a new file, IPScom will create temporary working files based on the default files of the selected Firmware Version. When the user saves the Control File, these files will be used. When IPScom is closed, these files are deleted.

- **Open** – Opens the file browser window to allow the user to select an existing file. It will not allow the user to create a new file.

  When opening a file, IPScom extracts the files stored in the Control File. The user can select "Save" or "Save As" to store these into the Control File. If the user attempts to use an old *.spf file, IPScom copies the setpoints file to the temporary working *.spf file and creates default working files so a Control File can be saved.

- **Import spf File** – This menu item allows the user to select a legacy *.spf file and insert it into the Control File.

- **Compare** – The Setpoints File Compare feature provides the user with the ability to compare two Setpoints Files, "*.sup" or legacy "*.spf" and generate a report that presents the differences in setpoint values and settings in a side by side format. The report can be printed and can be displayed with just the differences or all the settings that exist in both files. The more current setpoint file may be edited and saved.

- **Exit** – Exits the IPScom program.

Figure 3-19   New File Dialog Screen

File Open

File

Save File
Save File As
Export spf File
Close

Read from Device
Write to Device

Exit

The **File** toolbar item when IPScom is not connected to a control or a file is open provides the following features:

- **Save File** – This menu item will concatenate the working files into one Control File and then save it. If no filename has been associated (i.e. New File), a save window will be displayed so that the file can be named.
- **Save File As** – This menu item will concatenate the working files into one Control File and then save it.
- **Export spf File** – The feature allows the user to export an *.spf file to be used in the File Compare feature.
- **Close** – Closes the open file in the window.

Connected Mode
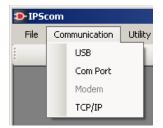
File

Save File
Save File As
Export spf File
Close

Read from Device
Write to Device

Exit

The **File** toolbar item when IPScom is connected to a control or a file is open provides the following features:

- **Read from Device** – When connected to a control and no file is previously open, this menu item allows the user to download all the temporary files from the control to a working directory.
- **Write to Device** – When connected to a control and no file is previously open, this function allows the user to select and send to the control in one step an *.SUP file that contains:
  - The Active Setpoint Profile
  - Seven, Inactive Setpoint Profiles
  - Configuration
  - Communication Settings
- **Exit** – Exits the IPScom program.

COMMUNICATION MENU

Communication Menu (Not Connected)

The **Communication** (Not Connected) drop down menu is displayed when IPScom is not connected to a recloser control. This menu provides the user with access to the screens that are necessary to establish communication with the target recloser control. Menu selections include **USB**, **Com Port**, **Modem** and **TCP/IP**.

USB

The **USB** menu selection initiates the USB dialog screen to connect to the M-7679 USB Port (Figure 3-4). The user is prompted to input the required Device and Access Level Code.

Com Port

The **Com Port** menu selection initiates the **Serial Port** dialog screen (Figure 3-20). The user is prompted to input the necessary communications information to open Serial communications through the selected Comm Port.

Figure 3-20   Serial Port Communication Dialog Screen

Device Address

Individual recloser control Device Addresses should be between 1 and 255. The default Device Address is 1. The individual addressing capability of IPScom and the recloser control allows multiple systems to share a direct or modem connection when connected through the Serial Port using a communications-line splitter. One such device enables 2 to 6 units to share one communications line.

> ▲ **CAUTION:** The **Echo Cancel** check box should only be used when several relays are connected using a fiber optic loop network. Otherwise, echo cancel must not be selected or communication will be prevented.

When communicating by way of a fiber optic loop network, echo cancelling is available by checking the Echo Cancel box. This command masks the sender's returned echo.

> ▲ **CAUTION:** If the serial port is connected to something other than a modem, and an IPScom modem command is executed, the results are unpredictable. In some cases, the computer may have to be reset.

TCP/IP

The **TCP/IP** menu selection initiates the TCP/IP Connection dialog screen (Figure 3-21). The user is prompted to input the necessary communications information to open communications through the Ethernet port. The user can add the IP Address with Domain/Name of the users choice into the Address book and select "Save" for future use.

Figure 3-21   TCP/IP Connection Dialog Screen

Communication Menu (Connected)

The Connected **Communication** drop down menu is displayed when IPScom is connected to a recloser control. This menu provides the user with access to the screens that are necessary to **Disconnect** from the target recloser control or access the **Setup** menu items.

Disconnect

The Disconnect menu item when selected prompts the user to confirm (Figure 3-22) the disconnect command.
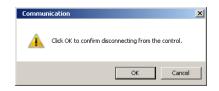
Figure 3-22   Disconnect Command Confirmation Screen

Open Terminal Window

Not Available at this time.

Communication/Setup/Comm Port

The **Setup/Comm Port** submenu provides the user with the capability to setup and configure Port 1 and Port 4 (Figure 3-23).

Figure 3-23   Setup Comm Port Dialog Screen

Communication/Setup/Ethernet Settings

The **Setup/Ethernet Settings** submenu provides for the setup and configuration of the optional Ethernet Ports 2 and 3 (Figure 3-24).

Figure 3-24   Ethernet Setup Dialog Screen

Communication/Setup/Protocol Address

The **Setup/Protocol Address** submenu provides the user with the capability to setup a MODBUS Protocol Address from 1 to 255 or a DNP Protocol Address from 1 to 65519 (Figure 3-25). The default Address is 1.

Figure 3-25   Protocol Address Screen

Communication/Setup/Comm Port Security/Physical Ports

The **Comm Port Security/Physical Ports** submenu provides the user with the capability to enable/disable the recloser control physical communication ports to comply with cyber security requirements (Figure 3-26).

Figure 3-26   Enable/Disable Physical Communication Ports Dialog Screen

Communication/Setup/Comm Port Security/Protocol Access

The **Comm Port Security/Protocol Access** submenu provides the user with the capability to enable/disable specific communication protocols to comply with cyber security requirements (Figure 3-27).
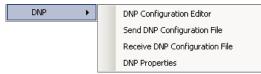
Figure 3-27   Enable/Disable Protocol Access Dialog Screen

Communication/Setup/Protocol/IEC 61850

The **Setup/Protocol/IEC 61850** submenu provides the user with the capability to send or retrieve a CID file when connected to a control.

Communication/Setup/Protocol/DNP

DNP ▶	DNP Configuration Editor
	Send DNP Configuration File
	Receive DNP Configuration File
	DNP Properties

DNP/DNP Configuration Editor

The DNP Configuration Editor menu selection opens the M-7679 DNP Configuration Editor dialog screen (Figure 3-28) which provides the user with the following capabilities:

- M-7679 default DNP configuration file (*.xml) can be loaded for editing or become the basis for new DNP configuration files.
- Selected DNP configuration files (*.xml) other than M-7679 default file can be loaded for editing or become the basis for new DNP configuration files.
- Binary Inputs, Analog Inputs, Binary/Control Outputs and Analog Outputs may be added, edited or deleted.
- Dummy positions may be added to allow SCADA table matching.
- "Insert Offset Point" can be used to match a SCADA table.
- Variations may also be edited.
- File can be saved to disk.
- Saved files can be sent to the connected control.
- Items in the editor can be moved, added and removed by dragging and dropping.
- Enable/Disable unsolicited response.
- Screen can be printed.
- Master Address for unsolicited responses and/or Source Address Validation.
- See **Appendix C** for detailed information.
- A DNP Device Profile conforming to the DNP standard can be generated listing only the user selected DNP points. This XML formatted document can be used to record the control's DNP map setup.

Figure 3-28   M-7679 DNP Configuration Dialog Screen

DNP/Send DNP Configuration File

The Send DNP Configuration File menu selection provides the user with the capability to upload a DNP configuration file to the control. To upload a DNP configuration file proceed as follows:

1. From the IPScom Main Screen select **Communication/Setup/Protocol/DNP/ Send DNP Configuration File**. IPScom will display the Open File Dialog screen ([Figure 3-29](#)) with a default *.xml file extension.

Figure 3-29   DNP Open File Dialog Screen

2. Select the target file, then select "Open". IPScom will display the "DNP Configuration File Upload" status screen ([Figure 3-30](#)).

Figure 3-30   DNP Configuration File Upload Status Screen

3. When the DNP Configuration file has been uploaded IPScom will display a confirmation screen.

DNP/Receive DNP Configuration File

The Receive DNP Configuration File menu selection provides the user with the capability to download a DNP configuration file from the control. To download a DNP configuration file proceed as follows:

1. From the IPScom Main Screen select **Communication/Setup/Protocol/DNP/ Receive DNP Configuration File**. IPScom will briefly display the "Retrieving Directory" screen ([Figure 3-31](#)) and then display the "Save As" dialog screen ([Figure 3-32](#)) with a default *.xml file extension.
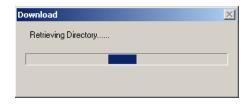
Figure 3-31   DNP Retrieving Directory Screen

Figure 3-32   Receive DNP Configuration File Save As Dialog Screen

2. Select the target file or enter a valid name for the new file, then select "Save". IPScom will display "DNP Download" status screen(Figure 3-33).

Figure 3-33   DNP Download Status Screen

3. When the DNP Configuration file has been downloaded IPScom will display a confirmation screen (Figure 3-34). Select "OK". IPScom will return to the Main Screen.

Figure 3-34   DNP Configuration File Retrieved Successfully Confirmation Screen

DNP/DNP Properties

The DNP Properties dialog screen (Figure 3-35) allows the user to set Source Address Validation parameters and also UDP Port Settings.

Figure 3-35   DNP Properties Dialog Screen

Setup/Communication Security/Security Mode/Radius Configuration

For Cyber Security, IPScom allows the user to configure up to two Remote Authentication Radius servers.

Figure 3-36   Radius Configuration Dialog Screen

Setup/Communication Security/Security Mode/IPsec Configuration/Enable

For Cyber Security, IPScom allows the user to enable Internet Protocol Security (IPsec). Select "Enable" from the IPsec Configuration dropdown menu. IPScom will display the "IPsec Enable Screen" (Figure 3-37).

Figure 3-37   IPsec Enable Dialog Screen

IPsec Configuration/Configure Endpoint

Selecting IPsec Configuration/Configure Endpoint displays the "Configure Endpoint" (Figure 3-38) dialog screen which allows the user to add and configure IPsec Endpoints.

Figure 3-38   IPsec Configure Endpoint Dialog Screen

Select an available Endpoint from the "Configure Endpoint" screen and then select "Edit". IPScom will display the "IPsec General Settings" screen (Figure 3-39) which allows the user to configure IPsec security settings, including IKE (Internet Key Exchange) Policy, IPsec Policy, Policy Lifetimes and Identities.

Figure 3-39   IPsec General Settings Dialog Screen

IPsec Configuration/Send Configuration File

Sends the IPsec Configuration file to the connected control.

IPsec Configuration/Retrieve Configuration File

Retrieves the IPsec Configuration file from the connected control.

IPsec Configuration/IPsec Log/Enable

This selection allows the user to enable recording of the IPsec log messages (Figure 3-40).
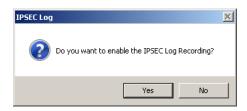
Figure 3-40   IPsec Log Enable Dialog Screen

When IPsec Log recording is enabled, IPScom will display the following information screen:

Figure 3-41   IPsec Log Menu Information Screen

IPsec Configuration/IPsec Log/Retrieve

When IPsec Log recording is enabled, this selection allows the user to retrieve the IPsec Log from a connected control. IPScom will display the IPSEC Log (*.ilg) Save As screen which allows the user to save the Log file to the desired location (Figure 3-42). IPScom will display a download status screen and then display a confirmation screen (Figure 3-43).

Figure 3-42   IPSEC Log Save As Dialog Screen

Figure 3-43   IPSEC Log Saved Confirmation Screen

IPsec Configuration/IPsec Log/View

This selection allows the user to select a downloaded IPsec Log file (*.ilg) for viewing. Navigate to the desired IPSEC Log file and "Open". IPScom will display the IPSEC Log Viewer (Figure 3-44).

Figure 3-44   IPsec Log Viewer Screen

MONITOR MENU

The **Monitor** Menu provides access to the screens used to monitor recloser control parameters. The submenus provided are: **Primary Metering**, **Secondary Metering**, **Phasor Diagram**, **Function Status**, **Recloser Status Monitoring, Demand Metering, Harmonics, Sync Scope, Counters, Live Oscillograph, Battery Charger Monitoring** and **Breaker Accumulator Status.**

Monitor/Primary Metering

The Primary Metering screen (Figure 3-45) allows the user to review PRIMARY parameters
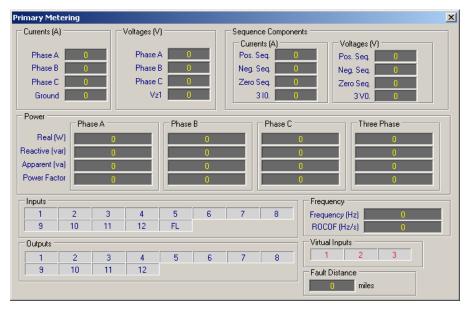
Figure 3-45   IPScom Primary Metering Screen (Voltage Input Option X4, L4, H4 or VT)

Monitor/Secondary Metering

The Secondary Metering screen (Figure 3-46) allows the user to review SECONDARY parameters:
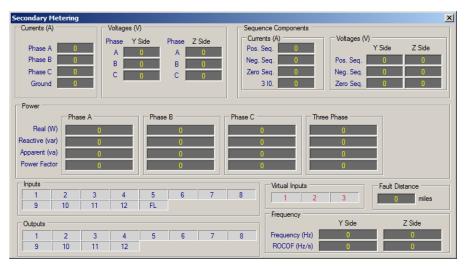
Figure 3-46   IPScom Secondary Metering Screen (Voltage Input Option X6, L6 or H6)

Monitor/Phasor Diagram

The **Phasor Diagram** (Figure 3-47) provides the user with the ability to evaluate a reference Phase Angle to Phase Angle data from other windings. The Phasor Diagram also includes a menu that allows the user to select/deselect sources to be displayed and Freeze capability to freeze the data displayed on the Phasor Diagram.
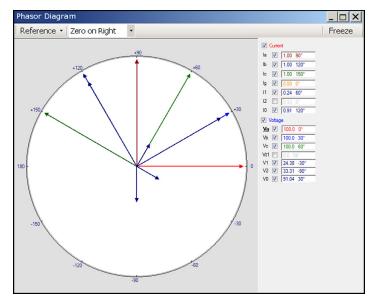
Figure 3-47   Phasor Diagram

Monitor/Function Status

The Function Status screen (Figure 3-48) displays the status of various functions, with a red circle indicating functions that have tripped, and a green circle for those functions that have picked up and are timing. Also displayed are Active Inputs and Outputs.

Figure 3-48   Function Status Screen

Monitor/Recloser Monitoring

The Recloser Status screen (Figure 3-49 and Figure 3-50) displays the Breaker Status, Recloser Settings and the Reclose Status. The Graph section of the screen displays real time recloser control status parameters.
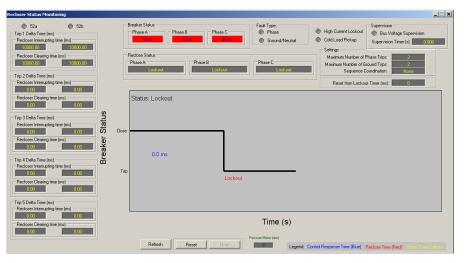
Figure 3-49   Recloser Status Monitoring (F79) Screen (Three-Phase Ganged)

Figure 3-50   Recloser Status Monitoring (F79) Screen (Independent Phase)

Monitor/Demand Metering

The Demand Metering submenu item displays the Demand Metering screen (Figure 3-51). Real-time demand and metering information can be monitored from an addressed recloser control.

The **Demand Interval** applies to the Demand Present and the Demand History parameters. The Demand Interval can be set to 15, 30, and 60 minutes.

The **Max Demand Load Current (I_L)** setting is an element of the Total Demand Distortion calculation and is applied when the Total Demand Distortion function is enabled.

All Demand History and Energy Metering Values include the date and time at which each occurred.

■**NOTE:** Selecting "**UTC**" at the bottom of the screen displays the Date/Time in Universal Time Code format. Display either Primary or Secondary values using the "**Toggle**" selection.

The **Energy Metering** section displays the Energy Metering parameters. This feature enables the user to review real-time and historical demand metering information. This section includes Forward and Reverse Watt Hours and Forward and Reverse VAr Hours.

Figure 3-51   Demand Metering Screen

Monitor/Harmonics

The input signal is sampled at 128 samples per cycle, giving an overall sampling rate of 7680 samples per second for a 60 Hz system. This provides the ability to reproduce signals of up to 3840 Hz. Therefore, up to the 63rd harmonic can be calculated using discrete Fourier transform with a fundamental frequency of 60 Hz. The fundamental for both the Voltage and Current channels is calculated every sample meaning, every 130.2 μs. These voltage and current magnitudes are used in a real-time decision making algorithm and real-time metering.

Total Harmonic Distortion (THD) for both voltage and current are calculated and displayed using the following equations:

$$V\text{ THD} = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + V_5^2 + ...}}{V_1} \times 100 \%$$

$$I\text{ THD} = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + I_5^2 + ...}}{I_1} \times 100 \%$$

Total Demand Distortion (TDD) for current is calculated and displayed using the following equation:

$$I\text{ TDD} = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + I_5^2 + ...}}{I_L} \times 100$$

Figure 3-52   Harmonic Analysis Screen

Monitor/Sync Scope

The Sync Scope submenu item displays the Sync Scope monitoring screen (Figure 3-53). The Sync Scope graphic representation provides the phase difference between the measured quantities. See **Function 25 Sync Check** in Chapter 4 for additional information.

▲**CAUTION:** The M-7679 Sync Scope should not be used to determine phase conditions for manual synchronizing because of possible communications time delay.
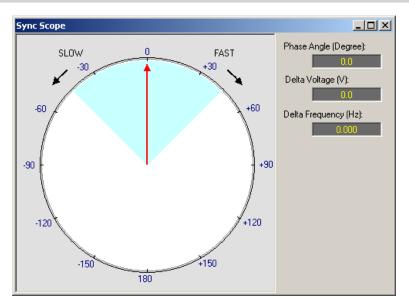
Figure 3-53   Sync Scope Monitor Screen

Monitor/Counters

The Counters submenu item displays the Counters Monitoring/Setting screen (Figure 3-54). The control includes the following counters:

- Total Overcurrent Phase A Pickup and Trip
- Total Overcurrent Phase B Pickup and Trip
- Total Overcurrent Phase C Pickup and Trip
- Ground/Neutral Pickup and Trip
- Recloser/Breaker Operations Phase A, B and C

The Pickup and the Trip are only for overcurrent functions. The Recloser/Breaker Operations counter is the sum of the number of times the trip outputs were energized and the number of times the close outputs were energized. Counters are available as triggers for Datalogging and Sequence of Events.

The counter values are stored in non-volatile memory and are not affected by a loss of power to the control. Each counter accommodates 99,999,999 operation counts. Each counter provides the user with the ability to preset a value. The counter will increment from the preset value. Each counter can be reset to zero.

Recloser/Breaker Operation Alarm Limit

The "Operation Limit" provides the user with the ability to set a predetermined alarm point for the number of Recloser/Breaker operations initiated by the control. When the "Operation Limit" setting is exceeded the "Max Breaker Operations" alarm will be triggered if enabled.

■ **NOTE:** The Undo/Refresh and Save buttons are applicable for the Operation Limit only, and do not affect the Counters. The Exit button closes the window.
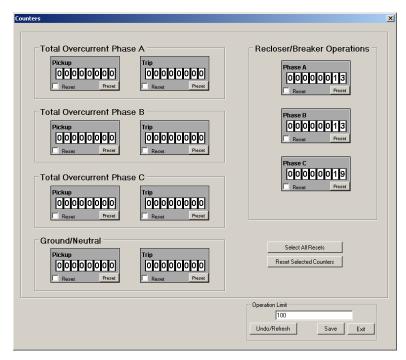
Figure 3-54   Counters Dialog Screen

Monitor/Live Oscillograph

Selecting the Live Oscillograph submenu item displays the Live Oscillograph confirmation screen (Figure 3-55). Select "Yes" and IPScom will display the Live Oscillograph screen (Figure 3-56). Select "Start" to display live data for the eight channnels with Power, Power Quality, Phasors and Harmonics. Select "Stop" during the live display to pause the screen.

Figure 3-55   Live Oscillograph Confirmation Screen
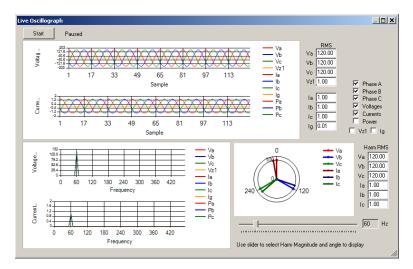
Figure 3-56   Live Oscillograph Display Screen

Monitor/Battery Charger Monitoring

When the Battery Charger function is Enabled in the **Setpoints/Common Setpoints/IED Power Supply/Battery Charger Monitor** screen, this selection displays the Battery Charger Monitoring screen (Figure 3-57). Available monitoring parameters are based on the Battery Type selection. When the Battery Charger function is Disabled, IPScom will display an error message (Figure 3-58).

Figure 3-57   Battery Charger Monitoring Screen

Figure 3-58   Battery Charger Function Disabled Error Screen

Monitor/Breaker Accumulator Status

When the Breaker Monitor function is enabled, the Breaker Accumulator Status screen (Figure 3-59) will display the Accumulator Status based on the Breaker Monitor Timing selection of the active profile. Preset Accumulator values for each phase may also be set.

Figure 3-59   Breaker Accumulator Status Screen

SETUP MENU

The **Setup** menu provides access to the screens used to configure, monitor or interrogate the recloser control. The submenus provided are: **Select Active Profile, Configuration, Setpoints, Alarms, Recloser Wizard, Data Logging, Oscillograph, Sequence of Events, Display I/O Map, Custom Curve Editor** and **Display All Settings.**

Setup/Select Active Profile

Selects the Active Setpoint Profile providing the operating parameters of the control.

Setup/Configuration/Relay

The **Configuration/Relay** selection displays the **System Setup** dialog screens which allow the user to input the relevant information regarding the system on which the recloser control is applied. Example screens are shown in Figure 3-64 through Figure 3-71. The settings displayed are based on the hardware configuration. See **Section 4.2 System Setup** for detailed information regarding the specific elements of the System Setup dialog screens.

System Setup/Interface Configurator

Selecting **Interface Configurator** (Figure 3-60) displays the Interface Type Information screen (Figure 3-61). The dropdown choices available are based on the selected Recloser Type: Three-Phase Ganged or Independent Phase Capable (Figure 3-62 or Figure 3-63). Selecting a specific Recloser or Adapter Chassis from this list will automatically populate the initial settings for the Interface Type. This includes Inputs, Outputs, Pulse Width and Battery Type. When any changes to these settings are made, the "Interface Type" will revert to "Custom". See **Section 4.2 System Setup** for additional information.
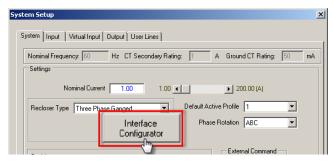
Figure 3-60   System Setup: Interface Configurator Selection

Figure 3-61   Interface Type Selection Information Screen

Figure 3-62   Interface Type – Three-Phase Ganged Options

Figure 3-63   Interface Type – Independent Phase Capable Options

Figure 3-64   System Setup Screen (Shown: Voltage Input X4, Three-Phase Ganged)

Figure 3-65   System Setup Screen (Shown: Voltage Input H6, Independent Phase Capable)

Figure 3-66   System Setup – Input Tab Dialog Screen (with Extended I/O)

Figure 3-67   System Setup – Input Tab Dialog Screen (Independent Phase Capable Option)

Figure 3-68   System Setup – Virtual Input Tab Dialog Screen

Figure 3-69   System Setup – Output Tab Dialog Screen (with Extended I/O)

Figure 3-70   System Setup – Output Tab Dialog Screen (Independent Phase Capable Option)

Figure 3-71   System Setup – User Lines Tab Dialog Screen

Setup/Configuration/Front Panel Functions

Front Panel Setup/File Menu

The Front Panel Setup "File/Update Files" menu allows the user to save ALL of the Front Panel configuration settings to the Control File. The Control File can then be saved to a PC or written to a connected control from the Main screen File Menu.

Front Panel Setup/Programmable Buttons

The Programmable Button feature allows the user to customize the functionality of the front panel pushbuttons S10 through S17 as shown in Figure 2-2. Pushbuttons S10, S11, S14, S15, S16 and S17 are preassigned, but can be reprogrammed by the user through the interactive Front Panel Setup dialog screen (Figure 3-72). These six pushbuttons can also be mapped to "Smart Functions" as shown in Figure 3-73.

Figure 3-72   Front Panel Setup Dialog Screen

Figure 3-73   Button Function Setup "Smart Functions" Dialog Screen

Front Panel Setup/LEDs

The LED programming feature allows the user to customize the functionality of the LEDs through the Front Panel Setup screen (Figure 3-72). Selecting an LED red, green, or amber button activates the LED Editor Dialog Screen (Figure 3-74) which provides an interactive worksheet for programming the desired logic to activate or deactivate the LEDs based on the status of the recloser control functions.

Selecting the "Latch" button allows the user to customize the latch behavior of the LED. The LED may be programmed to latch on Red, Green, Amber, or None.
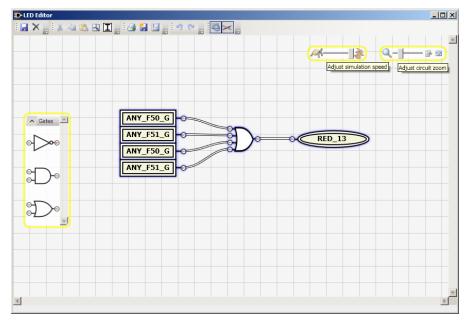
Figure 3-74   LED Editor Dialog Screen

Front Panel Setup/Wake Up Screen List

Select the "**Wake Up**" pushbutton in the Front Panel Setup Dialog Screen as shown below (Figure 3-75)to display the Wake Up Screen List (Figure 3-76).

The Wakeup Screens feature allows the user to select specific control parameters that will be displayed when the control is awakened by depressing the **EXIT/Wake** pushbutton. When the control is awakened the selected parameters are displayed in a cycling fashion. The display can also be directed to a specific parameter by utilizing the ⬆ or ⬇ pushbuttons. Pressing the **EXIT** pushbutton returns to the User Lines screen.

See **Section 4.1 Unit Setup** and **Chapter 2**, **Operation**, for detailed information.

Wake Up Screen List/Miscellaneous

- **List Count** – Displays a count of the selected Wakeup Screen parameters (Limit 30).
- **Clear All** – The **Clear All** command clears ALL Wakeup Screen parameter selections from the Control activate list.
- **Done** – Select **Done** when the Wake Up list selection is complete.
- **Cancel** – The **Cancel** command cancels any Wakeup Screen changes before the changes have been sent to either the Device or File.
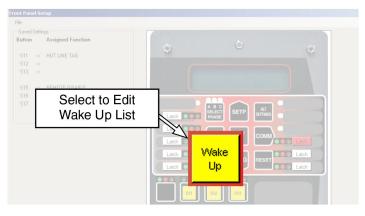
Figure 3-75   Front Panel Setup Dialog Screen – Edit Wake Up Screen Selection
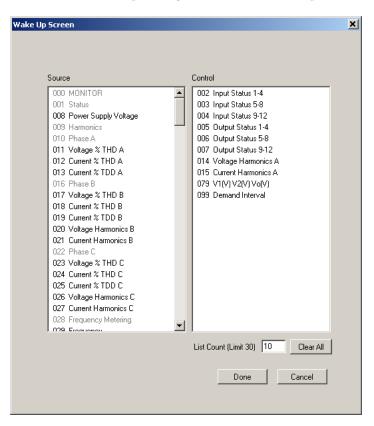
Figure 3-76   Wake Up Screen List Dialog Screen

Setup/Configuration/Profile Manager

Profile Manager allows the user to perform the following:

- Set the Maximum Number of Profiles in use
- Assign a custom name to each profile

Profile Manager/Profile Names

The user may assign a custom name to each available profile. Each Profile Name can have up to 20 ASCII characters (excluding "~" and "\").

When connected, the control will then display the custom profile name in the Edit Profile and Active Profile menus. If the user has not assigned a custom name, then the control will display the generic "Profile #" where # is the profile number.

In IPScom, the custom name will display on the Profile tab in the Setpoints screen. The custom name will also be displayed in the Select Active Profile menu and status bar.

Profile Manager/Maximum Number of Profiles

The user may define the maximum number of profiles that can be used. The default maximum number of profiles is eight. The profiles available for programming will always be consecutive, for example if the maximum number of profiles is set to 4, then the ONLY profiles that will be available for programming will be Profile 1, 2, 3 and 4 all other Setpoint Profile tabs will be grayed out.

Figure 3-77   Profile Manager Dialog Screen

Setup/Configuration/Fault Distance Parameters

The Fault Distance Parameters window (Figure 3-78) allows the user to enter the necessary parameters used to calculate Fault distance. The fault locator uses the following to calculate fault distance:

- Fault Type
- Replica Line Impedance Settings (Z_{1L} and Z_{0L})
- Line Length
- Fault Conditions

The fault distance is calculated without communications channels, special instrument transformers, or pre fault information.

This feature contributes to efficient dispatch of line crews and fast restoration of service. The fault locator requires three-phase voltage inputs (V_A, V_B and V_C). Wye-connected voltages are required for phase and ground fault distance calculations (i.e., all fault types). Only phase fault distance calculations are available with delta-connected voltages (i.e., A-B[G], B-C[G], C-A[G] and A-B-C).

The fault distance is not available when no voltage or only a single-phase voltage is connected. The fault distance also does not operate for ground faults on ungrounded, high-impedance grounded, or Petersen Coil grounded systems.

The Fault Distance is displayed in the Primary and Secondary Metering screens, as well as in the IPScom bottom menu bar.

Figure 3-78   Fault Distance Parameters

Triggers

An event record with the fault distance is generated when the following functions trip:

- 50P, 50N, 50G/GS
- 51P, 51N, 51G/GS
- 46DT, 46IT
- 67P, 67N, 67G/GS, 67Q

Triggers are selectable to each individual element level (e.g., 67G3).

Fault Type

The fault type is displayed in the IPScom bottom menu bar using the following key:

- AG for A-phase to ground faults
- BG for B-phase to ground faults
- CG for C-phase to ground faults
- AB for A–B phase-to-phase faults
- BC for B–C phase-to-phase faults
- CA for C–A phase-to-phase faults
- ABG for A–B phase-to-phase to ground faults
- BCG for B–C phase-to-phase to ground faults
- CAG for C–A phase-to-phase to ground faults
- ABC for three-phase faults

Line Settings

Line impedance settings Z1MAG, Z1ANG, Z0MAG, and Z0ANG are used in the fault locator where:

$$Z_{1L} = \left| Z1MAG \right| \angle Z1ANG$$

$$Z_{0L} = \left| Z0MAG \right| \angle Z0ANG$$

A corresponding line length setting (LL) is also used in the fault locator.

Fault Location – Oscillograph

The fault location is displayed in the oscillograph file and can be selected at any point along the event.

Setup/Setpoints

The **Setpoints** menu selection displays the Setpoints dialog screen from which the individual Function Setting dialog screens can be accessed. Figure 3-79 and Figure 3-80 represent typical examples of the Setpoints dialog screen. Selecting a Function Setting button will display the corresponding function dialog screen (See Figure 3-81 as an example).

See **Chapter 5 Setpoints** for detailed information regarding the specific elements of the Setpoints screens.
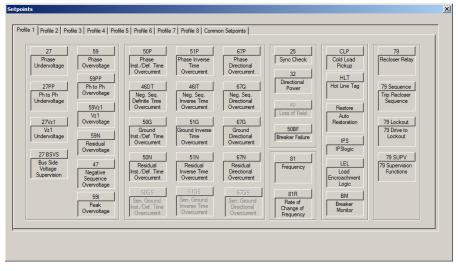
Figure 3-79   Setpoints Dialog Screen Example
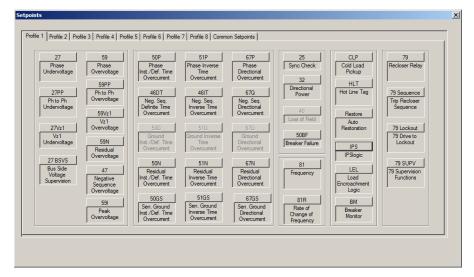
Figure 3-80   Setpoints Dialog Screen with 200 mA, 50 mA or 10 mA Ground CT Option

Figure 3-81   Example Function Dialog Screen

Setup/Alarms

The **Alarms** selection displays the Alarms dialog screen (Figure 3-82). The following Alarms can be enabled or disabled:

- Trip Close Alarm – occurs if the 52A and 52B contacts are in the same state.
- Battery Status Alarm – occurs if the battery is not present, fails the load test, or is not charging.
- Gas Pressure Alarm – occurs if the input for the gas pressure is high.
- Max Breaker Operations Alarm – occurs if the Operations Limit is exceeded.

The following Alarms are enabled by default and may not be disabled:

- EEprom Setpoints Checksum Alarm – occurs if the checksum is bad.
- DSP Watchdog Alarm – occurs if the DSP is not running correctly.
- EEprom Calibration Checksum Alarm – occurs if the checksum is bad.
- Flash Not Formatted Alarm – occurs if the internal flash drive is not formatted.
- Internal Battery Failure – occurs when the internal battery that provides back up power to the non-volatile memory has failed. This condition will set the alarm when the control reboots and the battery has been determined to have failed.

Figure 3-82   Alarms Dialog Screen

Setup/Recloser Wizard

The **Recloser Wizard** selection displays the Recloser Common Settings dialog screen (Figure 3-83). Selecting "Next" advances through a series of six additional screens (Figure 3-84 through Figure 3-90) which guide the user through the necessary steps to configure the Recloser Control.

- Settings Dialog Screen
- Phase Overcurrent Dialog Screen
- Ground Overcurrent Dialog Screen
- Residual Overcurrent Dialog Screen
- Cold Load Dialog Screen
- Reclosing Dialog Screen
- Settings Final Confirmation Screen

■**NOTE:** See **Section 5.5 Independent Phase Operation Mode** for information regarding the Recloser Wizard settings with the Independent Phase Capable Option.
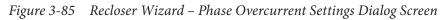
Figure 3-83   Recloser Wizard – Recloser Common Settings Screen (Three-Phase Ganged)

Figure 3-84   Recloser Wizard – Settings Dialog Screen

Figure 3-85   Recloser Wizard – Phase Overcurrent Settings Dialog Screen

Figure 3-86   Recloser Wizard – Ground Overcurrent Settings Dialog Screen

Figure 3-87   Recloser Wizard – Residual Overcurrent Dialog Screen

Figure 3-88   Recloser Wizard – Cold Load Settings Dialog Screen

Figure 3-89   Recloser Wizard – Automatic Reclosing Settings Dialog Screen

Figure 3-90   Recloser Wizard – Navigation Panel Dialog Screen

Setup/Data Logging

The **Data Logging** feature provides the user with the ability to initiate data logging of all control parameters of the selected control for downloading at a later time. Data is recorded internally into non volatile memory. The data log is transferred in the Comtrade format. The Comtrade format consist of two files, the configuration file (*.cfg) and the data file (*.dat).

Data logging will continue indefinitely as long as the Data Log Interval is set to a non-zero value. A zero value for the data log interval will effectively disable data logging. The data log, can be downloaded using IPScom. The data can be viewed using the included BecoPlot Analysis Software or any Comtrade compatible viewer.

Data logging interval ranges from 0 to 3600 seconds with an increment of 60 seconds. Once data logging is enabled, the control will store the data in records at the data log interval rate. Each record has the following data:

- Active Profile
- Current Max/Inst/Avg/Min (A, B, C, G)
- Voltage Max/Inst/Avg/Min (A, B, C, Vz1)
- Voltage/Voltage Load (Positive, Negative, Zero)
- Current (Positive, Negative, Zero)
- Real Power (A, B, C, 3Ph)
- Reactive Power (A, B, C, 3Ph)
- Power Factor (A, B, C, 3Ph)
- Apparent Power (A, B, C, 3Ph)
- Frequency
- Counters
- Current Harmonics THD (A, B, C)
- Voltage Harmonics THD (A, B, C)
- TDD (A, B, C)
- Function Pickup
- Function Timeout
- Inputs
- Outputs

■**NOTE:** Data logging includes Minimum, Maximum and Average quantities for both voltage and primary phase current.

The checksum is used to ensure the integrity of the record stored. Due to the internal structure of the Comtrade format, time stamping is always performed. A total of 6 Mbytes of data can be saved in non volatile memory.

See **Section 4.1 Unit Setup** and **Chapter 2**, **Operation**, for detailed information.

Data Logging/Setup

This submenu item displays the **Data Logging Setup** Dialog Screen (Figure 3-91). In the **Logging Timer** section, the **Data Log Interval** allows the user to input the interval in minutes at which the data will be logged. The **Save** command saves the Data Logging Setup changes to either the Open File when in File mode or the recloser control when IPScom is connected to a control. The **Exit** command cancels any Data Logging setup changes before the changes have been sent to either the Recloser Control or Open File.

Figure 3-91   Data Logging Setup Dialog Screen

Data Logging/Retrieve

This submenu item when selected, opens the Data Log "Save As" dialog screen (Figure 3-92). Enter the desired name and location for the Data Log record file and select "Save". IPScom will display Figure 3-93 which allows the user to also save the Data Log as a (*.csv) file which can be viewed in a spreadsheet program. Select "Yes" or "No". IPScom initiates the retrieval of the current data logging file from the control.
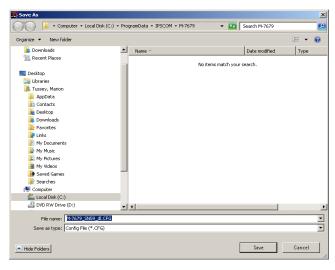
Figure 3-92   Data Logging Record "Save As" Dialog Screen
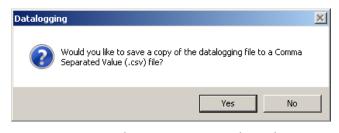
Figure 3-93   Datalogging Save CSV File Dialog Screen

Data Logging/Clear

This submenu item when selected, clears the data logging information stored in the control.

Setup/Oscillograph

The **Oscillograph** submenu allows setting and control over the recloser control's oscillograph recorder. The **Setup** command allows the user to set the number of samples per cycle, the post trigger delay, the length (in cycles) of the Oscillograph record and triggering designations to be made (Figure 3-94).

> ■**NOTE:** Selecting "Trigger Selection" in the Setup Oscillograph Recorder screen displays the "Oscillograph Trigger" dialog screen (Figure 3-95). It is NOT a command to trigger the Oscillograph.

The Setup/Oscillograph submenu item **Trigger** sends a command to the recloser control to capture a waveform. **Retrieve** allows the selection of a specific Oscillograph record (Figure 3-96) and downloads and saves the data to a Comtrade format file (Figure 3-98). **Clear** erases all existing records. The included BecoPlot Oscillograph Analysis Software program (Utility/BecoPlot) or any Comtrade reader is required to view the downloaded oscillograph files.

See **Section 4.1 Unit Setup** and **Chapter 2**, **Operation**, for detailed information.

Figure 3-94   Setup Oscillograph Recorder Dialog Screen

Figure 3-95   Oscillograph Trigger Selection Dialog Screen

Figure 3-96   Retrieve Oscillograph Record Selection Dialog Screen

Figure 3-97   Retrieve Oscillograph Record Auto Save Popup Screen
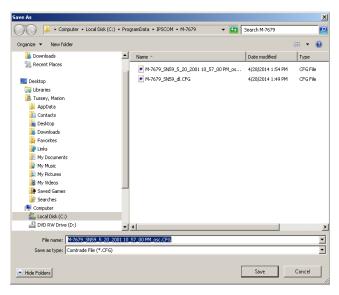
Figure 3-98   Oscillograph Record Save As Dialog Screen

Setup/Sequence of Events

The Sequence of Events submenu allows the user to **Setup**, **Retrieve** and **Clear** Sequence of Events records.

The **Setup** command displays the **Sequence of Events Trigger Setup** dialog screen (Figure 3-99). To enable a trigger, scroll down through the Trigger listing on the left side of the dialog screen and drag the desired triggers to the "Enable Trigger" section on the right side of the screen. The trigger list can be filtered to display specific "Functions" (Overcurrent, Overvoltage, Overfrequency, Function ABC) or specific "Actions" (Pickup, Timeout, Pickup Dropout, Timeout Dropout). The **Retrieve** command downloads and saves the record to file (Figure 3-100). The **Clear** command clears all Sequence of Events records in the recloser control.

See **Section 4.1 Unit Setup** and **Chapter 2**, **Operation**, for detailed information.

Figure 3-99   Sequence of Events Setup Dialog Screen

Figure 3-100   Sequence of Events Save As Dialog Screen

Setup/Display I/O Map

The **Display I/O Map** submenu displays the I/O Map dialog screen (Figure 3-101), which contains a chart of programmed input and output contacts, in order to allow scrolling through all recloser control output and blocking input configurations.

The I/O Map screen includes Function hyperlinks which allow the user to open an individual recloser control function setpoints screen and return to the scrolling dialog screen. All available parameters can be reviewed or changed when opening a function setpoints screen from the Display I/O Map scrolling dialog screen.
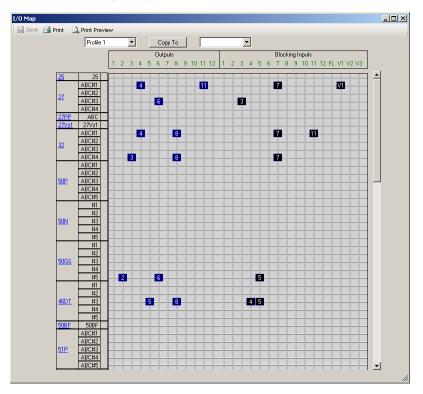
Figure 3-101   Display I/O Map Dialog Screen

Setup/Custom Curve Editor

The **Custom Curve Editor** submenu displays the Custom Curves interactive dialog screen (Figure 3-102), which allows the user to define up to 4 custom Inverse Time Curves. Each curve has a total of 64 user defined "x-y" coordinates. The "x" coordinate is the pickup ratio and the "y" coordinate is the reciprocal of the time value.

See **Section 5.1 System Setpoints** for detailed information.
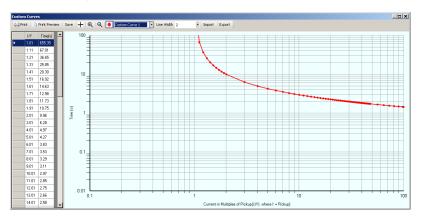
Figure 3-102   Custom Curves Dialog Screen

Setup/Display All Settings

Selecting **Display All Settings** displays the **All Setpoints** interactive screen (Figure 3-103). This screen contains the settings for each control function within a single window to allow scrolling through all control setpoint and configuration values. The individual Feature and Function selections are described in the applicable sections.

The All Setpoints screen includes Hyperlinks to allow the user to access the individual control function dialog screen, review and/or change settings, then return to the scrolling All Setpoints screen. All available function parameters can be reviewed or changed in the individual control function dialog screen. The All Setpoints screen can also be printed to any system printer.

Figure 3-103   Display All Setpoints Interactive Screen

UTILITY MENU

Utility/Remote Control

The **Remote Control** feature allows the user to observe the status of the individual phase breakers of the recloser. The user can also initiate the following commands:

- • Trip Lockout
- • Close
- • Reset
- • Disable Hot Line Tag

Trip Lockout – sends a remote Trip and Lockout command with a user confirmation.

Close – sends a remote Close command with a user confirmation.

Reset – sends a remote Reset command to clear the lockout state ot target LEDs with a user confirmation.

Disable Hot Line Tag – A Hot Line Tag (HLT) can only be deactivated by the same source that activated the HLT. The HLT status and the HLT attributes are saved in nonvolatile memory and will not be affected by a power loss.

The HLT attributes are the Channel ID or, with Ethernet communications, the Mac Address and the Source Mac Address. Source Validation is always performed either by the Channel ID or, if enabled, by the Mac Address of the client. The firmware will use the stored "Source Mac Address" value to determine whether to use the Channel ID or the Mac Address for Source Validation. This setting is stored in nonvolatile memory at the instant of HLT activation.

When the Remote Control application is launched, IPScom will determine the HLT status. This status will determine the state of the "Enable Hot Line Tag" button. If the HLT state is inactive, the user is allowed to activate HLT. If the HLT state is active, the HLT button will display "Disable Hot Line Tag".

If the Disable Hot Line Tag and the Channel ID, or the Mac Address, does not match the Source, the firmware will not allow the command. If the command is not accepted, the state of the "Disable Hot Line Tag" button will not change. When the front panel is used to toggle the HLT, the Firmware will reject the command if it was originally enabled by remote connection whose Channel ID and MAC Address are stored in nonvolatile memory.

Figure 3-104   Remote Control Screen (Shown: Three-Phase Ganged Operation)

Utility/Remote Output Control

When the Recloser Control Outputs "Enable Remote Control" feature is enabled, the user can perform the following operations from the IPScom "Remote Output Control" dialog screen Figure 3-105:

- Energize Output 1 or 2
- Energize Outputs 3 and 4 (also 5 through 12 for Expanded I/O units)
- De-energize Output 1 or 2
- De-energize Outputs 3 and 4 (also 5 through 12 for Expanded I/O units)
- Reset Latched Outputs 3 and 4 (also 5 through 12 for Expanded I/O units)
- Force Output Reset of all Outputs

Figure 3-105   Remote Output Control Dialog Screen

Utility/Hardware Menu

Hardware/Update Firmware

The **Update Firmware** feature is available from the Utility menu selection. This feature allows the user to upload firmware updates to the recloser control. Firmware updates may be uploaded at any time, as the control settings are not affected. To send a firmware update to the recloser control, proceed as follows:

1. Remove the recloser control from service.
2. From the IPScom Main Screen select **Utility/Hardware/Update Firmware**. IPScom will display the Open file dialog screen (Figure 3-106) with a default *.ppf file extension.
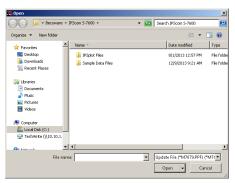
Figure 3-106   Update Firmware Open File Dialog Screen

3. Select the target file, then select **Open**. IPScom will display the following progress screens ([Figure 3-107](#) and [Figure 3-108](#)).
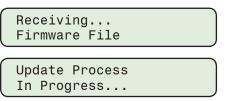
Figure 3-107   Sending Firmware File Progress Screen

Figure 3-108   Firmware is Being Programmed Progress Screen

During the firmware update process, the recloser control HMI will display the following:

```
Receiving...
Firmware File
```

```
Update Process
In Progress...
```

4. Upon completing the firmware update IPScom will display the following confirmation screen ([Figure 3-109](#)).

Figure 3-109   Firmware Updated Successfully Confirmation Screen
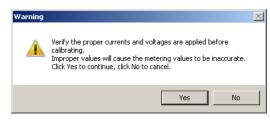
5. Select **OK**. The control HMI will display the following sequence of screens and reboot automatically. IPScom will return to the Main screen and communication will need to be reestablished.

```
Updating firmware
Please Wait
```
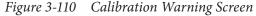
```
ATTENTION! Rebooting
in 28 seconds
```

Hardware/Calibrate

The **Calibrate** menu selection provides the user with the capability to perform a calibration of the control. Upon applying specified voltage and current inputs, the control will perform the calibration automatically and report the success or failure of the calibration.

> ■**NOTE:** See Section 4.2 System Setup for details regarding calibration with LEA input option.

Figure 3-110   Calibration Warning Screen

Figure 3-111   Calibration Successful Confirmation Screen

Figure 3-112   Calibration Done with Errors Screen

Hardware/Set Date & Time

The **Utility/Set Date & Time** submenu item enables the user to synchronize the internal clocks using the PC Clock or the addressed Control Clock.

Figure 3-113   Setup Date & Time Dialog Screen

Selecting **Settings** from the Setup Date & Time dialog screen displays the "Time Zone and Daylight Savings" dialog screen (Figure 3-114)

Figure 3-114   Time Zone and Daylight Savings Dialog Screen

Hardware/Date & Time Compare

The **Utility/Hardware/Date & Time Compare** submenu item enables the user to review the internal clocks for the PC or the addressed control.

Figure 3-115   Date and Time Compare Screen

Hardware/Front Panel Labels

Selecting **Utility/Hardware/Front Panel Labels** opens a pdf form file in Adobe Acrobat (Figure 3-116). This form allows the user to create and print custom labels for the user programmable front panel LEDs and Pushbuttons. The desired custom labels are setup in the form template. The printout can then be inserted behind the front panel overlay.
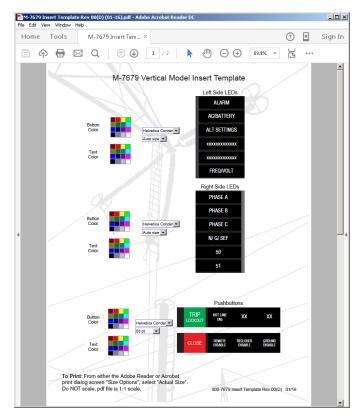
Figure 3-116   Front Panel Labels PDF Form Dialog Screen

Utility/Cybersecurity Menu

Cybersecurity/Manage Accounts

The Manage Accounts feature allows the user to change their password at any time (Figure 3-117). The Security Policy Administrator is able to:

- Send/Receive Account Permissions from the control
- Manage the permissions associated with User Accounts and assign new Roles with customized permissions
- View/Retrieve the Audit Log
- Set Access Password Type

See **Appendix D, Cyber Security** for a comprehensive overview of the Manage Accounts screens and setting up Cyber Security.

Figure 3-117   Change Password Dialog Screen

Cybersecurity/SD Card Key Generator

The SD Card Key Generator feature allows a User Name and Password to be saved to an SD Card. The SD Card with Key Generated User Name and Password can be inserted into the SD Card slot on the unit and all security privileges (from the HMI) will be available to the user.

Figure 3-118   SD Card Key Generator Dialog Screen

Utility/Data Analysis Menu

Data Analysis/SOE Viewer/Sequence of Events Viewer

The View Sequence of Events Record screen (Figure 3-119) allows the user to open and print Sequence of Events files.

Figure 3-119   View Sequence of Events Dialog Screen

Data Analysis/SOE Viewer/PQ Viewer

The PQ Events Viewer (Figure 3-120) allows the user to open and print ITIC data from a Sequence of Events file. Hovering over a plotted point will display the details of the event in the "Event Data" portion of the screen. Select the "PQ Table Form" tab to view the ITIC event parameters in a Table format.
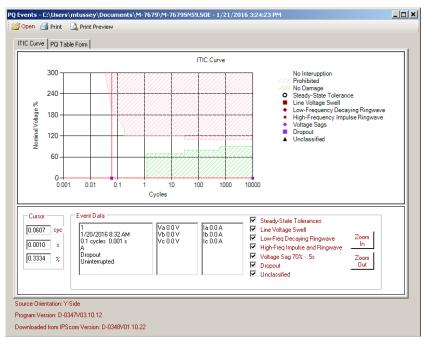
Figure 3-120   PQ Events Viewer Dialog Screen

Data Analysis/Message Log

The Message Log records commands sent to the control in a circular buffer. The **Message Log/Retrieve** selection allows the user to download and save the Message Log file (*.mlg) to the desired location. The Message Log can also be saved as a Comma Separated Values file (*.csv).

The **Message Log/View** selection prompts the user to open a saved Message Log file. IPScom will then open the Log file in the Message Log Viewer (Figure 3-121). Each Message Log entry includes:

- Index Number
- Timestamp
- Event Description

Figure 3-121   Message Log Viewer Screen

Data Analysis/Fault Recorder

The Fault Recorder submenu allows the user to **Retrieve, Clear** and **View** Fault Recorder record files. The **Retrieve** command downloads and saves the record to a (*.flt) file. The **Clear** command clears all Fault Recorder records in the recloser control. The **View** command launches the Fault Recorder Viewer (Figure 3-122). Double-click a file to display the Fault Record Event Detail screen (Figure 3-123).

■**NOTE:** The Fault Recorder Viewer can also be accessed from the **Utility** Menu when IPScom is initially opened, before connecting or entering File mode.

Figure 3-122   Fault Recorder Viewer Screen

Figure 3-123   Fault Recorder Event Detail Screen

Data Analysis/Trip Sequence Events

The M-7679 has the ability to record Recloser Trip Sequence Events and store the record in non-volatile memory. Any change in the Trip Sequence Event State will initiate recording. Each record contains the following data:

- TSE state
- Recloser Status
- Profile number
- F79 Info
- Input Status
- Reclose Delay Timer
- Reclose Reset Timer

- Trip Timer
- Recloser interrupt time
- Supervision Timer
- Reset From Lockout Timer
- Function Pickup
- Functions Operate
- Time Stamp

The Trip Sequence Events submenu allows the user to **Retrieve, Clear** and **View** Trip Sequence Event files. The **Retrieve** command downloads and saves the record to a (*.TSE) file. The **Clear** command clears all Trip Sequence Event records in the recloser control.

The **View** command launches the Trip Sequence Viewer. Select **Open** to load a saved "TSE" file. Events are listed at the bottom of the window with the most recent event first. Double-click an event to display the Trip Sequence details in the graphical display (Figure 3-124). The Viewer contains Playback Controls that will cycle through the events. The user may click forward or reverse to view one step at a time or automatically play the sequence with adjustable speed control and pause the playback at any time.

> ■**NOTE:** The Trip Sequence Viewer can also be accessed from the **Utility** Menu when IPScom is initially opened, before connecting or entering File mode.
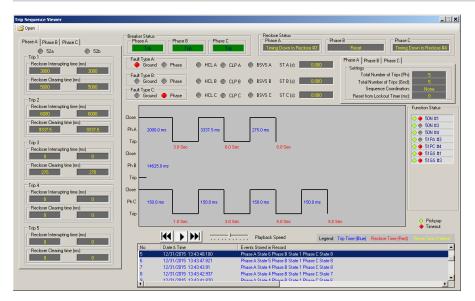
Figure 3-124   Trip Sequence Viewer Screen (Shown: Independent Phase Example)

Data Analysis/SD Card Download Converter

This feature allows Data Log or Oscillograph files downloaded from the M-7679 to an SD card to be converted to *.cfg file format.

Data Analysis/BecoPlot

The BecoPlot Oscillographic Analysis Software runs in conjunction with IPScom software on any Windows™ based computer running Windows 2000 or later, to enable the plotting and printing of waveform data downloaded from the M-7679 Recloser Control. See **Section 3.7 BecoPlot** for detailed information for this feature.

HELP MENU

The **Help** menu provides four selections. The **Contents** selection initiates a link to a PDF (Portable Document File) version of this instruction book for easy reference. Adobe Acrobat® Reader is required to view this document.

The M-7679 Instruction Book has Bookmarks for ease of navigation. By showing the "Bookmarks pane" in Adobe Acrobat Reader, the user can directly access selected topics.

Help/About

The **About** selection displays the IPScom version. (Figure 3-125).

Figure 3-125   Help "About" Screen

When connected to a Recloser Control, selecting "Details" from the About screen allows the user to save the recloser control information to a text file for viewing. See Figure (Figure 3-126).
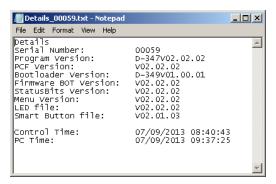
Figure 3-126   Details Text File Example

Help/Information

The **Information** selection provides a means for the user to enter Optional Information if desired, generally used for third party software (Figure 3-127).

This information will be saved ONLY in the SPF file, not in the control. This information can be added to provide third party software the means to add customized information to the SPF file.

- Serial Number String: any serial number the user wants to assign
- Location string: Any string describing the location of a control
- Manufacturer string: Constant
- Relay Model: User customizable Model number
- Date/Time of last Modification: This will automatically be filled when the user saves a file locally to the hard drive
- PC-Software name : Any string a customer wants to use, generally used to denote third party software
- PC-Software Version: Any string to denote customer third party version of software

Figure 3-127   Information Screen

This information is available under the following XML tags:

<PRi>

<SN V="D-0123V01.00.00" Desc="Serial number string" />

<LOC V="Central office" Desc="Location string" />

<MAN V="Beckwith Electric Co., Inc." Desc="Manufacturer string" />

<MOD V="M7679 V01" Desc="Relay Model string" />

<UTC V="1386002176.38692" Desc="Date/Time of last modification UTC format" />

<APP V="IPscom" Desc="PC-Software name which generated SPF file string" />

<VER V="V01234" Desc="PC-Software version which generated SPF file string" />

</PRi>

This information is available ONLY after the SPF file is decrypted.

Help/E-mail Support

When connected to a control, the **E-mail Support** feature allows the user to easily send all necessary support files to support@beckwithelectric.com. The feature is available from the Help menu or by selecting the "**@**" icon in the Quick Access toolbar. See **Chapter 2, Operation** for more detailed information.

3.7   BecoPlot Analysis Software

The BecoPlot Analysis Software operates in conjunction with all IPScom Communications Software on any computer running Windows™. BecoPlot allows the user to plot and print relay data contained in Comtrade formatted files (*.cfg).

Overview

BecoPlot is a windows based program for viewing the data that has been retrieved using the Data Logging and Oscillograph features of IPScom.

When BecoPlot is started, a menu and tool bar are displayed. This section describes each BecoPlot menu selection and explains each BecoPlot command in the same order that they are displayed in the software program. Figure 3-128 presents the BecoPlot Menu and Submenu Callouts.

Starting BecoPlot

1. Select the BecoPlot menu item from the IPScom Menu (Utility/BecoPlot). The BecoPlot Window and Toolbar is displayed (Figure 3-128).

2. Select File/Open from the menu, and browse for the desired .cfg file.

3. Open the file. BecoPlot should display the saved data, as shown in Figure 3-129 & Figure 3-130.

Figure 3-128   BecoPlot Main Window with Submenus
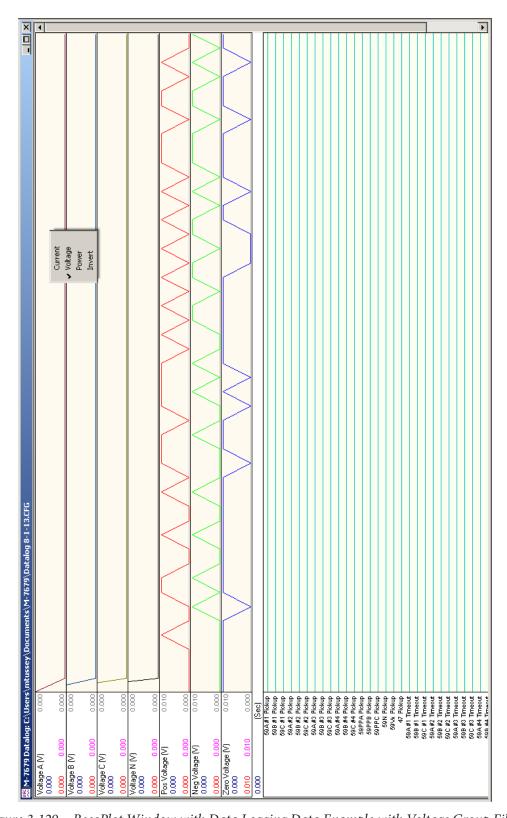
Figure 3-129   BecoPlot Window with Data Logging Data Example with Voltage Group Filter
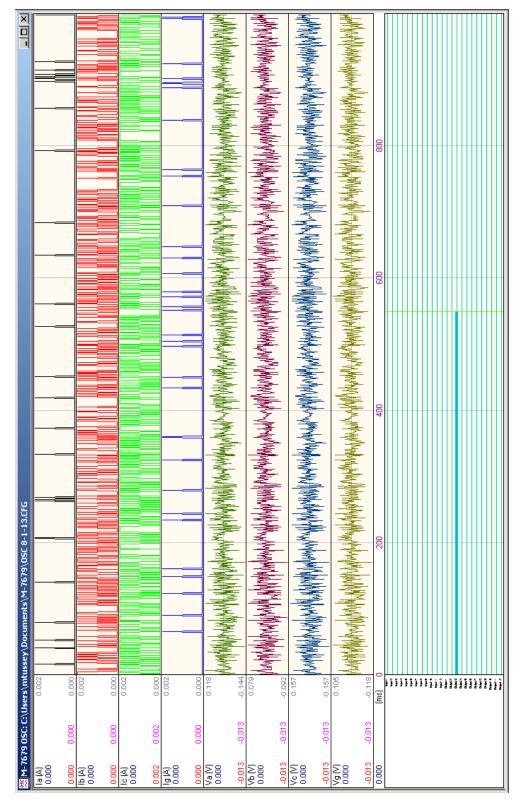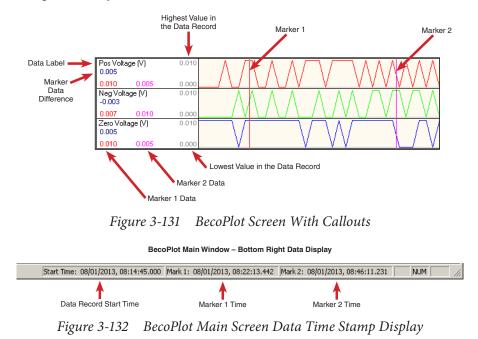
Figure 3-130   BecoPlot Window with Oscillograph Data Example

Markers

BecoPlot includes two user selectable markers. The first is positioned by double clicking on the plotted wave form data. The second is positioned by pressing and holding the **SHIFT** key and then double clicking on the plotted wave form data.

The markers can be dragged by moving the cursor over the marker until the cursor changes to a double-headed arrow ↔, then holding down the Left mouse button and dragging the marker. The first marker can also be moved an interval at a time by pressing the **LEFT** or **RIGHT** arrow key. The second marker can be moved by pressing the Shift key and the Left or Right arrow key.

Figure 3-131   BecoPlot Screen With Callouts

BecoPlot Main Window – Bottom Right Data Display

Figure 3-132   BecoPlot Main Screen Data Time Stamp Display

Right-Click Filter Menus

Right-Click menus are available to allow filtering of the data results. The Datalog screen contains additional Shift/Right-Click menus which allow filtering by Groups. Figure 3-133 and Figure 3-134 show the right-click menus available in either a Datalog or Oscillograph file.
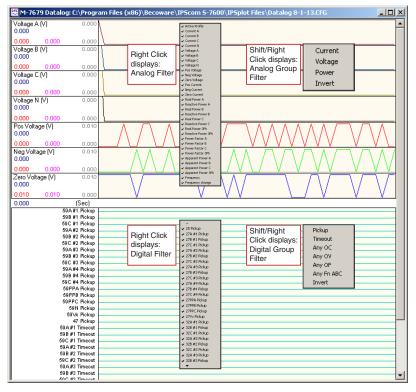
Figure 3-133   Datalog File Right-Click Filter Menus
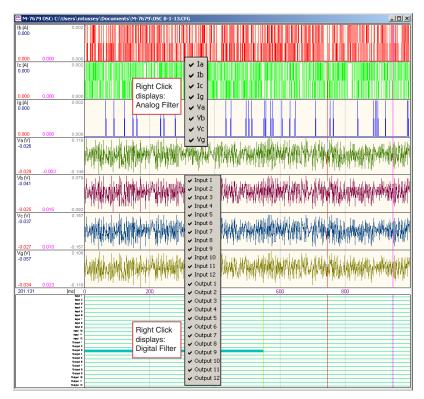
Figure 3-134   Oscillograph File Right-Click Filter Menus

File Menu

```
File
  Open...                    Ctrl+O
  Close

  Print...                   Ctrl+P
  Print Preview
  Print Setup...

  1 OSC 8-1-13.CFG
  2 Datalog 8-1-13.CFG
  3 Oscillograph Data File.CFG
  4 Datalog 7 23.CFG
  5 C:\Users\...\OSC 5-10-13.cfg
  6 Datalog File with VAr Control.cfg
  7 C:\Users\...\Datalog File.cfg
  8 OSC 1.cfg

  Exit
```

The **File** menu allows the user to:

- Open an BecoPlot (.cfg) file previously downloaded by IPScom.
- Print the displayed BecoPlot data.
- A Print Preview of the displayed BecoPlot data.
- Select the printer and printer settings to be used.
- Select from previously viewed (.cfg) files (the last eight files displayed).
- Exit the BecoPlot program.

View Menu

```
View
  Device Information

  Original Waveform
  Fundamental
  Harmonics

  Power Factor
  Apparent Power
  PQ Diagram
  Apparent and PF

  Zoom In          +
  Zoom Out         -
  View ALL

✓ Toolbar
✓ Status Bar
```

The **View** menu allows the user to:

- Display the Device Information (Figure 3-135) for the corresponding BecoPlot data file.
- Original Waveform
- Fundamental
- Harmonics
- Power Factor
- Zoom In, increase the resolution of the tap data displayed on the screen.
- Zoom Out, decrease the resolution of the tap data displayed on the screen.
- View ALL, returns the display to include all data within the record.
- Select which Tool Bar (Toolbar/Status Bar) is available on the display window.

Figure 3-135   Device Information Screen

Settings Menu

Select Wave Form

Allows the selection of any of the following Parameters to be plotted or printed (Figure 3-136):

- Current (Ia, Ib, Ic, Ig)
- Inputs 1 through 12
- Voltage (Va, Vb, Vc, Vg)
- Outputs 1 through 12
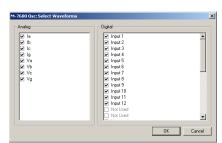
Figure 3-136   Select Waveforms Dialog Screen

Select Color

Provides the user with the capability to change Foreground and Background display color of individual Waveform traces for customized plotting (Figure 3-137).

Figure 3-137   Select Color Dialog Screen

Change Scale

Provides the user with the capability to change the scaling of the displayed parameter.

Figure 3-138   Change Scale Screen

Search Time Stamp

Provides the user with the capability to place the marker exactly at the desired time stamp in the BecoPlot window.

Figure 3-139   Search Time Stamp Screen

Help Menu

The **Help** menu provides access to the **About BecoPlot** command which provides version information for BecoPlot.

Figure 3-140   About BecoPlot Screen

4 System Setup

■ **CYBER SECURITY NOTE:**

When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

Chapter four is designed for the person or group responsible for the Unit Setup and Configuration of the M-7679 Recloser Control.

Chapter 4 consists of:

- The Unit Setup Section, which consists of general unit setup information, Communications setup, Oscillograph, Sequence of Events and Data Logging setup.
- The System Setup Section provides the definitions of system quantities and equipment characteristics required by the control which include CT, VT configuration selection, and Input and Output assignments.
- Functional and connection diagrams for a typical application of the control.

The selection of the M-7679 System Setup parameters can be performed using the S-7600 IPScom Communications Software and will be included where applicable.

4.0   Quick Index

4.1   Unit Setup

GENERAL UNIT SETUP

The General Unit setup consists of the setup of the following features and functions:

- User Lines
- Time and Date
- Communications
- Oscillograph
- Sequence of Events
- Load Profile Trending (Data Logging)

Cyber Security

Access to all features using either the Front Panel HMI or IPScom Communications Software is subject to the Access Permissions Policy as designated by the Security Policy Administrator. See **Appendix D, Cyber Security** for a comprehensive overview of Managing Account Permissions and setting up Cyber Security.

USER LINES

The user station identification lines (User Lines) allow the user to uniquely identify the unit. The user can customize the User Lines for up to 8 individual device profiles. Each line of this display can have up to 20 ASCII characters (excluding "~" and "\"). User Lines are factory preset with "Beckwith Electric P1" for Line 1 and "M-7679" for Line 2.

Setting User Lines from IPScom

To change the User Lines from IPScom perform the following:
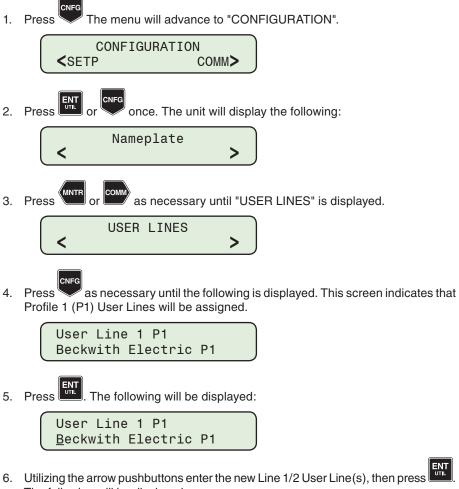
1. Select **Setup/Configuration/Relay** from the IPScom toobar. IPScom will display the System Setup dialog screen. Select the "User Lines" tab. IPScom will display the User Lines dialog screen (Figure 4-1).

2. Input the new Line 1/Line 2 information for the specific profiles.

3. Select **Save**, the desired User Lines will be saved to either the Control or Open File.

Figure 4-1   User Lines Dialog Screen

Setting User Lines From The HMI

When [ENT UTIL] is pressed at the Configuration/User Lines/User Line 1 or User Line 2 menu, an underline cursor is displayed under the left-most character. Each character is changed by using the ↑ and ↓ pushbuttons to select the ASCII character (the ASCII character list begins with "!"). The ← or → pushbutton is used to move the underline to the next character. When the **ENT** pushbutton is pressed, the new user line is stored into nonvolatile memory.

1. Press [CNFG] The menu will advance to "CONFIGURATION".

```
     CONFIGURATION
  ❮SETP          COMM❯
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
       Nameplate
  ❮                 ❯
```

3. Press [MNTR] or [COMM] as necessary until "USER LINES" is displayed.

```
      USER LINES
  ❮                 ❯
```

4. Press [CNFG] as necessary until the following is displayed. This screen indicates that Profile 1 (P1) User Lines will be assigned.

```
  User Line 1 P1
  Beckwith Electric P1
```

5. Press [ENT UTIL]. The following will be displayed:

```
  User Line 1 P1
  Beckwith Electric P1
```

6. Utilizing the arrow pushbuttons enter the new Line 1/2 User Line(s), then press [ENT UTIL]. The following will be displayed.

```
  User Line 1 P1
  Beckwith Electric P1
```

7. Press [CNFG] to advance to the User Line 1/User Line 2 screens for Profiles 2 through 8. Repeat the steps above to assign User Lines to additional Profiles.

SYSTEM CLOCK

This feature allows the user to set the recloser control internal clock. The clock is used to time stamp system events and oscillograph operations. The system clock includes the capability to enable/disable Daylight Savings Time.

If the IRIG-B interface is used, the hours, minutes, and seconds information in the clock will be synchronized with IRIG-B time information every hour.

The recloser control can accept a demodulated IRIG-B signal using the 2 pin terminal block (TB-4). TTL is the only format supported.

IPScom Date & Time Compare

The **UtilityDate & Time Compare** submenu item enables the user to compare the control date/time with the PC date/time.

1. From the IPScom Main Screen Utility dropdown menu select **Date & Time Compare**. IPScom will display Figure 4-2.

Figure 4-2   Date & Time Compare Screen

IPScom Set Date & Time

The **Utility/Set Date & Time** submenu item enables the user to to set the recloser control Date & Time and enable or disable Daylight Savings Time.

▲**CAUTION:** Whenever the clock is reset and data logging is enabled the data log should be cleared.

1. From the IPScom Main Screen Utility dropdown menu select **Set Date & Time**. IPScom will display a warning (Figure 4-3) regarding time stamped values.

Figure 4-3   Setup Date & Time Warning Screen

2. Select **OK**. IPScom will display Figure 4-4.

Figure 4-4   Setup Date & Time Dialog Screen
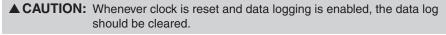
3. From the Setup Date & Time dialog screen (Figure 4-4) select **Settings**. IPScom will display the "Time Zone and Daylight Savings" settings dialog screen (Figure 4-5).
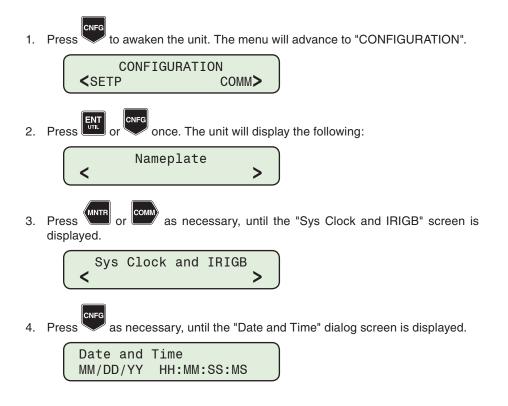
Figure 4-5   Time Zone and Daylight Savings Settings Dialog Screen

4. Enter the desired settings and select **Save**. IPScom will return to the Setup Date and Time dialog screen.

5. From the Setup Date & Time dialog screen (Figure 4-4) select either **Control Clock** or **PC Clock**.

6. If PC Clock was selected and the Date/Time of the PC is the desired time to be set in the control, then select **Save**.

7. If Control Clock was selected, then input the desired Date/Time, then select **Save**.

8. IPScom will briefly display a "Setpoints Saved" confirmation screen and then return to the Main Screen.

Setting Date & Time and Daylight Savings From The HMI

▲ **CAUTION:** Whenever clock is reset and data logging is enabled, the data log should be cleared.

1. Press [CNFG] to awaken the unit. The menu will advance to "CONFIGURATION".

```
        CONFIGURATION
   <SETP              COMM>
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
        Nameplate
   <                      >
```

3. Press [MNTR] or [COMM] as necessary, until the "Sys Clock and IRIGB" screen is displayed.

```
     Sys Clock and IRIGB
   <                      >
```

4. Press [CNFG] as necessary, until the "Date and Time" dialog screen is displayed.

```
   Date and Time
   MM/DD/YY  HH:MM:SS:MS
```

5. Press ⬛. The following will be displayed.

```
Set Date and Time
MM/DD/YY  HH:MM:SS
```

■**NOTE:** The cursor will be positioned under the left hand "Month" element of the date. Utilizing the Up/Down arrow pushbuttons will change the Month. Utilizing the Right/Left arrow pushbuttons will move the cursor between each element of the date and time.

6. Utilizing the arrow pushbuttons enter the desired Date and Time, then press ⬛. The following will be displayed reflecting the settings that were entered.

```
Set Date and Time
XX/XX/XX  XX:XX:XX:XX
```

7. Press ⬛ as necessary, until the "Daylight Saving" dialog screen is displayed.

```
Daylight Saving
DISABLE
```

8. Press ⬛. The following will be displayed.

```
Daylight Savings
DISABLE
```

9. Press ⬛ or ⬛ to select "ENABLE", then press ⬛. The following will be displayed:

```
Daylight Saving
ENABLE
```

10. Press ⬛ as necessary, until the "Time Zone" dialog screen is displayed.

```
Time Zone
−5
```

11. Press ⬛. The following will be displayed.

```
Time Zone
−5
```

12. Utilizing the arrow pushbuttons enter the Time Zone where the recloser control is installed.

Press ⬛. The following will be displayed reflecting the setting that was entered.

```
Time Zone
XX
```

COMMUNICATION SETUP

Communication setup can be accomplished utilizing either IPScom or the HMI. The Communication setup consists of the setup of the following features and functions:

- COM Port definitions and Device Address
- Ethernet Port Settings
- Installing Modems

The M-7679 includes five physical communication ports. The unused communications ports can be disabled through software to comply with cyber security requirements.

- Front – USB Port, Type B, Version 1.1. This port is used to locally set and interrogate the control using a portable computer.
- Port 1, (standard) located on the rear of the control can be either a Serial TIA-232, TIA-485, Fiber, or none.
- Port 2/Port 3, (optional) located on the rear of the control can be either a RJ45 Ethernet 10/100 BASE-T or Fiber Ethernet 100 BASE-FX.

  Ethernet Ports are auto-detect, auto-negotiable 10/100Mbps, with support for multi-user rights for up to eight concurrent users.

- Port 4, (optional) located on the rear of the control can be either a Serial TIA-232, TIA-485, Fiber, or none.

Time Synchronization Port:

- IRIG - B (B000)
- Input – Demodulated
- Input level – TTL
- Isolation – 1,500 Vdc

Direct Connection

In order for IPScom to communicate with the recloser control using direct serial connection, a serial "null modem" cable is required, with a 9-pin connector (DB9P) for the system, and an applicable connector for the computer (usually DB9S or DB25S).

An optional 10 foot null modem cable (M-0423) is available from the factory, for direct connection between a PC and the recloser control's serial port.

When fabricating communication cables, every effort should be made to keep cabling as short as possible. Low capacitance cable is recommended. The TIA-232 standard specifies a maximum cable length of 50 feet for TIA-232 connections. If over 50 feet of cable length is required, other technologies should be investigated.

Other communication topologies are possible using the M-7679 Recloser Control. An Application Note, "Serial Communication with Beckwith Electric's Integrated Protection System Relays" is available from the factory or from our website at www.beckwithelectric.com.

▲ **CAUTION:** The **Echo Cancel** check box should only be used when several recloser controls are connected using a fiber optic loop network. Otherwise, echo cancel must not be selected or communication will be prevented.

▲ **CAUTION:** If the serial port is connected to something other than a modem, and an IPScom modem command is executed, the results are unpredictable. In some cases, the computer may have to be reset.

IPScom COM Port Setup

> ■**NOTE:** Communication must be established with the target recloser control for this procedure. The IPSCom installation and establishing initial Local communications are covered in Chapter 3 IPScom.

1. From the IPScom Main Screen menu select **Communication/Setup/Comm Port**. IPScom will display the Setup Comm Port dialog screen (Figure 4-6).

   The System COM Port that is in use will be indicated at the top of the display.

Figure 4-6   Setup Comm Port Dialog Screen
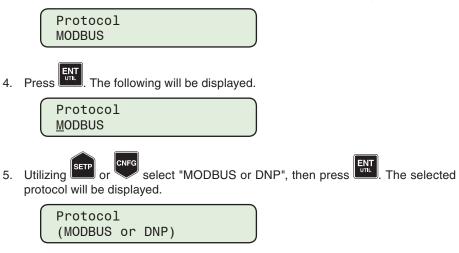
2. Select the desired COM Port to be setup (1 or 4).
3. Enter the desired communications parameters:
   • Protocol (MODBUS or DNP)
   • Baud Rate (1200 to 115200)
   • Parity (None, odd or even)
   • Stop Bits (1 or 2)
   • TX Delay (0 to 5000 ms)
   • Sync Time (0 to 5000 ms)

4. Select **Save**. IPScom will save the settings to the device or open file.

HMI COM Port Setup

If the default value for a parameter does not need to be changed, skip the applicable steps.

> ■**NOTE:** The steps necessary for configuring PORT 1 are described here. The steps to configure PORT 4 are similar.

1. Press **COMM** to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
      COMMUNICATIONS
 ❮CNFG              UTIL❯
```

2. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
      PORT1 Settings
 ❮                     ❯
```

3. Press [CNFG ⌄] as necessary, until the "Protocol" menu item is displayed.

> ```
> Protocol
> MODBUS
> ```

4. Press [ENT UTIL]. The following will be displayed.

> ```
> Protocol
> MODBUS
> ```

5. Utilizing [SETP] or [CNFG ⌄] select "MODBUS or DNP", then press [ENT UTIL]. The selected protocol will be displayed.

> ```
> Protocol
> (MODBUS or DNP)
> ```

6. Follow the procedure above to enter the desired:
    • Baud Rate (1200 to 115200)

    • Parity (None, odd or even)

    • Stop Bits (1 or 2)

    • TX Delay (0 to 5000 ms)

    • Sync Time (0 to 5000 ms)

7. PORT 1 is now available for communications.

Optional Ethernet Ports

The optional Ethernet Ports are available through an RJ45 (10/100 Base-T) or a Fiber Optic (100 Base-Fx) interface for ethernet communication to the M-7679. The port supports up to 8 concurrent connections. The maximum number of allowed DNP connections is four. The maximum number of MODBUS connections is four. The port supports DHCP protocol and also allows manual configuration of the Ethernet port. MODBUS protocol "Port Number" and DNP Protocol "Port Number" are required for manual configuration.

If no communication activity is detected on a previously open ethernet socket, for the amount of time specified by the "Keep Alive Time" setting, the control will then close the socket and make it available for future connection.

> ■**NOTE:** Keep Alive Time applies only to Ethernet communication.

Dual Ethernet Support

Optional Dual Ethernet hardware is supported which can provide two individual Mac addresses that act as separate connections, with two TCP stacks. Self-Healing Ring topology is supported using either a managed or unmanaged ethernet switch. Failover Network topology is also supported.
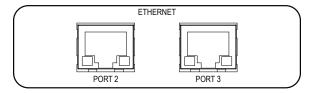
Figure 4-7   Optional Dual Ethernet Ports

Ethernet Port Configuration From IPScom

■**NOTE:** Manual configuration of the Ethernet Port (not enabling DHCP Protocol) requires that the IP Address, Net Mask and Gateway settings be obtained from the System Administrator.

1. Ensure the following conditions exist:
   a. IPScom is installed on the host computer
   b. The host computer is physically connected to the target control through either a USB or Serial Port connection
   c. The host computer and the control are physically connected to the target Ethernet network

2. Start the IPScom program. IPScom will display the IPScom **Main** dialog screen.

3. Select **Communication/USB or Com Port** from the **Communication** drop-down menu. IPScom will display the appropriate Connection Dialog Screen (Figure 3-4 or Figure 3-20).

4. Select **Connect**, IPScom will attempt to connect to the target control.

5. If IPScom returns a Failed to Connect Error screen, repeat Steps 3 and 4.

6. IPScom will display the "Connected" confirmation screen (Figure 4-8). IPScom will display the connected version of the IPScom Main Screen (Figure 3-14).

Figure 4-8   Connected Confirmation Screen

7. From the **Communication** drop-down menu, select **Setup/Ethernet Settings**. IPScom will then display the Ethernet Setup dialog screen (Figure 4-9).

8. If the Ethernet network that the target control is connected to *supports DHCP Protocol*, then perform the following:
   a. From the Setup Ethernet dialog screen (Figure 4-9) select **DHCP Protocol** "Enable".
   b. Select the desired "Keepalive Time" duration.
   c. Select "Save" to save the settings to the target control.
   d. Go to Step 10.

9. If the Ethernet network that the target control is connected to *does not support DHCP Protocol*, or manual configuration is desired, perform the following:
   a. Select **DHCP Protocol** "Disable".
   b. Select the desired "Keepalive Time" duration.
   c. Enter the IP Address, Net Mask, Gateway and the applicable MODBUS Port settings.
   d. Select "Save" to save the settings to the target control.

■**NOTE:** The DNP and MODBUS Port addresses can not be set to the same value.

10. If the Network MODBUS Port address is not "502", set these parameters to match the target network settings.

The Ethernet option for the control is now enabled. See **Communication Using Ethernet Connection** section of Chapter 3 to connect to the target control through the Ethernet connection.

Figure 4-9   Setup Ethernet Dialog Screen

Network Time Synchronization

■**NOTE:** Network Time Synchronization requires the SNTP (Simple Network Time Protocol) "Server Name" or "Server IP Address" to be known.

1. From the **Communication** drop-down menu, select **Setup/Ethernet Settings**. IPScom will then display the " Ethernet Setup" dialog screen (Figure 4-9).
2. From the "SNTP Server" section of the dialog screen proceed as follows:
    a. If the Server Name is known, enter the Server Name and then select "Lookup". IPScom will search for the corresponding IP Address.
    b. If the server IP Address is known, enter the IP Address.

3. Select "Save". IPScom will save the settings to the device or open file.

Ethernet Port Configuration on a network that underlinesupports DHCP Protocol, from the HMI

1. Press COMM to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
        COMMUNICATIONS
 CNFG            UTIL
```

2. Press ENT/UTIL or CNFG once. The unit will display the following:

```
        PORT1 Settings
 <                    >
```

3. Press ⬡MNTR or ⬡COMM as necessary until "Ethernet" is displayed.

```
        Ethernet
  <                  >
```

4. Press ■ENT UTIL or ⬟CNFG once. The unit will display the following:

```
        Settings
  <                  >
```

5. Press ⬟CNFG pushbutton as necessary until "DHCP Enable" is displayed. If "DHCP Enable" is ENABLED, go to Step 9.

```
  DHCP Enable
  DISABLE
```

6. Press ■ENT UTIL. The following will be displayed.

```
  DHCP Enable
  D̲ISABLE
```

7. Utilizing ■SETP or ⬟CNFG select **ENABLE**, then press ■ENT UTIL.

```
  DHCP Enable
  ENABLE
```

8. The control is now addressable from IPScom over the target network.

■**NOTE:** The DNP and MODBUS Port addresses can not be set to the same value.
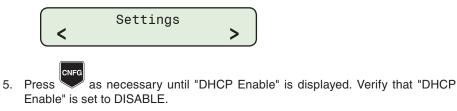
Also, if the network MODBUS Port address is not "502", go to the MODBUS Port Settings section of this chapter.

Ethernet Port Configuration on a network that does not support DHCP Protocol, from the HMI

1. Press ⬡COMM to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
     COMMUNICATIONS
  ❮CNFG           UTIL❯
```

2. Press ■ENT UTIL or ⬟CNFG once. The unit will display the following:

```
     PORT1 Settings
  <                  >
```

3. Press ⬡MNTR or ⬡COMM as necessary until "Ethernet" is displayed.

```
        Ethernet
  <                  >
```

4. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

> Settings
> <   >

5. Press [CNFG] as necessary until "DHCP Enable" is displayed. Verify that "DHCP Enable" is set to DISABLE.

> DHCP Enable
> DISABLE
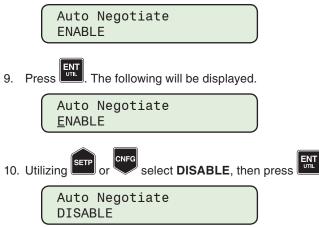
6. Continue through the sub-menu to enter the desired:
   • Static IP Address
   • Net Mask
   • Gateway

■**NOTE:** Auto negotiation is an <u>Ethernet</u> procedure by which two connected devices choose common transmission parameters, such as speed and duplex mode. In this process, the connected devices first share their capabilities for these parameters and then choose the fastest transmission mode they both support.

7. If the control is connected to a host device which is capable of 10 and 100 mbps transmission rates and handles both half or full duplex modes, then the Ethernet port is now configured to support network communications with the MODBUS port default values. If the network requires specific MODBUS port settings, then see the MODBUS Port Setting section in this chapter.

■**NOTE:** Auto Negotiation must be disabled if using Fiber Ethernet.

8. Utilize [SETP] or [CNFG] to navigate to the "Auto Negotiate" menu item, if a fixed speed of 100 mbps is desired as in the case of Fiber Optic mode

> Auto Negotiate
> ENABLE

9. Press [ENT UTIL]. The following will be displayed.

> Auto Negotiate
> ENABLE

10. Utilizing [SETP] or [CNFG] select **DISABLE**, then press [ENT UTIL].

> Auto Negotiate
> DISABLE

The Ethernet port is now configured to support network communications with the MODBUS port default values. If the network requires specific MODBUS port settings, see the following MODBUS Port Settings section.

MODBUS Port and DNP Port Settings From The HMI

1. Press [COMM] to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
         COMMUNICATIONS
    <CNFG              UTIL>
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
         PORT1 Settings
    <                      >
```

3. Press [MNTR] or [COMM] as necessary until "Ethernet" is displayed.

```
            Ethernet
    <                      >
```

4. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
            Settings
    <                      >
```

5. Press [CNFG] as necessary, until the "Modbus Port" menu item is displayed.

```
    Modbus Port
        502
```

6. Press [ENT UTIL]. The following will be displayed.

```
    Modbus Port
        50_2_
```

■**NOTE:** The DNP and MODBUS Port addresses can not be set to the same value.

7. Utilizing the arrow pushbuttons enter the desired address, then press [ENT UTIL].

```
    Modbus Port
        xxx
```

8. Press [CNFG] once. The following will be displayed.

```
    DNP Port
     20000
```

9. Press [ENT UTIL]. The following will be displayed.

```
    DNP Port
     2000_0_
```

10. Utilizing the arrow pushbuttons enter the desired address, then press [ENT UTIL].
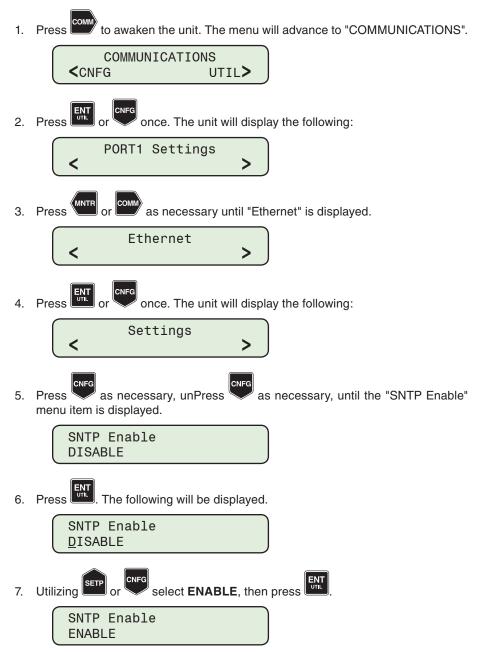
```
┌─────────────────────────────────────┐
│  DNP Port                            │
│   xxxxx                              │
└─────────────────────────────────────┘
```
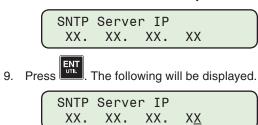
The control is now addressable from IPScom over the network. Ensure that the MODBUS Port values are the same as the values manually set when attempting to communicate with the control from IPScom.

Network Time Synchronization Settings From The HMI

To enable and configure the SNTP (Simple Network Time Protocol) to allow Network Time Synchronization perform the following:

1. Press [COMM] to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
┌─────────────────────────────────────┐
│         COMMUNICATIONS               │
│  ❮CNFG              UTIL❯             │
└─────────────────────────────────────┘
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
┌─────────────────────────────────────┐
│         PORT1 Settings               │
│  ❮                    ❯              │
└─────────────────────────────────────┘
```

3. Press [MNTR] or [COMM] as necessary until "Ethernet" is displayed.

```
┌─────────────────────────────────────┐
│           Ethernet                   │
│  ❮                    ❯              │
└─────────────────────────────────────┘
```

4. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
┌─────────────────────────────────────┐
│           Settings                   │
│  ❮                    ❯              │
└─────────────────────────────────────┘
```

5. Press [CNFG] as necessary, unPress [CNFG] as necessary, until the "SNTP Enable" menu item is displayed.

```
┌─────────────────────────────────────┐
│  SNTP Enable                         │
│  DISABLE                             │
└─────────────────────────────────────┘
```

6. Press [ENT UTIL]. The following will be displayed.

```
┌─────────────────────────────────────┐
│  SNTP Enable                         │
│  DISABLE                             │
└─────────────────────────────────────┘
```

7. Utilizing [SETP] or [CNFG] select **ENABLE**, then press [ENT UTIL].

```
┌─────────────────────────────────────┐
│  SNTP Enable                         │
│  ENABLE                              │
└─────────────────────────────────────┘
```

8. Press [SETP] or [CNFG] as necessary until "SNTP Server IP" is displayed.

```
┌─────────────────────────────┐
│  SNTP Server IP             │
│   XX.   XX.   XX.   XX       │
└─────────────────────────────┘
```

9. Press [ENT UTIL]. The following will be displayed.

```
┌─────────────────────────────┐
│  SNTP Server IP             │
│   XX.   XX.   XX.   XX       │
└─────────────────────────────┘
```

10. Utilizing the arrow pushbuttons input the desired IP Address, then press [ENT UTIL]. The desired IP Address will be displayed.

Ethernet Keepalive Time Settings From The HMI

This setting provides the user with the ability to set the Ethernet connection timeout parameter. The default value is 120 seconds and can be set to any value from 1 to 50000 seconds.

1. Press [COMM] to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
┌─────────────────────────────┐
│      COMMUNICATIONS         │
│  ❮CNFG            UTIL❯      │
└─────────────────────────────┘
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
┌─────────────────────────────┐
│      PORT1 Settings         │
│  ❮                  ❯       │
└─────────────────────────────┘
```

3. Press [MNTR] or [COMM] as necessary until "Ethernet" is displayed.

```
┌─────────────────────────────┐
│        Ethernet             │
│  ❮                  ❯       │
└─────────────────────────────┘
```

4. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
┌─────────────────────────────┐
│        Settings             │
│  ❮                  ❯       │
└─────────────────────────────┘
```

5. Press [CNFG] as necessary, until the "IP Keepalive Timer" menu item is displayed.

```
┌─────────────────────────────┐
│  IP Keepalive Timer         │
│      120 sec                │
└─────────────────────────────┘
```

6. Press [ENT UTIL]. The following will be displayed.

```
┌─────────────────────────────┐
│  IP Keepalive Timer         │
│      120 sec                │
└─────────────────────────────┘
```

7. Utilizing the arrow pushbuttons enter the desired setting, then press [ENT UTIL]. The desired Keepalive Time setting will be displayed.

OSCILLOGRAPH SETUP

The Oscillograph Recorder provides comprehensive data recording (voltage, current, and status input/output signals) for all monitored waveforms. The oscillograph recorder stores 100 records of up to 480 cycles regardless of the sampling rate (at 16, 32, 64 or 128 samples per cycle). Oscillograph data can be downloaded using the communications ports to any Windows™ based computer running the IPScom S-7600 Communications Software. The included BecoPlot Oscillograph Analysis Software program (Utility/BecoPlot) or any Comtrade reader is required to view the downloaded oscillograph files. Oscillograph records are retained if power to the control is interrupted.

The general information required to be input to complete the Oscillograph Setup includes:

- **Samples/Cycle** – The number of samples/cycle can be selected to either 16, 32, 64 or 128 samples/cycle.
- **Post-Trigger Delay** – A post-trigger delay of 5% to 95% must be specified. After triggering, the recorder will continue to store data for the programmed portion of the total record before re-arming for the next record. For example, a setting of 80% will result in a record with 20% pretrigger data, and 80% post-trigger data.
- **Length of OSC** – The length of the Oscillograph record in cycles can be specified from 60 to 480 cycles for 60 Hz applications and from 50 to 400 cycles for 50 Hz applications.
- **Function Triggers** – The recorder can be triggered remotely through communications using IPScom, or automatically, using programmed status signals (Figure 4-11).

Setup Oscillograph Recorder (IPScom)

1. From the IPScom Main Screen menu, select **Setup/Oscillograph/Setup**. IPScom will display the Oscillograph Setup dialog screen (Figure 4-10).
2. Select the number of Samples/Cycle.
3. Select the length of the Oscillograph record.
4. Select the Post Trigger Delay.
5. Select "Trigger Selection" from the setup screen. To enable a trigger scroll down through the Trigger listing on the left side of the dialog screen and drag the desired triggers to the "Enable Trigger" section on the right side of the screen. The trigger list can be filtered to display specific "Functions" (Overcurrent, Overvoltage, Overfrequency, Function ABC) or specific "Actions" (Pickup, Timeout, Pickup Dropout, Timeout Dropout).
6. Select "Save". IPScom will save the settings to either the control or open file.

Figure 4-10   Oscillograph Setup Dialog Screen

Figure 4-11   Oscillograph Trigger Selection Dialog Screen

SEQUENCE OF EVENTS RECORDER

Protective function Pickup, Trip, Dropout and/or Output/Input Pickup or Dropout are selected to trigger the Sequence of Events Recorder.

Setup Sequence of Events Recorder (IPScom)

1. From the IPScom Main Screen menu select **Setup/Sequence of Events/Setup**. IPScom will display the Sequence of Events Setup dialog screen (Figure 4-12).

2. To enable a trigger, scroll down through the Trigger listing on the left side of the dialog screen and drag the desired triggers to the "Enable Trigger" section on the right side of the screen. The trigger list can be filtered to display specific "Functions" (Overcurrent, Overvoltage, Overfrequency, Function ABC) or specific "Actions" (Pickup, Timeout, Pickup Dropout, Timeout Dropout).

3. Select "Save". IPScom will save the settings to either the control or open file.
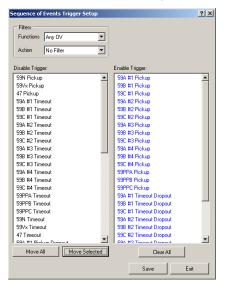
Figure 4-12   Sequence of Events Setup Dialog Screen

DATA LOGGING

> ▲**CAUTION:** Whenever the M-7679 clock is reset and data logging is enabled the data log should be cleared.

The Data Logging feature allows the user to record data internally into non volatile memory. The data log is transferred in the Comtrade format. The Comtrade format consists of two files, the configuration file (*.cfg) and the data file (*.dat) when downloaded using IPScom. When downloading utilizing a Smart Flash SD Card two files are downloaded, the configuration file and the data file.

> ■**NOTE:** During Data Log retrieval, the control will not save any new data until file retrieval is completed. File retrieval takes at least 15 seconds (file close timeout) plus the actual download time.

Data logging will continue indefinitely as long as the Data Log Interval is set to a non-zero value. A zero value for the data log interval will effectively disable data logging. The data log can be downloaded using IPScom. The data log file must be converted to Comtrade format by IPScom to be viewed using any Comtrade compatible viewer.

Data logging interval ranges from 0 to 3600 seconds with an increment of 60 seconds. Once data logging is enabled, the control will store the data in records at the data log interval rate. Each record has the following data:

- Active Profile
- Current Max/Inst/Avg/Min (A, B, C, G)
- Voltage Max/Inst/Avg/Min (A, B, C, Vz1)
- Voltage/Voltage Load (Pos., Neg., Zero)
- Current (Positive, Negative, Zero)
- Real Power (A, B, C, 3Ph)
- Reactive Power (A, B, C, 3Ph)
- Power Factor (A, B, C, 3Ph)
- Apparent Power (A, B, C, 3Ph)

- Frequency
- Counters
- Current Harmonics THD (A, B, C)
- Voltage Harmonics THD (A, B, C)
- TDD (A, B, C)
- Function Pickup
- Function Timeout
- Inputs
- Outputs

> ■**NOTE:** Data logging includes Minimum, Maximum and Average quantities for both voltage and primary phase current for each of the three phases.

Due to the internal structure of the Comtrade format, time stamping is always performed. A total of 14 Mbytes of data can be saved in non volatile memory.

Data Logging Setup (IPScom)

1. Select **Setup/Data Logging/Setup** from the IPScom toolbar. IPScom will display the Data Logging Setup dialog screen (Figure 4-13).

> ■**NOTE:** The Data Logging Setup dialog screen contains a self calculating "Duration" parameter that represents the number of days and the specific time when the data logging buffer will be full. The Data Log Interval is considered in this calculation.

2. Enter a Data Log Interval (0 to 3600 seconds).
3. Select "Save". IPScom will save the settings to either the control or open file.

Figure 4-13   Data Logging Setup Dialog Screen

ALARMS

The following Alarms can be enabled or disabled:

- Trip Close Alarm – occurs if the 52A and 52B contacts are in the same state.
- Battery Status Alarm – occurs if the battery is not present, fails the load test, or is not charging.
- Gas Pressure Alarm – occurs if the input for the gas pressure is high.
- Max Breaker Operations Alarm – occurs if the Operations Limit is exceeded.

The following Alarms are enabled by default and may not be disabled:

- EEprom Setpoints Checksum Alarm – occurs if the checksum is bad.
- DSP Watchdog Alarm – occurs if the DSP is not running correctly.
- EEprom Calibration Checksum Alarm – occurs if the checksum is bad.
- Flash Not Formatted Alarm – occurs if the internal flash drive is not formatted.
- Internal Battery Failure – occurs when the internal battery that provides back up power to the non-volatile memory has failed. This condition will set the alarm when the control reboots and the battery has been determined to have failed.

Setup Alarms from IPScom

1. From the IPScom Main Screen menu select **Setup/Alarms**. IPScom will display the Alarms Setup dialog screen (Figure 4-14).
2. Select any desired alarms.
3. Select "Save". IPScom will save the settings to either the control or open file.

Figure 4-14   Alarms Setup Dialog Screen

4.2   System Setup

System setup data is required for proper operation of the recloser control.

The System Setup consists of defining common information like CT and VT ratios, nominal voltage rating, nominal current rating and which profile is the Active Profile, etc. Values are entered similar to other setpoints. Configuration information is common to all profiles, and should be entered before setpoint and time settings.

SELECTING THE ACTIVE SETPOINT PROFILE

To select the Active Setpoint Profile perform the following:

1. Start IPScom, then establish communications with the target control.

■**NOTE:** To select a profile for **editing**, use the "Setpoints" dialog screen or the Recloser Wizard.

2. Select **Setup/Select Active Profile** from the IPScom toolbar. If custom Profile Names have been setup, they will display in this dropdown.

Setup		
Select Active Profile ▶	✓	Profile 1
Configuration ▶		Profile 2
Setpoints		Profile 3
Alarms		Profile 4
Recloser Wizard		Profile 5
Data Logging ▶		Profile 6
Oscillograph ▶		Profile 7
Sequence of Events ▶		Profile 8
Display I/O Map		
Custom Curve Editor		

▲**CAUTION:** The control will immediately respond to the new Active Setpoint Profile settings. If the control is in Lockout state, the Active Profile will not change until the Lockout is removed.

3. Select the desired profile to activate. The Active Profile will be indicated in the menu dropdown. The recloser control front panel will display the User Lines for the Active Profile.

RECLOSER CONTROL SYSTEM SETUP

The following settings have been configured at the factory and are indicated (grayed out and can not be changed).

- Nominal Frequency (50 or 60 Hz)
- CT Secondary Rating (1 or 5 Amp)
- Ground CT Rating (1 A, 5 A, 200 mA, 50 mA or 10 mA)
- Voltage Inputs (VT, H4, L4, X4, H6, L6, X6)

■**NOTE:** When a "New File" is created in IPScom File Mode, these settings are selectable. Ensure that the settings match the factory settings of the target unit. Attempting to write a file to a M-7679 that does not match the configuration settings, will result in IPScom returning an error message.

To setup the Recloser System perform the following:

1. From the IPScom Main Screen menu select **Setup/Configuration/Relay**. IPScom will display the applicable System Setup dialog screen (Figure 4-15, Figure 4-16 or Figure 4-17) as determined by the factory hardware configuration.

■**NOTE:** See **Section "4.3   System Diagrams"** for Typical VT Three-Line Connection Diagrams.

2. Enter the desired settings. The configuration settings shown below are determined by the factory hardware configuration, and are displayed as applicable.

- Nominal Voltage
- Nominal Current
- Recloser Type
- VT Configuration
- Default Active Profile
- Phase Rotation
- Bushing Phase Assignment
- Source Orientation
- CT Polarity Reversal Enable

- External Command Enable
- Lockout Operation
- 69 Switch Operation
- HCL Operating Current Reference
- Vz1 Usage
- Power Supply Type
- CT and VT Ratios
- Voltage Input Configuration

3. Clicking the "Interface Configuration" button displays a dropdown list which allows the user to select the applicable M-2979 Recloser Cabinet or Adapter Chassis/ Adapter Kit. See "**Interface Configurator**" later in this Chapter for details.

4. Clicking the "Voltage Input Configuration" button displays the applicable Voltage Input Configuration dialog screen. See "**Voltage Input Configuration**" later in this Chapter for details.

5. Select **Save**, the System Settings will be saved to either the Control or Open File.

Source Orientation Setting with LEA Hardware Options H6, L6 or X6

This setting is used to determine on which side the calculation of demand metering and energy metering is done. In addition this is also used for F32, F59I, THD protective function and CBEMA.

CT Polarity Reversal Enable

With LEA Hardware options H6, L6 or X6; enabling this setting reverses *ONLY* the **current** polarity by 180 degrees.

External Command Enable

When enabled, the M-7679 will detect external commands (external close or external trip) and will take action similar to Trip-Lockout and Close front panel commands to its lockout state, based on the received external command. See External Commands on page 5–78.

Figure 4-15   System Setup Screen, Voltage Input Option H4, L4 or X4 (Three-Phase Ganged)

Figure 4-16   System Setup Screen, Voltage Input H6, L6 or X6 (Independent Phase Capable)

Figure 4-17   System Setup Dialog Screen, Voltage Input Option VT

VOLTAGE INPUT CONFIGURATION

The following Table lists the factory hardware options available for Voltage Inputs in the M-7679.

Analog Hardware Voltage Input Options	
VT	120–300 Vac Voltage Inputs (4)
H4	LEA High Voltage Inputs (4) An0-An2 are configurable phase current, An3 is ground current, (3 LEAHs) An4-An6 are configurable load phase voltages and (1 LEAH) An7 is a source phase voltage or gnd voltage
L4	LEA Low Voltage Inputs (4) An0-An2 are configurable phase current, An3 is ground current, (3 LEALs) An4-An6 are configurable load phase voltages and (1 LEAL) An7 is a source phase voltage or gnd voltage
X4	LEA Low Voltage Inputs (3) + LEA High Input (1) An0-An2 are configurable phase current, An3 is ground current, (3 LEALs) An4-An6 are configurable load phase voltages and (1 LEAH) An7 is a source phase voltage or gnd voltage
H6	LEA High Voltage Inputs (6) An0-An2 are configurable phase current, An3 is ground current, (3 LEAHs) An4-An6 are configurable load phase voltages and (3 LEAHs) An7-An9 are source phase voltages
L6	LEA Low Voltage Inputs (6) An0-An2 are configurable phase current, An3 is ground current, (3 LEALs) An4-An6 are configurable load phase voltages and (3 LEALs) An7-An9 are source phase voltages
X6	LEA Voltage Inputs (3) + LEA High Input (3) An0-An2 are configurable phase current, An3 is ground current, (3 LEALs) An4-An6 are configurable load phase voltages and (3 LEAHs) An7-An9 are source phase voltages
LEAH = Low Energy Analog sensor High range (60–300 Vac) similar to a VT. **LEAL** = Low Energy Analog sensor Low range (0.1–12 Vac). By default **Y** side is configured as source side and **Z** is configured as load side voltage. ■**NOTE:** When configuration is H6, L6 or X6 all ground voltage functions are disabled.	

Table 4-1   Analog Hardware Voltage Input Options

Voltage Input Configuration Settings

When an LEA Hardware Option is present, the IPScom System Setup dialog screen (Figure 4-18) will contain an additional "Voltage Input Configuration" button. This selection will display the applicable Voltage Input Configuration dialog screen (Figure 4-22 through Figure 4-28).

The LEA Configuration settings are used by the control for LEAL and LEAH in order to calculate internal parameters such as multipliers for primary voltage calculation and scale factor to calculate a normalized voltage to 120 V.

Figure 4-18   System Setup Dialog Screen Voltage Input Configuration Button

LEA Calibration Voltage from IPScom

For more accuracy the user can recalibrate the control in the field to any V_{cal} value allowable with the LEA range. Upon applying specified voltage and current inputs, the control will perform the calibration automatically and report the success or failure of the calibration.

Figure 4-19   LEA Calibration Dialog Screen

Nominal Voltage Configuration – LEA Options H4, L4, X4, H6, L6 and X6

The LEA Configuration settings are used by the DSP for LEAL and LEAH in order to calculate internal parameters such as multipliers for primary voltage calculation and scale factor to calculate a normalized voltage to 120 V.

Example

Primary Nominal Voltage = 7200

LEA Output Voltage = 4 (as shown in Figure 4-19)

Internal V_{mult} = 7200/4 = 1800

V_{sec_nom} is internally a constant at 120 V

Then:
Normalized voltage = (4 x V_{sec_nom} x 1800)/7200 = 120 V

Normalized voltage = 120 V which is now going to be used internally by the control as the operating voltage that will be applied to the protective functions and for metering. The host side and IPScom will in turn use the internal V_{mult} to scale that value to primary quantity.

■**NOTE:** Default for X6, the Y side is Low and the Z side is high.

■**NOTE:** Primary Nominal Voltage is ONE common setting for all Phases and for both Y and Z sides.

LEA Output Voltage Calculation

LEA Configuration setting ranges are as follows:
- Primary Nominal Voltage (PNV): 2000 – 40000
- PTR: 1 – 10000
- RCF: 0.1 – 2.0

Default Values:
- Primary Nominal Voltage = 7200 V l-g
- RCF the Ratio Correction coefficient = 1
- PTR the PT ratio = 1800
- Lea Output Voltage = 4 V

The LEA Output Voltage is calculated utilizing "Primary Nominal Voltage" (V_{nom}), "PT Ratio" (PTR) and "Ratio Correction Factor" (RCF): LEA Output Voltage = [V_{nom_pri} /(PTR * RCF)]

The resultant LEA Output Voltage from the above calculation must be within 0.10 to 12.0 V for LEA Low Range and 60.0 to 300.0 V for High Range.

⚠ **CAUTION:** Misoperation of the unit will occur if the combination of settings for "Primary Nominal Voltage" (Vnom), "PT Ratio" (PTR) and "Ratio Correction Factor" (RCF) are written to the unit from a communication source other than IPScom (including the HMI) and result in a "LEA Output Voltage" that exceeds either the Low Range (0.10 to 12.0 V) or High Range (60.0 to 300.0 V).

Entering LEA Output Voltage calculation parameters and the system response to the entered values is subject to the following conditions:

- IPScom – If the combination of the V_{nom}, PTR and RCF exceeds the allowable LEA Output Voltage (Low or High range), IPScom will display an error message in red next to the Save button: "LEA Output Voltage is out of range for few terminals. Please change the PTR or Primary Nominal Voltage". The Save button will be greyed out, not allowing the settings to be saved to the unit.

- Communication source other than IPScom (including the HMI) – If the entered combination of V_{nom}, PTR and RCF exceeds the allowable LEA Output Voltage range (Low or High), the settings will be accepted by the unit but the unit will ignore the calculated out of range value and continue to use the last in range LEA Output Voltage.

Calibrating at different voltage will always be with reference to 7200 Primary nominal voltage, the PTR will be recalculated and the RCF will always be 1.

Calculation Formula for Secondary Voltage:

NCF = (Nom V_{sec} x PTR x RCF) / (Nom V_{pri})

Secondary Voltage = Lea Output Voltage * NCF

Example 1:

Nom V_{sec} = 120 V (always hardcoded in M-7679)

Nameplate Values are the following:
- Nom V_{pri} = 7200V
- PTR = 10000
- RCF = 0.897

LEA output voltage = [7200/(10000*0.897)] = 0.803

If the measured primary voltage V l-g = 7480 V
then:

Measured output voltage = 7480/10000 = 0.748 V

Corrected output voltage = 0.748/0.897 = 0.834

Calculated NCF = (120 x 10000 x 0.897)/7200 = 149.5

then:

Secondary voltage displayed ($V_{X\_display}$)= 0.834 x 149.5 = 124.67 V

Example 2:

All settings are the same as Example #1 except: RCF = 1.0

V l-g (nominal +5%) = 7200 x 1.05 = 7560 V
then:

Vx_display = 0.756 x 166.7 = 126.0 V (120 V + 5% = 126 V)

Phase Angle Shift Compensation

There are settings for each sensor as applicable to compensate or add phase angle shift to the corresponding measured signal. The angle range is from -180° to 180°, the positive angle represents leading direction and the negative angle represents lagging direction.

Example:

If Load Side Phase Shift 1 is 2°, the resultant calculated phasor for V1 load is shifted by 2 in the leading direction.

DUAL VT CONFIGURATION

With LEA Voltage Input option H4, L4, X4, H6, L6 or X6, the M-7679 has the capability to allow two VT configuration settings, one for the Y side (VTy) and one for the Z side (VTz). The available settings are determined by the factory hardware configuration.

When the Vy or Vz side voltage transducer is selected as "**VT**" the allowable VT configuration choices shown below are displayed as applicable.

- Wye
- Phantom Wye A
- Phantom Wye B
- Phantom Wye C
- Phantom Delta AB

- Phantom Delta BC
- Phantom Delta CA
- Open Delta AB
- Open Delta BC
- Open Delta CA

■**NOTE:** When LEA is LOW or HIGH, the only allowable LEA configuration is Wye.

LEA Hardware X4 Voltage Input Configuration Settings Examples

Figure 4-20   LEA Hardware X4 with Vz Side VT Configuration Dropdown

Figure 4-21   LEA Hardware X4 with Vz Side LEA High

LEA Hardware H4 Voltage Input Configuration Settings Examples

Figure 4-22   LEA Hardware H4 with Vy and Vz Side VT Configuration Dropdown

Figure 4-23   LEA Hardware H4 with Vy and Vz Side LEA HIGH

LEA Hardware L4 Voltage Input Configuration Settings Example

Figure 4-24   LEA Hardware L4 with Vy and Vz Side LEA LOW

LEA Hardware H6 Voltage Input Configuration Settings Examples
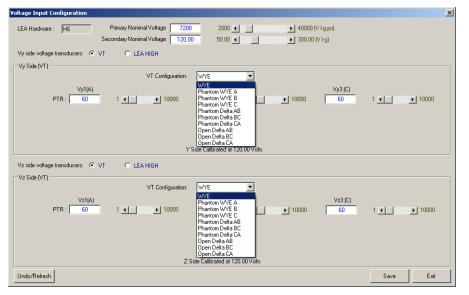
Figure 4-25   LEA Hardware H6 with Vy and Vz Side VT Configuration Dropdown

Figure 4-26   LEA Hardware H6 with Vy and Vz Side LEA HIGH

LEA Hardware L6 Voltage Input Configuration Settings Example
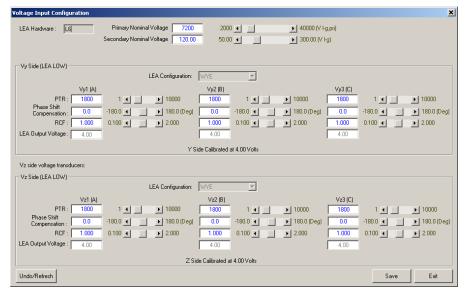
Figure 4-27   LEA Hardware L6 with Vy and Vz Side LEA LOW

LEA Hardware X6 Voltage Input Configuration Settings Examples
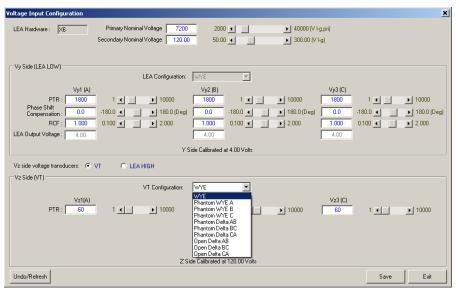
Figure 4-28   LEA Hardware X6 with Vy and Vz Side VT Configuration Dropdown
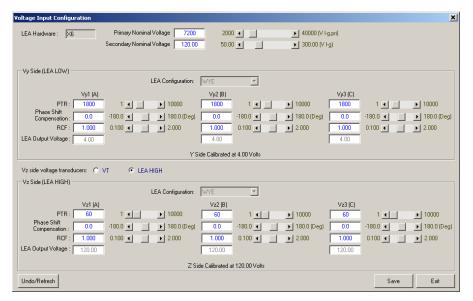
Figure 4-29   LEA Hardware X6 with Vy Side LEA LOW and Vz Side LEA High

PHANTOM VOLTAGE – VT CONFIGURATION

The M-7679 includes the capability to perform all three-phase voltage metering and protective functions utilizing a single VT input. The "VT Configuration" setting in the System Setup dialog screen (Figure 4-15) and the HMI "Configuration/Nameplate/VT Configuration" menu setting allows three-phase voltages and power quantities to be calculated/generated from a single metered quantity. The single-phase VT voltage input must be connected to either terminal TB5-9/10 (Vy_1/Ny) or TB5-11/12 (Vy_2/Ny) or TB5-13/14 (Vy_3/Ny).

The single-phase VT configuration settings available are shown in Table 4-2, depending on the connected voltage reference signals. The magnitude adjustment factors that are applied through the phantom voltage feature are, "1" for phase-to-neutral signals, and "1/ √3" to convert phase-to-phase signals to phase-to-neutral signals.

For example the M-7679 derives Phase B and Phase C phase signals by rotating the $V_{PHANTOM}$ element by either 120° or –120°, depending on the phase rotation setting.

When a Phantom Voltage VT Configuration is selected, the fundamental power and energy quantities are based on the derived phantom voltages. Sequence components are not calculated and set to zero internally.

Magnitude and Phase Displacement Adjustment, Multiplied By Reference Voltage to Create $V_{phantom}$			
Voltage Reference	VT setting	Systems With ACB Rotation	Systems With ABC Rotation
Va	Phantom WYE A	1∠0°	1∠0°
Vb	Phantom WYE B	1∠120°	1∠-120°
Vc	Phantom WYE C	1∠-120°	1∠120°
Vab	Phantom Delta AB	1/ √3 ∠-30°	1/ √3 ∠30°
Vbc	Phantom Delta BC	1/ √3 ∠90°	1/ √3 ∠-90°
Vca	Phantom Delta CA	1/ √3 ∠-150°	1/ √3 ∠150°

Table 4-2   Phantom Voltage VT Configuration Table

Phantom Voltage Examples – LEA Hardware X6

The following examples illustrate the following settings:

> VTy = WYE
>
> AINz = LEA HIGH
>
> VTz = VT Configuration = Phantom WYE A
>
> Bushing Assignment = ABC (**Example 1**)
>
> Bushing Assignment = BCA (**Example 2**)

■**NOTE:** The Bushing Assignment must match the PHANTOM Voltage Input or vice versa.

Bushing Phase Assignment ABC:

Figure 4-30   Example 1: Phantom WYE A, Bushing Assignment ABC

Bushing Phase Assignment BCA:
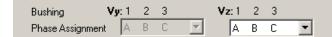
Figure 4-31   Example 2: Phantom WYE A, Bushing Assignment BCA
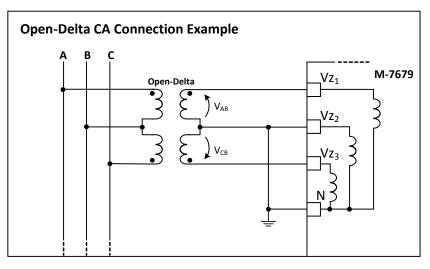
OPEN DELTA – VT CONFIGURATION
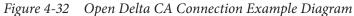
The following diagrams and screenshots illustrate several examples of Open Delta connections and the corresponding Voltage Input Configuration screens in IPScom.

Open Delta CA Example (LEA Hardware H6)

Bushing Phase Assignment: ABC

Figure 4-32   Open Delta CA Connection Example Diagram

Figure 4-33   Voltage Input Configuration Screen, Open Delta CA Example

Open Delta AB Example (LEA Hardware H6)

Bushing Phase Assignment: BCA
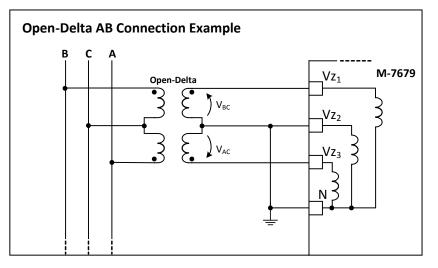
Figure 4-34   Open Delta AB Connection Example Diagram

Figure 4-35   Voltage Input Configuration Screen, Open Delta AB Example

Open Delta BC Example (LEA Hardware H6)

Bushing Phase Assignment: ABC
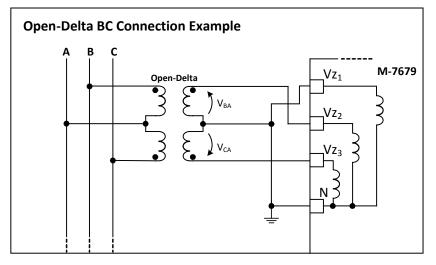
Figure 4-36   Open Delta BC Connection Example Diagram

Figure 4-37   Voltage Input Configuration Screen, Open Delta BC Example

Open Delta Configuration Table

Bushing Assignment	VT Configuration	V1	V2	V3
ABC	Open Delta AB	VAC	VBC	x
ABC	Open Delta BC	x	VBA	VCA
ABC	Open Delta CA	VAB	x	VCB
ACB	Open Delta AB	VAC	x	VBC
ACB	Open Delta BC	x	VBA	VCA
ACB	Open Delta CA	VAB	VCB	x
BAC	Open Delta AB	VBC	VAC	x
BAC	Open Delta BC	VBA	x	VCA
BAC	Open Delta CA	x	VAB	VCB
BCA	Open Delta AB	VBC	x	VAC
BCA	Open Delta BC	VBA	VCA	x
BCA	Open Delta CA	x	VCB	VAB
CAB	Open Delta AB	x	VAC	VBC
CAB	Open Delta BC	VCA	x	VBA
CAB	Open Delta CA	VCB	VAB	x
CBA	Open Delta AB	x	VBC	VAC
CBA	Open Delta BC	VCA	VBA	x
CBA	Open Delta CA	VCB	x	VAB
X = Not Connected, No Signal Required				

Table 4-3   Open Delta Configuration Table

PROTECTIVE FUNCTION SETTINGS WITH LEA HARDWARE H6, L6 OR X6

The LOAD or SOURCE (Y or Z) side voltages are used for input signals for the following functions:

- Voltage protection functions: **F25, F27, F27PP, F59, F59PP, F59N, F47**
- Functions that use voltage for directionality **F67P, F67N, F67G/GS** and **F67Q**

When the H6, L6 or X6 hardware option is present, IPScom will display an additional setting in the Function Setpoint dialog screen which allows the user to select the side voltage that will be used by the function. See Figure 4-38 through Figure 4-40 for example screens.

Figure 4-38   Function 27 Setpoints Dialog Screen with 6 Channel LEA Hardware Option

Figure 4-39   Function 67P Setpoints Dialog Screen with 6 Channel LEA Hardware Option

Figure 4-40   Function 25 Setpoints Dialog Screen with 6 Channel LEA Hardware Option

Frequency Calculation & Frequency Functions with LEA Hardware H6, L6 or X6

Frequency is calculated on both the Y and Z side. Frequency uses positive sequence voltage for DFT frequency calculation and maximum of the phase voltage magnitude for RMS frequency calculation. When the H6, L6 or X6 hardware option is present, IPScom will display an additional setting in the Frequency functions 81 and 81R which allows the user to switch the Operating voltage between the Y and Z side (Figure 4-41 and Figure 4-42).

Figure 4-41   Function 81 Setpoints Dialog Screen with 6 Channel LEA Hardware Option

Figure 4-42   Function 81R Setpoints Dialog Screen with 6 Channel LEA Hardware Option

LEA Metering with LEA Hardware H6, L6 or X6

IPScom will display LEA measured and calculated values in the Primary and Secondary Metering screens. See Figure 4-43 as an example.

■**NOTE:** Secondary Metering Screen is identical.

Figure 4-43   Primary Metering Screen with 6 Channel LEA Hardware Option

INTERFACE CONFIGURATOR
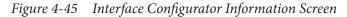
Selecting **Interface Configurator** (Figure 4-44) from the System Setup window, displays the Interface Type Information screen (Figure 4-45). Selecting a specific Recloser or Adapter Chassis from the dropdown list will automatically populate the initial settings for the Interface Type. This includes Inputs, Outputs, Pulse Width and Battery Type. The dropdown choices available are based on the selected Breaker Operation Type: Three-Phase Ganged or Independent Phase (Figure 4-46 or Figure 4-47).
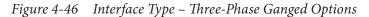
Figure 4-44   Interface Configurator Selection

Figure 4-45   Interface Configurator Information Screen

Figure 4-46   Interface Type – Three-Phase Ganged Options

Figure 4-47   Interface Type – Independent Phase Capable Options

Interface Configurator – Connected Mode

When connected to a control, IPScom will read the Interface Type and display the assigned interface in the Interface Type Information screen (Figure 4-45).

When the user changes the Interface Type and selects **Save** in the Interface Configurator screen, IPScom will display a confirmation prompt screen (Figure 4-48). Select "Yes" to save the settings. IPScom will then display a confirmation that the Interface has successfully changed (Figure 4-49).

Figure 4-48   Recloser Interface Save Confirmation Dialog Screen

Figure 4-49   Recloser Interface Successfully Changed Confirmation Screen

IPScom writes the new Interface Type setting to the control. The Firmware will change the Inputs, Outputs, Pulse Width and Battery Type as applicable. As the firmware updates these settings, IPScom will refresh any affected settings screens.

The factory setting (as shipped) is CUSTOM. The default Factory CUSTOM settings for the Inputs are shown in Table 4-4. The default Factory CUSTOM settings for the Outputs are shown in Table 4-6.

If the user makes any manual changes to the pre-defined settings, the "Interface Type" will revert to CUSTOM, and the firmware does not make any changes. Selecting "Save" will write the manual settings to the control. This provides complete user customization.

■**NOTE:** Any CUSTOM configuration that the user manually defines is not the same as the Factory (as shipped) CUSTOM configuration. This distinction is important to remember when changing settings manually.

Interface Configurator – File Mode

When the user is setting up a configuration file in File Mode, IPScom operates the same as described in Connected Mode. When the user selects a pre-defined Interface Type and then selects "Save", IPScom will change the Inputs, Outputs, Pulse Width and Battery Type as applicable and refresh any affected screens.

The Interface Type setting is part of the (.sup) file. When the user creates a file with a specific Interface Type configuration and writes that file to the control, the control will update the appropriate configuration settings.

MANUALLY SETTING THE SYSTEM INPUTS

The **Active State** is used to invert the input states based on the connections. This allows the user to change the input state without physically changing the input on the back of the unit. The **Close** parameter designates the operated state established by closing rather than opening an external contact.

To setup the System Inputs perform the following:

1. From the IPScom Main Screen menu select **Setup/Configuration/Relay**. IPScom will display the System Setup screen (Figure 4-15).
2. Select the **Input** tab. IPScom will display the Input dialog screen (Figure 4-50 or Figure 4-51).

■**NOTE:** Inputs 5 through 12 are available with the optional expanded I/O.

3. Select the Active State (Open or Close) for each Input.
4. Select the Function to be associated with each Input (Table 4-4).

■**NOTE:** The Logic Table displayed in the Input dialog screen will update based on the selected function.

5. Select **Save**, the System Settings will be saved to either the Control or Open File.

Figure 4-50   System Setup – Input Dialog Screen (Three-Phase Ganged)

Figure 4-51   System Setup – Input Dialog Screen (Independent Phase Capable)

M-7679 System Inputs Function Selections with Interface Type CUSTOM Factory Settings		
Input	**Three-Phase Ganged**	**Independent Phase Capable**
Input 1	**52a Phases ABC (CUSTOM)**	**52a Phase A (CUSTOM)** General
Input 2	**52b Phases ABC (CUSTOM)** 52b/69 Lockout	**52b Phase A (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching General 52b/69 Phase A Lockout 69 Lockout Phase A
Input 3	**69 Lockout (CUSTOM)** General	**General (CUSTOM)** 69 Lockout Phase A
Input 4	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching	**General (CUSTOM)** 69 Lockout Phase B
Input 5	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching	**General (CUSTOM)** 69 Lockout Phase C
Input 6	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching	**52a Phase B (CUSTOM)** General
Input 7	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching	**52b Phase B (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching General 52b/69 Phase B Lockout 69 Lockout Phase B
Input 8	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching	**52a Phase C (CUSTOM)** General
Input 9	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching	**52b Phase C (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching General 52b/69 Phase C Lockout 69 Lockout Phase C
Input 10	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching
Input 11	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching Battery Alarm	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching Battery Alarm
Input 12	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching AC Status	**General (CUSTOM)** Gas Pressure Hot Line Tag Profile Switching AC Status

■**NOTE:** Interface Type **CUSTOM** Factory settings are listed in **Bold** Type.

Table 4-4   System Inputs Function Selections

Virtual Inputs

The M-7679 includes 3 Virtual Inputs (V1, V2 and V3) in addition to the physical inputs. The Virtual Inputs can be assigned to any of the eight IPSlogic functions utilizing the IPScom System Setup/Virtual Input dialog screen (Figure 4-52). When the IPSlogic assigned to the selected Virtual Input operates, then the Virtual Input is asserted and the Function is blocked.

A Virtual Input may be selected as a Blocking Input in any protective Function Setpoint screen. As shown in Figure 4-53, once a Virtual Input has been assigned an IPSlogic function, the Virtual Input is displayed with a yellow highlight in each setpoint screen. Hovering over the input will display a tooltip with the assigned IPSlogic function.

The status of the Virtual Inputs is displayed in the Primary Metering screen (Figure 3-45), Secondary Metering screen (Figure 3-46) and the Function Status screen (Figure 3-48).

See **Section 4.4 System Setpoints/IPSlogic** for information regarding IPSlogic functions.

Figure 4-52   System Setup – Virtual Input Dialog Screen

Figure 4-53   Example – Virtual Input Assigned to an IPSlogic Function

Profile Switching By Inputs

Up to three inputs (IN 4 through IN 12) can be dedicated to switch among the 8 profiles of the M-7679. Table 4-5 shows the logic for the profile assignment.

Profile Switching Input 3	Profile Switching Input 2	Profile Switching Input 1	Profile Assigned
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

Table 4-5   Profile Switching Inputs Logic

Profile Switching Input 1 to Profile Switching Input 3 can be physically assigned to any of the digital inputs on terminal TB1, TB6 and TB7 (extended I/O). For example, if the extended I/O is not available then only one digital input is available for profile switching namely IN 4 on TB1. If more than 2 profiles are needed then the extended I/O must be purchased. Each physical input (IN 4 through IN 12) can be configured through IPScom to participate in the profile switching scheme.

The control determines which input is the least significant bit. The physical input with the smallest number designator will be the least significant bit. For example, if Inputs 4, 6 and 8 are chosen then Input 4 will be the least significant bit preceded by Input 6 and finally Input 8 shall be the most significant bit. The same rule applies if only two inputs are selected (maximum 4 profiles).

The user can configure up to three inputs (IN 4 through IN 12) for the profile selection. If one input is selected then the recloser control can only switch between profile 1 and 2. Two digital inputs provide up to 4 profiles (profile 1-4).

The inputs selected do not have to be consecutive terminals. IPScom provides safety logic to ensure that no more than three inputs can be selected for profile switching.

MANUALLY SETTING THE SYSTEM OUTPUTS

There are three output characteristics: Direct, Latched and Pulsed.

Direct mode – The contact can turn ON and OFF at any moment. Direct mode maintains the output contact energized as long as the condition that caused it to operate exists. After the actuating condition is cleared, the contact will reset after the programmed seal-in time has elapsed.

Latched mode – Once the contact is turned ON, it can only turn OFF when the recloser receives a reset signal and the condition that caused the contact to operate no longer exists.

Pulsed mode – The output contact will turn ON for the pulse duration and then turn OFF at the end of the pulse duration.

Pulse Width/Seal-In Time

The Pulse Width/Seal-In Time range is from 0.01 to 136 seconds. In Pulsed mode, this parameter is used for the pulse width duration. The contact will dropout after the specified delay expires, even if the condition which caused the recloser to pickup still exists. When the output is in Direct mode this is the Seal-In time, which is the minimum guaranteed time a contact will operate. In Latched mode this setting is ignored by the recloser.

Output Contact Type

General – designates contacts which have not been assigned to a protection function.

Trip Phase A (B, C) – with Independent Phase Capable option, designates contacts to be dedicated for the trip or open command. There can be up to three trip contacts: one for each phase operating independently or three trip contacts operating simultaneouosly. There can also be one trip contact operating all three phases. This will mainly be assigned to the 79 recloser function, but not limited to that function.

Close Phase A (B, C) – with Independent Phase Capable option, designates contacts to be dedicated for the close command. There can be up to three close contacts: one for each phase operating independently or three close contacts operating simultaneouosly. There can also be one close contact operating all three phases. This will mainly be assigned to the 79 recloser function, but not limited to that function.

Hot Line Tag – When Hot Line Tag is enabled the M-7679 will trip for a fault then go to lockout. The recloser control switches over to reserved settings for 50P, 51P, 50G and 51G.

Enable Remote Control – specifies the contacts that are allowed to be activated remotely through communications.

Manual Close Delay

The Manual Close Time Delay range is from 0 to 90 seconds. The recloser waits for the specified time delay before the output contact operation is activated. This is **not** the Seal-In time.

To manually setup the System Outputs perform the following:

1. From the IPScom Main Screen menu select **Setup/Configuration/Relay**. IPScom will display the System Setup screen (Figure 4-15).
2. Select the **Output** tab. IPScom will display the Output dialog screen (Figure 4-54 or Figure 4-55)

■**NOTE:** Outputs 5 through 12 are available with the optional expanded I/O.

3. Select the Characteristic (Direct, Latched or Pulsed) for each output.
   a. Three-Phase Ganged Recloser Type – Outputs 1 and 2 are fixed as Pulsed Outputs.
   b. Independent Phase Capable Recloser Type – Outputs 1, 2, 5, 6, 7 and 8 are fixed as Pulsed Outputs.

4. Enter the Pulse Width/Seal-In Time for each output.
5. Select the Function to be associated with each Output (Table 4-4).
6. Select whether the output can be operated remotely.
7. Enter the Manual Close Delay from 0 to 90 seconds in 1 second increments.

■**NOTE:** The **Undo/Refresh** command allows the user to undo any changes in the System Setup screens before the settings are saved to either the Device or Open File.

8. Select **Save**, the System Settings will be saved to either the Control or Open File.

M-7679 System Outputs Function Selections with Interface Type CUSTOM Factory Settings		
Output	Three-Phase Ganged	Independent Phase Capable
Output 1	**Trip Phases ABC (CUSTOM)**	**Trip Phase A (CUSTOM)**
Output 2	**Close Phases ABC (CUSTOM)**	**Close Phase A (CUSTOM)**
Output 3	**General (CUSTOM)** Hot Line Tag	**General (CUSTOM)** Hot Line Tag
Output 4	**General (CUSTOM)** Hot Line Tag Alarm	**General (CUSTOM)** Hot Line Tag Alarm
Output 5	**General (CUSTOM)** Hot Line Tag Trip Phase B	**Trip Phase B (CUSTOM)**
Output 6	**General (CUSTOM)** Hot Line Tag Close Phase B	**Close Phase B (CUSTOM)**
Output 7	**General (CUSTOM)** Hot Line Tag Trip Phase C	**Trip Phase C (CUSTOM)**
Output 8	**General (CUSTOM)** Hot Line Tag Close Phase C	**Close Phase C (CUSTOM)**
Output 9	**General (CUSTOM)** Hot Line Tag	**General (CUSTOM)** Hot Line Tag
Output 10	**General (CUSTOM)** Hot Line Tag	**General (CUSTOM)** Hot Line Tag
Output 11	**General (CUSTOM)** Hot Line Tag	**General (CUSTOM)** Hot Line Tag
Output 12	**General (CUSTOM)** Hot Line Tag Battery Alarm/Test	**General (CUSTOM)** Hot Line Tag Battery Alarm/Test
■**NOTE:** Interface Type **CUSTOM** Factory settings are listed in **Bold** Type.		

Table 4-6   System Outputs Function Selections

Figure 4-54   System Setup – Output Dialog Screen (Three-Phase Ganged with Extended I/O)

Figure 4-55   System Setup – Output Dialog Screen (Independent Phase Capable Option)

SETTING THE USER LINES

To setup the User Lines perform the following:

1. From the IPScom Main Screen menu select**Setup/Configuration/Relay**. IPScom will display the System Setup screen (Figure 4-15).

2. Select the **User Lines** tab. IPScom will display the User Lines dialog screen (Figure 4-56)

3. Enter the desired User Lines for up to 8 Profiles.

■**NOTE:** The **Undo/Refresh** command allows the user to undo any changes in the System Setup screens before the settings are saved to either the Device or Open File.

4. Select **Save**, the System Settings will be saved to either the Control or Open File.

Figure 4-56   System Setup – User Lines Dialog Screen

PROGRAMMABLE PUSHBUTTONS FEATURE

The M-7679 includes eight programmable pushbuttons S10 to S17 (Figure 4-57). The pushbuttons are programmable through the S-7600 IPScom Communications software.

The S10 (TRIP), S11 (HOT LINE TAG), S14 (CLOSE), S15 (REMOTE DISABLE), S16 (RECLOSE DISABLE) and S17 (GROUND DISABLE) pushbuttons are pre-programmed to default functions but can be reprogrammed by the user to the desired function. Also, the S12 and S13 pushbuttons are user programmable.

The programmable pushbuttons can be programmed to:

- Initiate an action
- Block an action
- Initiate and/or Block an action (Smart Function)

Also, the programmable pushbuttons have the capability to be programmed to wait for a confirmation from the user before executing the operation that it was assigned. Figure 4-58 and Figure 4-59 represent the elements of the Pushbutton Function Setup.
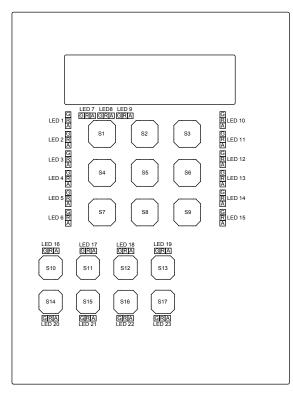
Figure 4-57   Pushbutton and LED Location Index

Figure 4-58   Front Panel Setup Dialog Screen

Figure 4-59   Front Panel Pushbutton Editor Dialog Screen

Action Initiate

The "Actions" that the pushbuttons can be programmed to initiate are shown in Table 4-7.

Block Initiate

Pushbutton Blocks include those Recloser operations and/or protective functions that can be assigned to a pushbutton. When the pushbutton is pushed, the assigned operations and/or protective functions will be blocked if the operation and/or protective function has not yet activated. If the operation has activated, the blocking has no effect.

The "Blocks" categories and the elements included in each category that the pushbuttons can be programmed to initiate are shown in Table 4-7.

INITIATE

SELECT PHASE
TRIP LOCKOUT
CLOSE
GROUND DISABLE
RECLOSE DISABLE
RESET
LOCK
REMOTE DISABLE
HOT LINE TAG
PROFILE SWITCH
External Battery Test
Go to Setpoints
Go to Monitor
Display Fault
Activate Profile 1
Activate Profile 2
Activate Profile 3
Activate Profile 4
Activate Profile 5
Activate Profile 6
Activate Profile 7
Activate Profile 8
Output Contact 1
Output Contact 2
Output Contact 3
Output Contact 4
Output Contact 5
Output Contact 6
Output Contact 7
Output Contact 8
Output Contact 9
Output Contact 10
Output Contact 11
Output Contact 12

BLOCKS

GLOBAL
Block Closing
Any Phase Protection Function Block
Any Overcurrent Block
Any Phase Overcurrent Block
Any Ground Block
Any Residual Block
Any Protection Function Block
Any Overvoltage Function Block
Any Undervoltage Block

PTOV/PTUV
Block F27 #1 Phase A
Block F27 #1 Phase B
Block F27 #1 Phase C
Block F27 #1 All Phases
Block F27 #2 Phase A
Block F27 #2 Phase B
Block F27 #2 Phase C
Block F27 #2 All Phases
Block F27 #3 Phase A
Block F27 #3 Phase B
Block F27 #3 Phase C
Block F27 #3 All Phases
Block F27 #4 Phase A
Block F27 #4 Phase B
Block F27 #4 Phase C
Block F27 #4 All Phases
Block 27PP Phase A
Block 27PP Phase B
Block 27PP Phase C
Block 27PP All Phases
Block 27Vz1
Block F47
Block F59 #1 Phase A
Block F59 #1 Phase B
Block F59 #1 Phase C
Block F59 #1 All Phases
Block F59 #2 Phase A
Block F59 #2 Phase B
Block F59 #2 Phase C
Block F59 #2 All Phases
Block F59 #3 Phase A
Block F59 #3 Phase B
Block F59 #3 Phase C
Block F59 #3 All Phases
Block F59 #4 Phase A
Block F59 #4 Phase B
Block F59 #4 Phase C
Block F59 #4 All Phases
Block F59N
Block F59Vz1
Block F59PP Phase A
Block F59PP Phase B
Block F59PP Phase C
Block F59PP All Phases
Block 59I Phase A
Block 59I Phase B
Block 59I Phase C
Block 59I All Phases

PTOC/PHIZ/POIC
Block F46DT #1
Block F46DT #2
Block F46DT #3
Block F46DT #4
Block F46DT #5
Block F46IT #1
Block F46IT #2
Block F46IT #3
Block F46IT #4
Block F46IT #5
Block F50 #1 Phase A
Block F50 #1 Phase B
Block F50 #1 Phase C
Block F50 #1 All Phases
Block F50 #2 Phase A
Block F50 #2 Phase B
Block F50 #2 Phase C
Block F50 #2 All Phases
Block F50 #3 Phase A
Block F50 #3 Phase B
Block F50 #3 Phase C
Block F50 #3 All Phases
Block F50 #4 Phase A
Block F50 #4 Phase B
Block F50 #4 Phase C
Block F50 #4 All Phases
Block F50 #5 Phase A
Block F50 #5 Phase B
Block F50 #5 Phase C
Block F50 #5 All Phases
Block F50N #1
Block F50N #2
Block F50N #3
Block F50N #4
Block F50N #5
Block F50G/GS #1
Block F50G/GS #2
Block F50G/GS #3
Block F50G/GS #4
Block F50G/GS #5
Block F50BF
Block F51 #1 Phase A
Block F51 #1 Phase B
Block F51 #1 Phase C
Block F51 #1 All Phases
Block F51 #2 Phase A
Block F51 #2 Phase B
Block F51 #2 Phase C

Table 4-7   Front Panel Pushbutton Selection Table (1 of 2)

Block F51 #2 All Phases
Block F51 #3 Phase A
Block F51 #3 Phase B
Block F51 #3 Phase C
Block F51 #3 All Phases
Block F51 #4 Phase A
Block F51 #4 Phase B
Block F51 #4 Phase C
Block F51 #4 All Phases
Block F51 #5 Phase A
Block F51 #5 Phase B
Block F51 #5 Phase C
Block F51 #5 All Phases
Block F51N #1
Block F51N #2
Block F51N #3
Block F51N #4
Block F51N #5
Block F51G/GS #1
Block F51G/GS #2
Block F51G/GS #3
Block F51G/GS #4
Block F51G/GS #5

PTOF/PTUF/PFRC
Block F81 #1
Block F81 #2
Block F81 #3
Block F81 #4
Block All F81
Block Over Frequency Functions
Block Under Frequency Functions
Block F81R #1
Block F81R #2
Block All F81R
Block All Frequency Functions

PDOP/PDUP/PTOC
Block F32 Phase A Directional Power #1
Block F32 Phase B Directional Power #1
Block F32 Phase C Directional Power #1
Block F32 Three Phase Directional Power #1
Block F32 Phase A Directional Power #2
Block F32 Phase B Directional Power #2
Block F32 Phase C Directional Power #2
Block F32 Three Phase Directional Power #2
Block F32 Phase A Directional Power #3
Block F32 Phase B Directional Power #3
Block F32 Phase C Directional Power #3
Block F32 Three Phase Directional Power #3
Block F32 Phase A Directional Power #4
Block F32 Phase B Directional Power #4
Block F32 Phase C Directional Power #4
Block F32 Three Phase Directional Power #4
Block all F67F Directional
Block F67P #1 Phase A

Block F67P #1 Phase B
Block F67P #1 Phase C
Block F67P #1 All Phases
Block F67P #2 Phase A
Block F67P #2 Phase B
Block F67P #2 Phase C
Block F67P #2 All Phases
Block F67P #3 Phase A
Block F67P #3 Phase B
Block F67P #3 Phase C
Block F67P #3 All Phases
Block F67P #4 Phase A
Block F67P #4 Phase B
Block F67P #4 Phase C
Block F67P #4 All Phases
Block F67P #5 Phase A
Block F67P #5 Phase B
Block F67P #5 Phase C
Block F67P #5 All Phases
Block F67N #1
Block F67N #2
Block F67N #3
Block F67N #4
Block F67N #5
Block F67G/GS #1
Block F67G/GS #2
Block F67G/GS #3
Block F67G/GS #4
Block F67G/GS #5
Block F67Q #1
Block F67Q #2
Block F67Q #3
Block F67Q #4
Block F67Q #5

RYSN
Block F25 Synchrocheck Magnitude
Block F25 Synchrocheck Angle
Block F25 Synchrocheck Frequency
Block F25

RREC
Block F79 Sequence Coordination
Block F79/50P High Current Lockout
Block F79/50N or F79/50G High Current Lockout
Block F79/50P and F79/50G High Current Lockout
Block F79 Recloser Relay

SCBR/XCBR/RBRF
Block F74 Trip Coil
Block F74 Close Coil

PMRI
Block Cold Load Pickup

PTOV/PTOC
Block F60FL Fuse Failure

Table 4-8   Front Panel Pushbutton Selection Table (2 of 2)

Smart Functions

The recloser control includes 20 Smart Functions (SF1-SF20). The Smart Functions can be programmed to any of the operation or protective functions listed in the "Action Initiate" and "Block Initiate" selections. However, a Smart Function cannot be mapped to another Smart Function as it is described in the INITIATE category. When a pushbutton is programmed to a Smart Function, the recloser control will prompt the user to choose the Smart Function to be executed.

```
   EXEC SMART FUNCTION
 <          SF1          >
```

By pressing the Left or Right arrow pushbutton, the user can scroll to the appropriate Smart Function. Pressing the ENT pushbutton will cause the recloser control to execute the selected Smart Function displayed on the HMI screen. If the EXIT key is pressed before the ENT pushbutton, the recloser control will exit out of the Smart Function mode. If no action is taken within 10 minutes, the recloser control will return to the main screen.

If the pushbutton is programmed to wait for a user confirmation, when pressed, the recloser control will prompt for a user confirmation before executing the Smart Function. In addition the Smart Function can be assigned a user defined name of up to 12 alphanumeric characters. For example SF1 can be assigned the name "TEST F27". The HMI will display the following when the smart key is activated.

```
   EXEC SMART FUNCTION
 <        TEST F27        >
```

Pushbutton Programming (Initiate Action/Block)

To program a programmable pushbutton to Initiate or Block a recloser function, proceed as follows:

1. From the IPScom Main Menu, select **Setup/Configuration/Front Panel Functions**. IPScom will display the "Front Panel Setup" dialog screen (Figure 4-58).

2. Select the desired programmable pushbutton. IPScom will display the Front Panel Pushbutton Editor dialog screen Figure 4-59.

3. Observe the "Currently Selected" section of the dialog screen and proceed as follows:

   a. If the selected pushbutton is not currently programmed, then go to Step 5.

   b. If the selected pushbutton indicates that it is currently programmed and the user desires to de-program the pushbutton, then select "Clear Function". IPScom will display a confirmation dialog screen Figure 4-60.

Figure 4-60   Clear Pushbutton Function Confirmation Screen

   c. Select "Yes". IPScom will clear the currently programmed function for the selected pushbutton.

4. From the "Initiate and Blocks" section of the dialog screen, expand either the "Initiate" or the "Blocks" Explorer Tree as necessary to navigate to the desired function.

5. Select the desired function to be activated when the pushbutton is pressed. The selected function will be displayed in the "Currently Selected" section of the dialog screen.

6. If a user confirmation is desired before the pushbutton activates the programmed function, then select the "User Confirmation to Execute" check box.

7. Select "Assign". IPScom will update the "Saved Settings" section of the dialog screen to indicate the pushbutton and the function that has been assigned.

8. To end the pushbutton editing session for the selected pushbutton select "Done". IPScom will return to the Front Panel Setup dialog screen Figure 4-58.

■**NOTE:** At this point the pushbutton assignments have not been saved or sent to the recloser control. Therefore, exiting from the Button Function Setup dialog screen at this time will result in all pushbutton reprogramming being lost. IPScom will display the following Warning screen (Figure 4-61).

Figure 4-61   Button Changes Not Saved Warning Screen

9. If additional pushbuttons are to be programmed, repeat Steps 2 through 8 as necessary to program additional pushbuttons.

10. If all the desired pushbuttons have been programmed, select File/Update Files.

The pushbutton programing process is complete.

Pushbutton Programming (Smart Function)

To program a programmable pushbutton to a Smart Function pushbutton, proceed as follows:
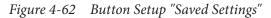
1. From the IPScom Main Menu, select **Setup/Configuration/Front Panel Functions**. IPScom will display the "Front Panel Setup" dialog screen (Figure 4-58).

2. Select the desired programmable pushbutton. IPScom will display the Front Panel Pushbutton Editor dialog screen Figure 4-59.

■**NOTE:** When the "Smart Function" check box is selected, previous pushbutton programming does not have to be cleared.

3. Select the "Smart Function" check box. The Front Panel Pushbutton Editor dialog screen Figure 4-59 will redisplay (Figure 4-63) as follows:

   • The "Currently Selected" section of the dialog screen will indicate that the selected pushbutton "Selected Function" is "Smart Functions"

   • A Smart Functions selection section of the dialog screen will be displayed that allows up to 20 Assigned Functions, that can be either "Initiate" and/or "Blocks" functions.

4. From the "Initiate and Blocks" section of the dialog screen, expand either the "Initiate" or the "Blocks" Explorer Tree as necessary to navigate to the desired function.

5. Select the desired function to be added to the Smart Function pushbutton. The selected function will be displayed in one of the twenty Assigned Function slots.

6. If a user confirmation is desired before the pushbutton activates the programmed function, then select the "User Conf" check box. Add or Clear assigned functions as desired.

7. Select "Done". IPScom will display the Front Panel Setup dialog screen Figure 4-58. The selected pushbutton status in the "Saved Settings" section of the dialog screen (Figure 4-62). will indicate that the pushbutton has been assigned as a Smart Function.

Figure 4-62   Button Setup "Saved Settings"

■**NOTE:** At this point the pushbutton assignments have not been sent to the recloser control or saved. Therefore, exiting from the Front Panel Setup dialog screen at this time will result in all pushbutton reprogramming being lost. IPScom will display the Warning screen (Figure 4-61).

8. If additional Smart Function pushbuttons are to be programmed, repeat Steps 2 through 7 as necessary to program additional pushbuttons.

9. If all the desired pushbuttons have been programmed, select File/Update Files.

The pushbutton programming process is complete.

Figure 4-63   Button Smart Function Setup Dialog Screen

USER PROGRAMMABLE FRONT PANEL LEDs

The LED programming feature allows the user to customize the functionality of the LEDs 2, 3, 4, 5, 6, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and 23 through the Front Panel Setup screen (Figure 4-58). Selecting an LED red, green, or amber button activates the LED Editor Dialog Screen (Figure 4-64) which provides an interactive worksheet for programming the desired logic to activate or deactivate the LEDs based on the status of the recloser control functions.

Selecting the "Latch" button allows the user to customize the latch behavior of the LED. The LED may be programmed to latch on Red, Green, Amber, or None. LEDs 10, 11 and 12 are fixed to latch on Red. LED 13 is programmable and defaulted to latch on Red. LEDs 2, 3, 4, 5, 6, 14 and 15 are programmable and defaulted to None.

Overview of LED Programming

The LED programming feature consists of assembling various logical nodes that are linked to provide the desired logic to activate or deactivate the LEDs based on the status of the recloser control functions. The LEDs can also be setup to accommodate inverse logic of the recloser control functions. The logical nodes can be selected to be either "AND", "OR" or "XOR" (Exclusive OR). Examples of an Exclusive OR would be:

- Zero XOR Zero = Zero
- Zero XOR One = One
- One XOR Zero = One
- One XOR One = Zero

All recloser function element status can be inverted in the logical nodes as well as the logical node outputs.

There are predefined collective function LED inputs. These can also be used as inputs. See Table 4-9 for the collective function input definitions.
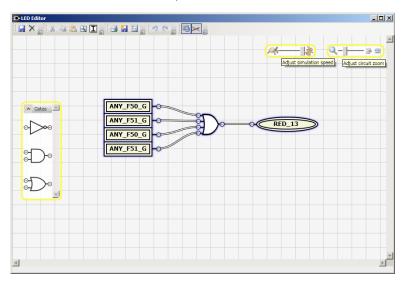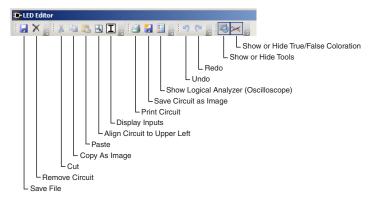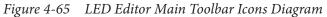
Figure 4-64   LED Editor Dialog Screen

LED Editor Main Toolbar

Hovering the mouse over the Main Toolbar icons will display a tootip and keyboard shortcut (if applicable). Refer to the following diagram for icon definitions (Figure 4-65).

Figure 4-65   LED Editor Main Toolbar Icons Diagram

Predefined LED Collective Function Input Definitions	
ANY_F27_P	27_1A_Pickup / 27_1B_Pickup / 27_1C_Pickup / 27_2A_Pickup / 27_2B_Pickup / 27_2C_Pickup / 27_3A_Pickup / 27_3B_Pickup / 27_3C_Pickup / 27_4A_Pickup / 27_4B_Pickup / 27_4C_Pickup
ANY_F50_A_Z_P	50_1A_Pickup / 50_2A_Pickup / 50_3A_Pickup / 50_4A_Pickup / 50_5A_Pickup
ANY_F50_B_Z_P	50_1B_Pickup / 50_2B_Pickup / 50_3B_Pickup / 50_4B_Pickup / 50_5B_Pickup
ANY_F50_C_Z_P	50_1C_Pickup / 50_2C_Pickup / 50_3C_Pickup / 50_4C_Pickup / 50_5C_Pickup
ANY_F50_G_N_P	50G_1_Pickup / 50G_2_Pickup / 50G_3_Pickup / 50G_4_Pickup / 50G_5_Pickup / 50N_1_Pickup / 50N_2_Pickup / 50N_3_Pickup / 50N_4_Pickup / 50N_5_Pickup
ANY_F51_A_Z_P	51_1A_Pickup / 51_2A_Pickup / 51_3A_Pickup / 51_4A_Pickup / 51_5A_Pickup
ANY_F51_B_Z_P	51_1B_Pickup / 51_2B_Pickup / 51_3B_Pickup / 51_4B_Pickup / 51_5B_Pickup
ANY_F51_C_Z_P	51_1C_Pickup / 51_2C_Pickup / 51_3C_Pickup / 51_4C_Pickup / 51_5C_Pickup
ANY_F51_G_N_P	51G_1_Pickup / 51G_2_Pickup / 51G_3_Pickup / 51G_4_Pickup / 51G_5_Pickup / 51N_1_Pickup / 51N_2_Pickup / 51N_3_Pickup / 51N_4_Pickup / 51N_5_Pickup
ANY_46_P	46DT_1_Pickup / 46DT_2_Pickup / 46DT_3_Pickup / 46DT_4_Pickup / 46DT_5_Pickup / 46IT_1_Pickup / 46IT_2_Pickup / 46IT_3_Pickup / 46IT_4_Pickup / 46IT_5_Pickup
ANY_27_T	27_1A_Timeout / 27_1B_Timeout / 27_1C_Timeout / 27_2A_Timeout / 27_2B_Timeout / 27_2C_Timeout / 27_3A_Timeout / 27_3B_Timeout / 27_3C_Timeout / 27_4A_Timeout / 27_4B_Timeout / 27_4C_Timeout
ANY_F50_A_Z_T	50_1A_Timeout / 50_2A_Timeout / 50_3A_Timeout / 50_4A_Timeout / 50_5A_Timeout
ANY_F50_B_Z_T	50_1B_Timeout / 50_2B_Timeout / 50_3B_Timeout / 50_4B_Timeout / 50_5B_Timeout
ANY_F50_C_Z_T	50_1C_Timeout / 50_2C_Timeout / 50_3C_Timeout / 50_4C_Timeout / 50_5C_Timeout
ANY_F50_G_N_T	50G_1_Timeout / 50G_2_Timeout / 50G_3_Timeout / 50G_4_Timeout / 50G_5_Timeout / 50N_1_Timeout / 50N_2_Timeout / 50N_3_Timeout / 50N_4_Timeout / 50N_5_Timeout
ANY_F51_A_Z_T	51_1A_Timeout / 51_2A_Timeout / 51_3A_Timeout / 51_4A_Timeout / 51_5A_Timeout
ANY_F51_B_Z_T	51_1B_Timeout / 51_2B_Timeout / 51_3B_Timeout / 51_4B_Timeout / 51_5B_Timeout
ANY_F51_C_Z_T	51_1C_Timeout / 51_2C_Timeout / 51_3C_Timeout / 51_4C_Timeout / 51_5C_Timeout
ANY_F51_G_N_T	51G_1_Timeout / 51G_2_Timeout / 51G_3_Timeout / 51G_4_Timeout / 51G_5_Timeout / 51N_1_Timeout / 51N_2_Timeout / 51N_3_Timeout / 51N_4_Timeout / 51N_5_Timeout
ANY_F81_T	81_1_Timeout / 81_2_Timeout / 81_3_Timeout / 81_4_Timeout
ANY_F46_T	46DT_1_Timeout / 46DT_2_Timeout / 46DT_3_Timeout / 46DT_4_Timeout / 46DT_5_Timeout / 46IT_1_Timeout / 46IT_2_Timeout / 46IT_3_Timeout / 46IT_4_Timeout / 46IT_5_Timeout
ANY_F59_Z_T	59_1A_Timeout / 59_1B_Timeout / 59_1C_Timeout /59_2A_Timeout / 59_2B_Timeout / 59_2C_Timeout / 59_3A_Timeout / 59_3B_Timeout / 59_3C_Timeout / 59_4A_Timeout / 59_4B_Timeout / 59_4C_Timeout

Table 4-9   Predefined LED Collective Function Input Definitions

Programming LEDs (IPScom)

1. From the IPScom Main Menu, select **Setup/Configuration/Front Panel Functions**. IPScom will display the "Front Panel Setup" dialog screen (Figure 4-58).

2. Select the desired LED and it's color to program. IPScom will activate the LED Editor Screen (Figure 4-64) which provides an interactive worksheet for programming the desired logic to activate or deactivate the LEDs based on the status of the recloser control functions.

3. Use the various elements of the LED Editor interactive worksheet to program the LED logic.

Add Inputs

Select the "Display Inputs" icon from the LED Editor toolbar to display the Input Selection dialog screen (Figure 4-66). Use this tool to filter, select and insert inputs onto the worksheet.
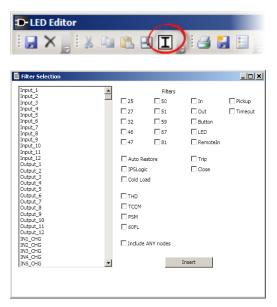
Figure 4-66   LED Editor Input Selection Dialog Screen

Add Logic Gates

Use the "Gates" tool to drag and drop logic gates onto the worksheet.
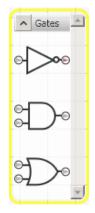
Figure 4-67   LED Editor "Gates" Tool

Show Logical Analyzer (Oscilloscope)

Use this tool to display the Oscilloscope for the currently selected LED circuit.
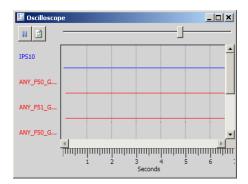
Figure 4-68   LED Editor Oscilloscope Tool

Saving LED Configuration

If all the desired LEDs have been programmed, select File/Update Files.

The LED programming process is complete.

WAKE UP SCREENS

If the "Wake/EXIT" pushbutton is selected, the control will respond as follows:

- Pressing "EXIT" when User Lines are being displayed will initiate a cycling display of the selected Wake Up parameters for a period of 15 minutes and then return to the User Lines display.

- If no Wake Up screens are selected, then nothing will be displayed and the User Lines will flash for a moment.

- When there is a Smart Flash SD Card present while in the Wake Up screen menu, an additional Smart Flash SD Card menu item will be present. All Wake Up screen parameters can be saved to the Smart Flash SD Card in *.csv format.

Selecting/Editing Wake Up Screen Parameters

To select or edit the Wake Up Screen parameters perform the following:

1. From the IPScom Main Menu, select **Setup/Configuration/Front Panel Functions**. IPScom will display the "Front Panel Setup" dialog screen (Figure 4-58).

2. Select the "Wake Up" button from the Front Panel Setup window. IPScom will display the Wake Up Screen selection window (Figure 4-70).

Figure 4-69   Select Wake Up Button
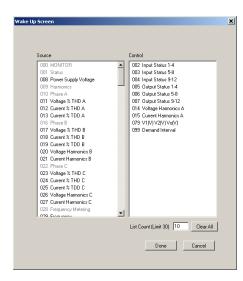
Figure 4-70   Wake Up Screen Dialog Screen

The order in which parameters are being displayed can be changed by dragging and dropping items in the "Control" window. **List Count** displays a count of the selected Wake Up Screen parameters (Limit 30). The **Clear All** command clears ALL Wake Up Screen parameter selections from the Control activate list.

3. Select the Wake Up Screen parameters to be displayed by moving (dragging and dropping) each parameter from the "Source" window on the left to the "Control" window on the right.

4. Select the Wake Up Screen parameters that are not to be displayed by moving (dragging and dropping) those parameters from the "Control" window to the "Source" window.

5. Select "Done". IPScom will return to the Front Panel Setup window (Figure 4-58).

6. If all the desired Wake Up Screens have been programmed, select File/Update Files.

The Wake Up Screen programming process is complete.

FRONT PANEL LABELS CONFIGURATION

Selecting **Utility/Front Panel Labels** opens a pdf form file in Adobe Acrobat (Figure 4-71). This form allows the user to create and print custom labels for the user programmable front panel LEDs and Pushbuttons. The desired custom labels are setup in the form template. The printout can then be inserted behind the front panel overlay.
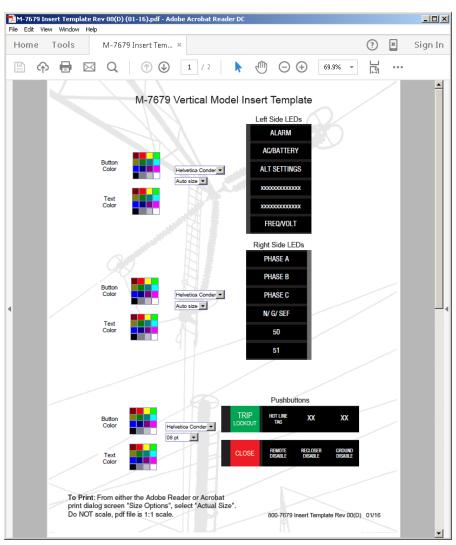
Figure 4-71   Front Panel Labels PDF Form Dialog Screen

4.3   System Diagrams
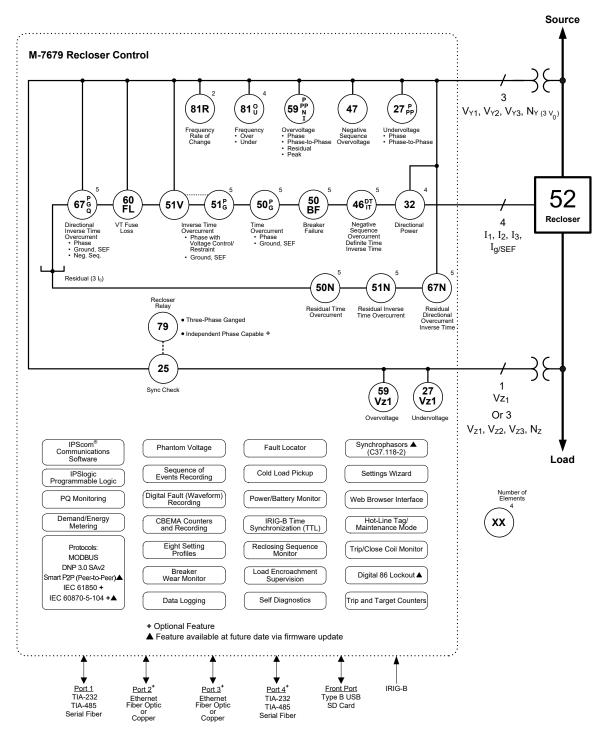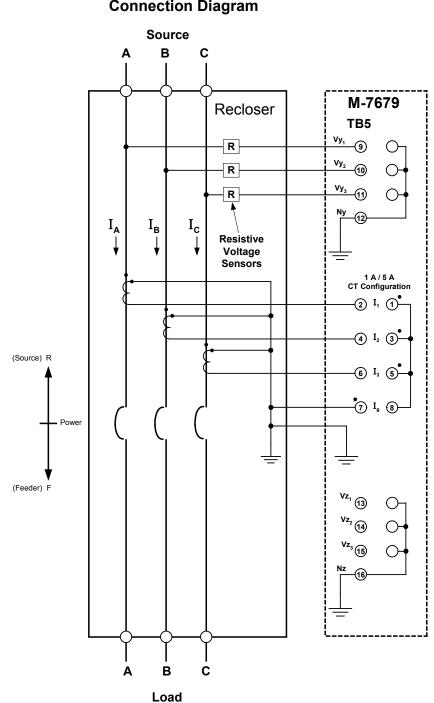
Figure 4-72   One-Line Functional Diagram

**M-7679 Typical
Connection Diagram**

Figure 4-73   Three-Line Connection Diagram

4.4 System Configuration from the HMI

SYSTEM CONFIGURATION

The System Configuration settings detailed in this Chapter are also available in the Front Panel HMI. See **Chapter 2 Operation** for an overview of the HMI Menu structure and navigation.

1. Press [CNFG] to wake the unit. The menu will advance to "CONFIGURATION".

```
      CONFIGURATION
 <SETP              COMM>
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
         Nameplate
 <                      >
```

3. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
 Nominal Voltage
   xxx.xx   V l-g
```

Continue through the Nameplate submenu to access the System Configuration screens. The displayed screens are based on the installed hardware. The following is a representative list:

- Nominal Voltage
- Nominal Current
- VTy Configuration
- VTz Configuration
- Phase Rotation
- Nominal Frequency
- CT Rating
- Default Profile

- Neutral Operating Current
- SEF Enable
- Vz1 Usage
- Power Supply Type
- Phase Assignment
- 69 Operation
- No Reset Before Close
- Interface Configuration

■**NOTE:** Hardware Options are Read Only screens which display the factory options installed in the unit.

LEA CONFIGURATION FROM THE HMI

LEA Common Settings
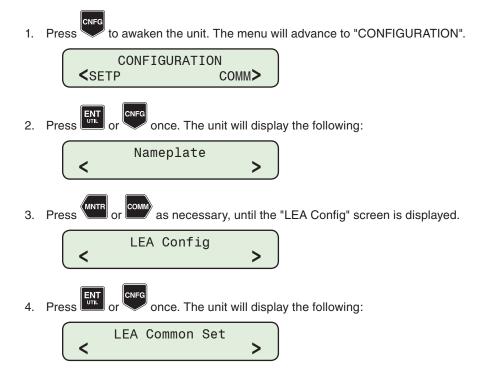
1. Press [CNFG] to wake the unit. The menu will advance to "CONFIGURATION".
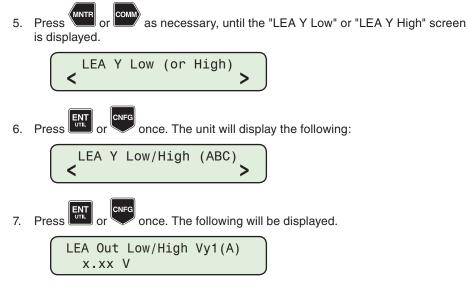
```
      CONFIGURATION
 <SETP              COMM>
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
         Nameplate
 <                      >
```

3. Press [MNTR] or [COMM] as necessary, until the "LEA Config" screen is displayed.

```
     LEA Config
 <                    >
```

4. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
    LEA Common Set
 <                    >
```

5. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
 LEA Hardware
 xx
```

Continue through the LEA Common Set submenu to access the remaining LEA Common Settings. The displayed screens are based on the installed LEA hardware. The following is a representative list:

- Primary Nominal Voltage
- LEA Orientation
- Phase Assignment Z
- Calibration Voltage Low/High Y
- Calibration Voltage Low/High Z

■**NOTE:** Hardware Options are Read Only screens which display the factory options installed in the unit. Calibration screens are Read Only calculated values.

LEA Y Side Settings

1. Press [CNFG] to awaken the unit. The menu will advance to "CONFIGURATION".

```
   CONFIGURATION
 <SETP          COMM>
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
     Nameplate
 <                    >
```

3. Press [MNTR] or [COMM] as necessary, until the "LEA Config" screen is displayed.

```
     LEA Config
 <                    >
```

4. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
    LEA Common Set
 <                    >
```

5. Press ⬡MNTR or ⬡COMM as necessary, until the "LEA Y Low" or "LEA Y High" screen is displayed.

```
┌─────────────────────────────────┐
│      LEA Y Low (or High)        │
│  ❮                           ❯  │
└─────────────────────────────────┘
```

6. Press ▢ENT/UTIL or ⬡CNFG once. The unit will display the following:

```
┌─────────────────────────────────┐
│      LEA Y Low/High (ABC)       │
│  ❮                           ❯  │
└─────────────────────────────────┘
```

7. Press ▢ENT/UTIL or ⬡CNFG once. The following will be displayed.

```
┌─────────────────────────────────┐
│  LEA Out Low/High Vy1(A)        │
│     x.xx V                      │
└─────────────────────────────────┘
```

Continue through the LEA Y submenu to access the remaining LEA Y Side settings. The displayed screens are based on the installed LEA hardware and VTy Configuration setting. The following is a representative list:

- PTR Low/High Vy1 (A)
- RCF Low/High Vy1 (A)
- Phase Low/High Vy1 (A)
- LEA Out Low/High Vy2(B)
- PTR Low/High Vy2(B)
- RCF Low/High Vy2(B)
- Phase Low/High Vy2(B)
- LEA Out Low/High Vy3(C)
- PTR Low/High Vy3(C)
- RCF Low/High Vy3(C)
- Phase Low/High Vy3(C)

■**NOTE:** Hardware Options are Read Only screens which display the factory options installed in the unit. Calibration screens are Read Only calculated values.

LEA Z Side Settings

1. Press ⬡CNFG to awaken the unit. The menu will advance to "CONFIGURATION".

```
┌─────────────────────────────────┐
│        CONFIGURATION            │
│  ❮SETP              COMM❯       │
└─────────────────────────────────┘
```

2. Press ▢ENT/UTIL or ⬡CNFG once. The unit will display the following:

```
┌─────────────────────────────────┐
│         Nameplate               │
│  ❮                           ❯  │
└─────────────────────────────────┘
```

3. Press ⬡MNTR or ⬡COMM as necessary, until the "LEA Config" screen is displayed.

```
┌─────────────────────────────────┐
│         LEA Config              │
│  ❮                           ❯  │
└─────────────────────────────────┘
```

4. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
        LEA Common Set
   <                      >
```

5. Press [MNTR] or [COMM] as necessary, until the "LEA Z Low" or "LEA Z High" screen is displayed.

```
     LEA Z Low (or High)
   <                      >
```

6. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
     LEA Z Low/High (ABC)
   <                      >
```

7. Press [ENT UTIL] or [CNFG] once. The following will be displayed.

```
  LEA Out Low/High Vz1(A)
      x.xx V
```

Continue through the LEA Z submenu to access the remaining LEA Z Side settings. The displayed screens are based on the installed LEA hardware and VTz Configuration setting. The following is a representative list:

- PTR Low/High Vz1 (A)
- RCF Low/High Vz1 (A)
- Phase Low/High Vz1 (A)
- LEA Out Low/High Vz2(B)
- PTR Low/High Vz2(B)
- RCF Low/High Vz2(B)
- Phase Low/High Vz2(B)
- LEA Out Low/High Vz3(C)
- PTR Low/High Vz3(C)
- RCF Low/High Vz3(C)
- Phase Low/High Vz3(C)

■**NOTE:** Hardware Options are Read Only screens which display the factory options installed in the unit. Calibration screens are Read Only calculated values.

5 Setpoints

■ **CYBER SECURITY NOTE:**

When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

Chapter five is designed for the person or group responsible for the System Setpoints of the M-7679 Recloser Control.

Chapter 5 consists of:

- • System Setpoints, Common Setpoints and Recloser Relay Setpoints Sections which describe the enabling of functions and setpoints, output contact assignments and digital input assignments.
- • A Recloser Wizard Section which describes the configuration of the recloser control using the interactive settings wizard.

The selection of the M-7679 Setpoints can be performed using the S-7600 IPScom Communications Software and will be included where applicable.

5.0   Setpoints Quick Index

5.1   System Setpoints

The individual protective functions, along with their pickup and timing settings are described in the following pages. Settings for disabled functions do not apply. Some menu and setting screens do not appear for functions that are disabled or not purchased. Dialog screens are as they appear using S-7600 IPScom Communications Software.

Setpoint Profiles (Multiple Settings Groups)

Up to eight setpoint profiles may be used. Each profile contains a function configuration and associated settings. One of the eight profiles may be designated as the Active Profile which will contain the parameters that the recloser control will actively use. Only the Active Profile may be edited.

A **Copy Settings** feature is available in the **Recloser Wizard** that copies an image of the Active Profile to any one of the other eight profiles. This feature can speed up the configuration process. Consider, for example, a situation where a breaker will be removed from service. Two profiles will be used: an "In Service" profile (Profile 1) and an "Out of Service" profile (Profile 2).

Profile 2 will be identical to the "In Service" profile, with the exception of the overcurrent settings. Profile 1 is set to be the Active profile, and all setpoints entered. An image of Profile 1 will then be copied to Profile 2 when selected in the final Recloser Wizard screen. Profile 2 is then selected as the Active Profile and the alternate Profile 2 setpoints modified.

▲ **CAUTION:** During profile switching, recloser control operation is disabled for approximately 1 second.

Utilizing the above feature not only accelerates the configuration process, but also helps to remove the possibility of errors since the setpoints are not re-entered manually.

Utilizing the Smart Flash SD Card to Save and Load Setpoint Files

The setpoints file consists of the specific setpoint settings for all 8 Profiles. Saving the control setpoint file to an SD Card allows the user to open the saved file in IPScom and then edit specific profiles while retaining any existing setpoint information for the profiles which are NOT changing. This edited file can then be saved onto an SD Card and reloaded onto the control.

■**NOTE:** Setpoint file names may include any of the printable ASCII characters, excluding the "~" or "\" characters.

▲**CAUTION:** Setpoint changes are immediately acted on by the control and may cause undesired control operation.

Configure Recloser Data

The recloser control is shipped with a certain group of standard functions, including other optional functions as purchased. Both of these groups define a configurable set of functions. Only members of this set may be enabled/disabled by the end user. *Optional functions not purchased cannot be enabled.*

Functions designated as **DISABLED** are inactive and will not be available for tripping. All menus associated with inactive functions will be unavailable.

The general information required to complete the input data on this section includes:

- Enable/Disable
- Function specific settings
- Output choices (OUT 1–OUT 4; for units with expanded I/O, OUT 5–OUT 12)
- Input blocking choices (IN 1–IN 4; for units with expanded I/O, IN 5–IN 12)

■**NOTE:** The Recloser Input/Output Configuration Worksheet is contained in **Appendix B**. The worksheet is provided to define and record the input and output configuration for the recloser control.

FUNCTIONS

Configuration of the recloser control consists of enabling the functions for use in a particular application, designating the output contacts each function will operate, and which control/status inputs will block the function. The choices include four programmable output contacts (OUT 1–OUT 4) and four control/status inputs (IN 1–IN 4), or OUT 5–12 and IN 5–12 for units purchased with expanded I/O.

The blocking control/status inputs and output contact assignments must be chosen before entering the settings for the individual functions. Both may be recorded on the Recloser Configuration Worksheet in **Appendix B**, **Recloser I/O Configuration Worksheet**.

Special Considerations

Status Inputs 1, 2 and 3 are pre-assigned as follows:
- IN 1, 52a breaker contact
- IN 2, 52b breaker contact
- IN 3, 69 Lockout

Outputs:
- 1, 2, 5, 6, 7 and 8 are form "a" contacts (normally open)
- 3, 4, 9, 10 and 11 are form "c" contacts (center tapped "a" and "b" normally closed)

The following functions in Table 5-1 can be configured using enable/disable output, and status input blocking designations:

FUNCTION	DESCRIPTION	FUNCTION	DESCRIPTION
25	Sync Check	67P	Phase Directional Overcurrent
27	Phase Undervoltage	67N	Residual Directional Overcurrent
27PP	Phase-to-Phase Undervoltage	67G	Ground Directional Overcurrent
27Vz1	Vz1 Undervoltage	67Q	Negative-Sequence Directional Overcurrent
27BSVS	Bus Side Voltage Supervision		
32	Directional Power	81	Frequency
46DT	Negative-Sequence Definite Time Overcurrent	81R	Rate-of-Change of Frequency
		BM	Breaker Monitor
46IT	Negative-Sequence Inverse Time Overcurrent	CLP	Cold Load Pickup
		HLT	Hot Line Tag
47	Negative-Sequence Overvoltage	Restore	Auto Restoration
50BF	Breaker Failure	PSBC	IED Power Supply/Battery Charger Monitor
50P	Phase Instantaneous/Definite Time Overcurrent		
		TCM/CCM	Trip/Close Circuit Monitoring
50G	Ground Instantaneous/Definite Time Overcurrent	THD/TDD	Total Harmonic Distortion/ Total Demand Distortion
50N	Residual Instantaneous/Definite Time Overcurrent	**Recloser Functions**	
51P	Phase Inverse Time Overcurrent with Voltage Control/Restraint	79	Auto Reclose
		79 Sequence	Trip Recloser Sequence
51N	Residual Inverse Time Overcurrent	79 Lockout	Drive to Lockout
51G	Ground Inverse Time Overcurrent	79 SUPV	Supervision Functions
59	Phase Overvoltage	**Optional Protective Functions** **(with 200 mA, 50 mA or 10 mA Ground CT option)**	
59PP	Phase-to-Phase Overvoltage		
59I	Peak Overvoltage	50GS	Sensitive Ground Instantaneous/ Definite Time Overcurrent
59N	Residual Overvoltage		
59Vz1	Vz1 Overvoltage	51GS	Sensitive Ground Inverse Time Overcurrent
60FL	VT Fuse Loss Detection		
		67GS	Sensitive Ground Directional Overcurrent

Table 5-1   Available Functions

CONFIGURING SETPOINTS

The **Setup/Setpoints** command displays the Setpoints dialog screen (Figure 5-1) from which the individual relay function dialog screens can be accessed. Selecting a Function Setting button will display the corresponding function dialog screen (See Figure 5-2 as an example).

Figure 5-1   Setpoints Dialog Screen

Figure 5-2   Sync Check Function Setpoints Screen Example

USER DEFINED CUSTOM CURVES

IPScom allows the user to define up to four custom overcurrent curves. Each curve has a total of 64 user defined "x-y" coordinates. The "x" coordinate is the pickup ratio and the "y" coordinate is the reciprocal of the time value.

To create a custom curve perform the following:

1. From the IPScom Main Screen menu select **Setup/Custom Curve Editor**. IPScom will display the Custom Curves interactive dialog screen (Figure 5-5).
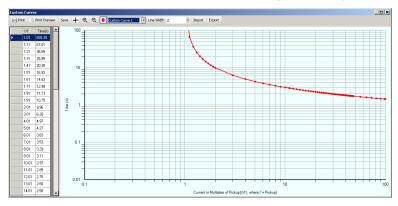
Figure 5-3   Custom Curves Interactive Screen

2. Select the Custom Curve (1 through 4) to be created or edited from the dropdown.
3. Use the left side table to manually enter the "x" (Current in Multiples of Pickup) and "y" (Time) coordinates. The corresponding point will be moved to the entered coordinates.
4. Select "Display Point" as shown below to show all points in the curve which can then be dragged into the desired position.

5. Select "Import" to load an existing curve into the window as a starting point, or to load data from an existing text file (Figure 5-4).

Figure 5-4   Custom Curve Import Screen

6. When the curve has been created as desired, select "Save". IPScom will display a "Setpoints Saved" confirmation screen (Figure 5-5).

Figure 5-5   Custom Curve Setpoints Saved Confirmation Screen

The Custom Curve is now available for use in any Inverse Time Overcurrent Setpoints screen. If desired, select "Export" to save the Custom Curve data to a text file.

25   SYNC CHECK

The sync check function (25) is used to ensure that the voltage magnitude, phase angle and frequency of the selected line reference phase (A, B or C) and the Bus (Vz_1 selected to $Vsync$) are within acceptable limits before the recloser is synchronized. The sync check function includes the following checks:

- Minimum Voltage
- Phase Angle
- Delta Frequency
- Delta Voltage
- Dead Line/Dead Bus
- Dead Line/Live Bus
- Live Line/Dead Bus

Undervoltage Permission (25D)

The Line Minimum Voltage Limit and Bus Minimum Voltage Limit define the Live/Dead voltage levels used in Undervoltage Permission schemes (Dead Line/Dead Bus, Dead Line/Live Bus and Live Line/Dead Bus) when the undervoltage scheme(s) are enabled.

When the measured $Vsync$ voltage is less than or equal to the Minimum Line Voltage Limit, $Vsync$ is considered dead. When the measured $Vsync$ is greater than or equal to Minimum Line Voltage Limit, $Vsync$ is considered live.

The opposite side of the breaker (i.e., bus) uses the positive sequence voltage measurement (V_1) for three-phase consideration in determining live/dead detection and is compared to the Minimum Bus Voltage Limit. The following different combinations may be selected:

- Dead Line/Dead Bus
- Dead Line/Live Bus
- Live Line/Live Bus

Sync Check Permission (25S)

The sync check permissions function consists of the angle difference, magnitude voltage difference and frequency difference elements. Each of these elements may be enabled individually.

The Sync Voltage and Reference Voltage must both be equal to or less than the Maximum Voltage setting in order for 25S to be enabled. The Sync Voltage and Reference Voltage must both also be equal to or greater than the Minimum Voltage setting in order for 25S to be enabled.

Figure 5-8 is the overall logic diagram for the Sync Check function.
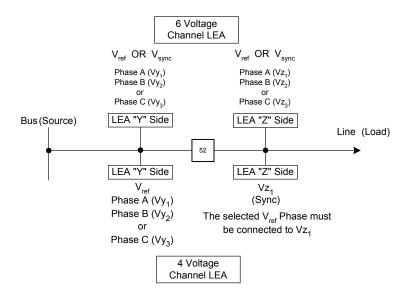
Figure 5-6   Function 25 Voltage Sources

Figure 5-7   Function 25 Sync Check Setpoints Screen
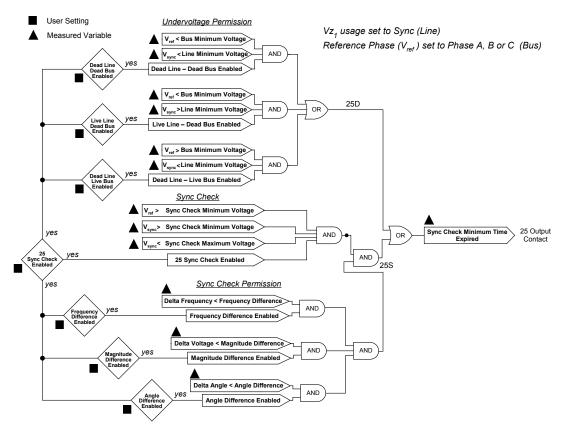
Figure 5-8   Function 25 Sync Check Logic Diagram

27   PHASE UNDERVOLTAGE

Use the Phase Undervoltage function (27) to detect any condition causing long- or short-term undervoltage. The ranges and increments are presented in and . 27 #2 through 27 #4 Screens are identical to 27 #1.

■**NOTE:** When the Auto Restoration function is enabled, select "Auto Restore" to include the 27 Undervoltage function in the Auto Restoration logic.

Figure 5-9   Function 27 Phase Undervoltage Setpoint Screen (Shown: Three-Phase Ganged Example)
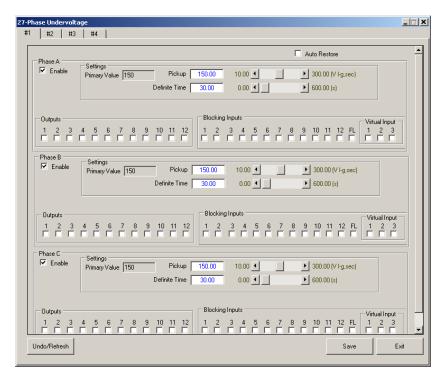
Figure 5-10   Function 27 Phase Undervoltage Setpoint Screen (Shown: Independent Phase Example)

27PP   PHASE-TO-PHASE UNDERVOLTAGE

Use the Phase-to-Phase Undervoltage function (27PP) to detect any condition causing long- or short-term undervoltage. This element operates on Phase-to-Phase voltage (i.e., V_{AB}, V_{BC}, V_{CA}). 27PP can only be enabled when the VT configuration is line-to-ground.

Figure 5-11   Function 27PP Phase-to-Phase Undervoltage Setpoints (Three-Phase Ganged Example)
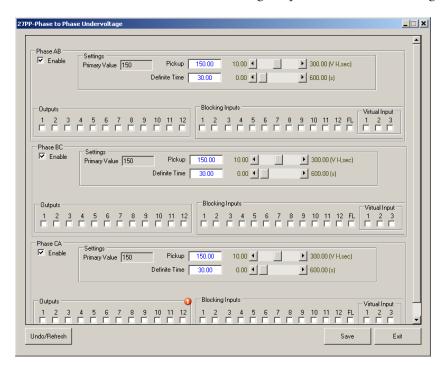
Figure 5-12   Function 27PP Phase-to-Phase Undervoltage Setpoints (Independent Phase Example)

27 VZ1   UNDERVOLTAGE

A single phase undervoltage element is available when the voltage input Vz1 is setup as 27/59. Use the 27 Vz1 Undervoltage function to detect any condition causing long term undervoltage on the line (load) side of the recloser control.

Figure 5-13   Function 27Vz1 Undervoltage Setpoints Screen

32   DIRECTIONAL POWER

Directional Power protection (32) is available as either Reverse Overpower, Reverse Underpower, Forward Overpower or Forward Underpower configuration presented in Figure 5-15. The directional power function provides four power elements, each with a magnitude setting and time delay, and configurable as an underpower or overpower element. Each element can be selected to operate on real or imaginary power.

Directional Power operates on three-phase power. The setting range is from –3.00 PU to 3.00 PU. Normalized PU power flow measurements are based on the Nominal Voltage and Nominal Current setting, as shown in **Section 4.3 System Setup**.

▲**CAUTION:** Proper CT polarity is important in defining the direction of power flow. Refer to Figure 4-73 for proper connections.

To calculate the desired pickup:

Line-to-Ground Voltage:

$P_{NOM} = 3 \bullet V_{NOM} \bullet I_{NOM}$ (Secondary Nominal Power)

$$Pickup = \pm \frac{Primary\ Power\ (Three\text{-}Phase)}{P_{NOM} \bullet VTR \bullet CTR}$$

Line-to-Line or Line-Ground-to-Line-Line:

$P_{NOM} = \sqrt{3} \bullet V_{NOM} \bullet I_{NOM}$ (Secondary Nominal Power)

$$Pickup = \pm \frac{Primary\ Power\ (Three\text{-}Phase)}{P_{NOM} \bullet VTR \bullet CTR}$$

Directional Choice

Typically, Forward looking elements are used to detect an overload while Reverse looking elements are used to detect a backfeed. Other applications are possible, such as the detection of an under power condition.
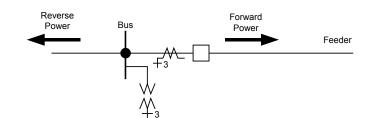
Figure 5-14   Directional Power Flow
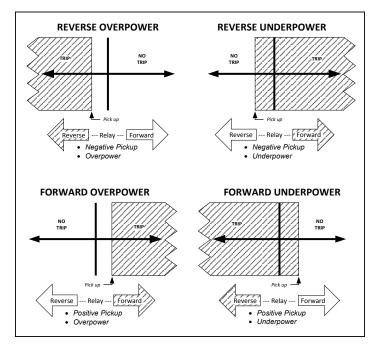
Figure 5-15   Directional Power Configurations
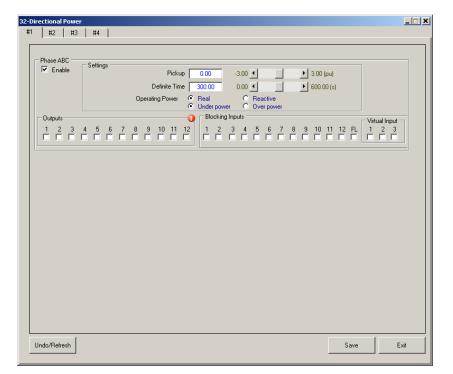
Figure 5-16   Function 32 Directional Power Setpoints Screen

46DT   NEGATIVE-SEQUENCE DEFINITE TIME OVERCURRENT

The Negative-Sequence Overcurrent function is very sensitive and can detect unbalance due to an open pole. Care must be taken not to set the pickup so sensitive it will operate due to unbalance from unequal single phase load. This function has a definite time element. The definite time pickup value and operating time are normally associated as an alarm. 46DT #2 through 46DT #5 screens are identical to 46DT #1.

Figure 5-17   Function 46DT Negative-Sequence Definite Time Overcurrent Setpoints Screen

46IT   NEGATIVE-SEQUENCE INVERSE TIME OVERCURRENT

The 46IT Inverse Time function can be selected as an IEC, IEEE, US, Traditional Recloser Curve (101-202), Definite Time or user defined Custom Curve. 46IT #2 through 46IT #5 screens are identical to 46IT #1.

Figure 5-18   Function 46IT Negative-Sequence Inverse Time Overcurrent Setpoints Screen

47   NEGATIVE-SEQUENCE OVERVOLTAGE

The Negative-Sequence Overvoltage function provides protection for voltage unbalance and reverse phase sequence. The operating signal is V_2.

Voltage unbalance can occur due to blown fuses on transformers, open conductors, load unbalance and other such events. Phase reversal may occur when lines are repaired and conductors are inadvertently swapped. Ranges and increments are presented in Figure 5-19.

Figure 5-19   Function 47 Negative-Sequence Overvoltage Setpoints Screen

50P   PHASE INSTANTANEOUS/DEFINITE TIME OVERCURRENT

The 50P Phase Instantaneous/Definite Time Overcurrent function provides fast tripping for high magnitude phase faults. The settings must be set such that it will not pickup for faults or conditions outside the immediate protective zone. The selected phase overcurrent elements (50P) operate when any individual Phase A, B or C current exceeds the pickup. 50P #2 through 50P #5 Screens are identical to 50P #1.

50P High Current Lockout (HCL)

There is a dedicated definite time phase and residual overcurrent for each auto-reclose shot. These are typically set to pickup for close-in high current magnitude faults and a short time delay (e.g., five cycles or less). If an HCL overcurrent element operates, then the auto-reclose cycle immediately goes to lockout.

Figure 5-20   Function 50P Phase Instantaneous/Definite Time Overcurrent Setpoints Screen

50G   GROUND INSTANTANEOUS/DEFINITE TIME OVERCURRENT

The 50G Ground Instantaneous/Definite Time Overcurrent function provides reliable protection for ground faults. This element can be set more sensitive than the phase overcurrent since ground current typically only exists during unbalanced conditions. The settings must be set such that they will not pickup for faults or conditions outside the immediate protective zone. 50G operates on the ground current input I_G. Operation occurs when the ground current magnitude exceeds the pickup. 50G #2 through 50G #5 Screens are identical to 50G #1.

50G High Current Lockout (HCL)

There is a dedicated definite time phase and residual overcurrent for each auto-reclose shot. These are typically set to pickup for close-in high current magnitude faults and a short time delay (e.g., five cycles or less). If an HCL overcurrent element operates, then the auto-reclose cycle immediately goes to lockout.

■**NOTE:** 50G High Current Lockout settings are only available when the HCL Operating Current Reference is configured as "G".

Figure 5-21   Function 50G Ground Instantaneous/Definite Time Overcurrent Setpoint Screen

50N   RESIDUAL INSTANTANEOUS/DEFINITE TIME OVERCURRENT

The 50N Residual Instantaneous/Definite Time Overcurrent function provides reliable protection for ground faults. This element can be set more sensitive than the phase overcurrent since neutral current typically only exists during unbalanced conditions. 50N operates on the arithmetic sum of the three-phase current (i. e., $I_a + I_b + I_c$). Operation occurs when the neutral current magnitude exceeds the pickup.

Ranges and Increments are presented in . 50N #2 through 50N #5 Screens are identical to 50N #1.

50N High Current Lockout (HCL)

There is a dedicated definite time phase and residual overcurrent for each auto-reclose shot. These are typically set to pickup for close-in high current magnitude faults and a short time delay (e.g., five cycles or less). If an HCL overcurrent element operates, then the auto-reclose cycle immediately goes to lockout.

■**NOTE:** 50N High Current Lockout settings are only available when the HCL Operating Current Reference is configured as "3IO".

Figure 5-22   Function 50N Residual Instantaneous/Definite Time Overcurrent Setpoint Screen

50GS   SENSITIVE GROUND INSTANTANEOUS/DEFINITE TIME OVERCURRENT

The 50GS Sensitive Ground Instantaneous/Definite Time Overcurrent function provides reliable protection for ground faults on high impedance grounded and ungrounded distribution systems. This element is set extremely sensitive since the ground fault current is very low. 50GS operates on the ground current input I_G. Operation occurs when the ground current magnitude exceeds the pickup. 50GS #2 through 50GS #5 Screens are identical to 50GS #1.

50GS High Current Lockout (HCL)

There is a dedicated definite time phase and residual overcurrent for each auto-reclose shot. These are typically set to pickup for close-in high current magnitude faults and a short time delay (e.g., five cycles or less). If an HCL overcurrent element operates, then the auto-reclose cycle immediately goes to lockout.

■**NOTE:** 50GS High Current Lockout settings are only available when the HCL Operating Current Reference is configured as "G".

Figure 5-23   Function 50GS Ground Sensitive Overcurrent Setpoints Screen

50BF   BREAKER FAILURE

■**NOTE:** The term breaker is used interchangeably with recloser.

The recloser control closes an output contact to trip the recloser when it detects a fault or other abnormal condition. Breaker failure protection provides another level of protection should the recloser fail to open. For example the recloser control can send a direct transfer trip command to the first upstream switch that can break fault current should the recloser fail.

■**NOTE:** The breaker failure protection can be initiated by a trip command from the recloser control or an external trip command.

The breaker failure condition is detected by the presence of current for a set time after a trip command has been sent to the recloser. The breaker failure timer is started whenever any one of the designated output contacts or the external programmed breaker initiate status input operates. The breaker failure timer continues to time if a current level detector is still picked up indicating the recloser is still closed; otherwise, the breaker failure timer is reset.

There is an option to issue a retrip command before a breaker failure trip is asserted if the recloser has a second trip coil.
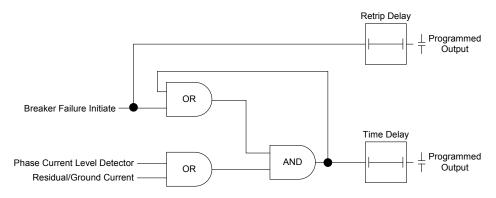
Figure 5-24   Breaker Failure Logic Diagram

Figure 5-25   Function 50BF Breaker Failure Setpoints Screen

51P   PHASE INVERSE TIME OVERCURRENT WITH VOLTAGE CONTROL OR VOLTAGE RESTRAINT

The Phase Inverse Time Overcurrent with Voltage Control/Restraint setting screen allows the user to Enable/Disable Phase Overcurrent protection and enter the operating parameters. Use up to five individual elements to provide inverse time phase overcurrent protection. The M-7679 provides over 50 different time-current curves plus four user programmable curves to facilitate coordination with other overcurrent elements in the network. Table 5-2 lists the choices of time-current curves. Use Traditional Recloser curve modifiers to alter the time-current curves (including both US or IEC):
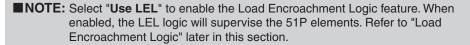
- Time Multiplier – shifts entire curve up or down
- Time Adder – adds set amount of time to curve
- Minimum Response Time – minimum time required to trip

Refer to Figure 5-27 Inverse Time Overcurrent Characteristic as a visual aid.

Time overcurrent relays (51) are basic to most distribution protection schemes. This is the main element to trip circuits selectively for phase faults and coordinate them with up or downstream devices. The 51P function includes voltage control or restraint. Under certain conditions, steady-state fault currents during a three-phase fault can decrease to below the full load current. In order to provide overcurrent protection for those conditions, the voltage control/restraint element should be enabled.

When voltage restraint is selected, the pickup of the 51P is modified continuously according to the voltage inputs, as shown in Figure 5-26. For voltage controlled operation, the function is not active unless the voltage is below the voltage control setpoint. 51P #2 through 51P #5 Screens are identical to 51P #1.

This function should be blocked by fuse loss if in the voltage control mode. Fuse loss blocking is not required for the restraint mode because the pickup is automatically held at 100% Pickup (see Figure 5-26) during fuse loss conditions, and will continue to operate correctly.

■**NOTE:** Select "**Use LEL**" to enable the Load Encroachment Logic feature. When enabled, the LEL logic will supervise the 51P elements. Refer to "Load Encroachment Logic" later in this section.
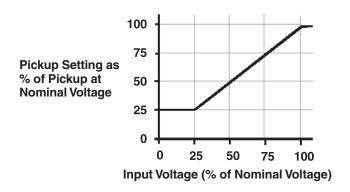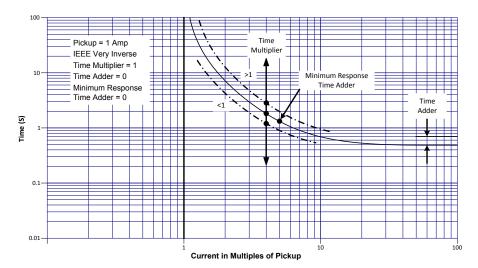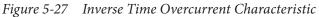
Figure 5-26   51P Voltage Restraint Characteristic

Curve Category	Curve Selection
IEC Curves (IEC 60255-151)	Inverse, Very Inverse, Extremely Inverse
IEEE Curves (IEEE C37.112)	Moderately Inverse, Very Inverse, Extremely Inverse
Traditional Recloser Curves ■NOTE: (Newer curves are shown with the older curve designations in parentheses)	101 (A); 102 (1); 103 (17); 104 (N); 105 (R); 106 (4); 107 (L); 111 (8*); 112 (15); 113 (8); 114 (5); 115 (P); 116 (D); 117 (B); 118 (M); 119 (14); 120 (Y); 121 (G); 122 (H); 131 (9); 132 (E); 133 (C); 134 (Z); 135 (2); 136 (6); 137 (V); 138 (W); 139 (16); 140 (3); 141 (11); 142 (13); 151 (18); 152 (7); 161 (T); 162 (KP); 163 (F); 164 (J); 165 (KG); 200; 201; 202
US Curves	Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse
Definite Time	Definite Time
User-Designed Programmable Curves	Four Programmable Curves

Table 5-2   M-7679 Curve Selection

Figure 5-27   Inverse Time Overcurrent Characteristic
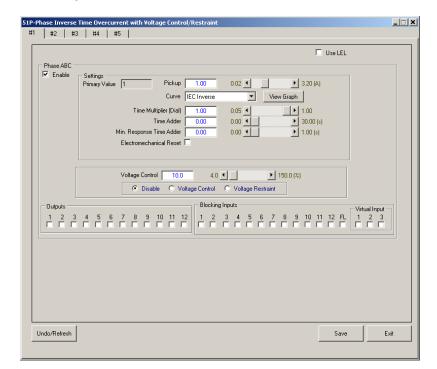
Figure 5-28   Function 51P Phase Inverse Time Overcurrent with Voltage Control/Restraint Setpoints Screen (Three-Phase Ganged Operation)

51N   RESIDUAL INVERSE TIME OVERCURRENT

The (51N) Residual Inverse Time Overcurrent function provides protection against ground faults and operates on the neutral current ($I_N = I_A + I_B + I_C$). These elements have greater sensitivity than the phase overcurrent protection, but care should be taken to set the pickup above normal standing unbalance due to conditions such as unequal single phase load. Ranges and increments are presented in Figure 5-29.

The curves available for use are shown in Table 5-2. An additional one cycle time delay should be added to these curves in order to obtain the recloser operating time. The operating time is fixed at 20 times pickup and above since the inverse time-current characteristics saturate at this level. 51N #2 through 51N #5 Screens are identical to 51N #1.

Figure 5-29   Function 51N Residual Inverse Time Overcurrent Setpoints Screen

51G   GROUND INVERSE TIME OVERCURRENT

The 51G Ground Inverse Time Overcurrent function provides protection against ground faults and operates on the single phase current input I_G. These elements have greater sensitivity than the phase overcurrent protection, but care should be taken to set the pickup above normal standing unbalance due to conditions such as unequal single phase load.

The curves available are listed in Table 5-2. 51G #2 through 51G #5 Screens are identical to 51G #1.

Figure 5-30   Function 51G Ground Inverse Time Overcurrent Setpoints Screen

51GS   SENSITIVE GROUND INVERSE TIME OVERCURRENT

The 51GS Sensitive Ground Inverse Time Overcurrent function provides protection against ground faults and operates on the single phase current input I_G. These elements are extremely sensitive to provide protection for high impedance grounded and ungrounded distribution systems. Care should be taken to set the pickup above normal standing unbalance due to conditions such as unequal single phase load.

The curves available are listed in Table 5-2. 51GS #2 through 51GS #5 Screens are identical to 51GS #1.
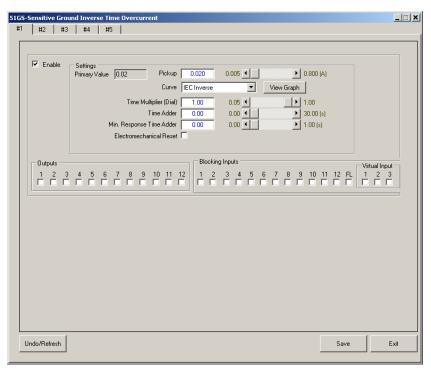
Figure 5-31   Function 51GS Sensitive Ground Inverse Time Overcurrent Setpoints Screen

59   PHASE OVERVOLTAGE

Use the 59 Phase Overvoltage function to provide overvoltage protection. The recloser control provides overvoltage protection functions with four definite-time setpoints, any one of which can be programmed to trip the recloser or send an alarm.

Ranges and increments are presented in Figure 5-32. 59 #2 through 59 #4 Screens are identical to 59 #1.

■**NOTE:** When the Auto Restoration function is enabled, select "Auto Restore" to include the 59 Phase Overvoltage function in the Auto Restoration logic.

Figure 5-32   Function 59 Phase Overvoltage Setpoints Screen (Three-Phase Ganged Operation)

59PP   PHASE-TO-PHASE OVERVOLTAGE

Use the Phase-to-Phase Overvoltage function (59PP) to detect overvoltage conditions. This element operates on Phase-to-Phase voltage (i.e., V$_{AB}$, V$_{BC}$, V$_{CA}$). Therefore it does not pickup due to ground effects such as ground potential rise or zero-sequence mutual coupling. Ranges and increments are presented in Figure 5-33. 59PP can only be enabled when the VT configuration is line-to-ground.

*Figure 5-33   Function 59PP Phase-to-Phase Overvoltage Setpoints Screen
(Three-Phase Ganged Operation)*

59N   RESIDUAL OVERVOLTAGE

The 59N function responds only to the fundamental frequency component, rejecting all other harmonic components. This overvoltage function is only available when the recloser control is configured for Line-to-Ground or Line-Ground-to-Line-Line voltage. The operating signal is the arithmetic sum of the three phase-to-ground voltages (i.e., $V_A + V_B + V_C$).

Ranges and increments are presented in Figure 5-34.

Figure 5-34   Function 59N Residual Overvoltage Setpoints Screen

59I   PEAK OVERVOLTAGE

Most overvoltage relays operate based on the RMS value of voltage. There is, however, a system phenomenon known as ferroresonance which may occur on an islanded system with induction generators and capacitor banks. At this time, the voltage waveform will be expected to be very rich in harmonics, to the extent that it is possible that the peak voltage of the nonsinusoidal wave will be dangerously high, even though the RMS value of the same voltage remains in an acceptable range.

Because it is necessary to describe voltage for this purpose in terms of the peak value of voltage (not RMS), it is convenient to define the pickup in per unit of the peak of the nominal sinusoidal waveform. The per unit (PU) value is based on the RMS nominal voltage setting. For example, a pickup equal to 100 percent for 120 volts nominal will operate at the following instantaneous peak voltage: $120 \, V \cdot \sqrt{2} = 170 \, V$.

Figure 5-35   Function 59I Peak Overvoltage Setpoints Screen (Three-Phase Ganged Operation)

59VZ1   OVERVOLTAGE

A single phase overvoltage element is available when voltage input Vz1 is setup as 27/59. Use the 59Vz1 Overvoltage function to detect any condition causing long term overvoltage on the line side of the recloser control.

The function 59Vz1 can detect ground faults if the voltage input Vz1 is connected across a broken delta VT and provides protection for ground faults on the distribution feeder (Figure 5-36). Set the pickup setting higher than the maximum standing system unbalance voltage. The time delay should be set to coordinate with downstream ground relaying. Ranges and increments are presented in Figure 5-37.
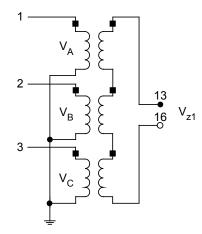
Figure 5-36   Vz1 Broken Delta Connection
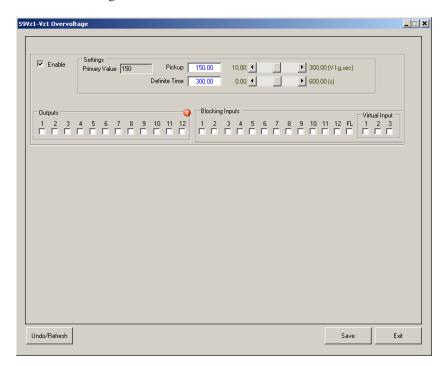
Figure 5-37   Function 59Vz1 Overvoltage Setpoints Screen

67P   PHASE DIRECTIONAL OVERCURRENT

> ■**NOTE:** 67P is intended to only operate for balanced three-phase faults. 67Q
> operates for phase-to-phase and phase-to-phase-to-ground while 67N (or
> 67G) operates for single phase-to-ground faults. Therefore, every fault type
> is covered (i.e., AG, BG, CG, AB, BC, CA, ABG, BCG, CAG and ABC).

Each Phase Directional Overcurrent element can be configured as Directional or Non-Directional. Forward or Reverse looking operation depends upon the setting for the Maximum Sensitivity Angle. Figure 5-38 "Phase Directional Overcurrent – Directional Characteristic" illustrates an element to be forward looking for three-phase faults on a distribution feeder. 60 to 70 degrees is a typical line angle for a distribution feeder. The polarizing voltage is V_1.

Each directional element has two Maximum Sensitivity Angles. Figure 5-39 illustrates the directional characteristic when the second Maximum Sensitivity Angle is enabled. This is the umbrella characteristic and adds security to the directional decision.

Up to five independent Phase Directional Overcurrent elements can be enabled, 67P#1 through 67P#5. Therefore, they can be used for high speed communication assisted tripping schemes that require both forward and reverse looking elements. Ranges and increments are presented in Figure 5-40.

Minimum Polarizing Voltage

The directional element can be selected to either trip or block trip when the polarizing voltage drops below a settable level (i.e., 2.0-10.0 percent of the nominal voltage). Use this option to prevent unwanted operation for cases such as a fault in the non-trip direction coupled with a bolted short circuited located at the VT secondary terminals.

Definite/Inverse Time Characteristic

Each element can be configured to operate on a Definite or an Inverse Time Overcurrent characteristic. Refer to Function 51P, Phase Inverse Time Overcurrent, earlier in this section, for detailed information regarding the Inverse Time Overcurrent settings.
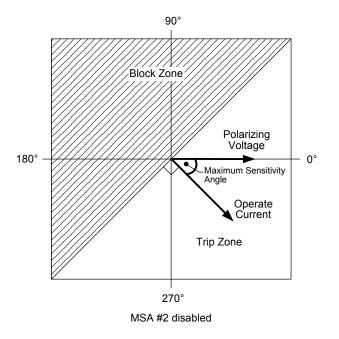
Figure 5-38   67P Phase Directional Overcurrent – Directional Characteristic

90°

Blocking Zone

Zero Sensitivity Line

V$_{POL}$

180°   0°

MSA #1

MSA #2

MSA #2

I$_{OP}$

Trip Zone

270°

V$_{POL}$ = Polarizing Voltage (Reference)
I$_{OP}$ = Operate Current
MSA #1 = Maximum Sensitivity Angle #1
MSA #2 = Maximum Sensitivity Angle #2
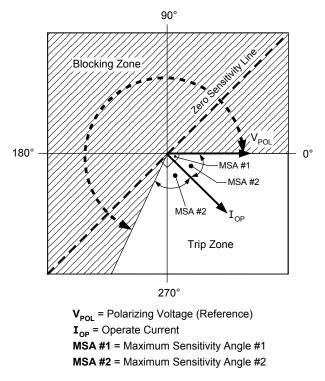
Figure 5-39   67P Directional Characteristic with Second Maximum Sensitivity Angle Enabled

*Figure 5-40   Function 67P Directional Overcurrent **Definite Time** Setpoints Screen*

*Figure 5-41   Function 67P Directional Overcurrent **Inverse Time** Setpoints Screen*

67 Directionality View

Selecting "Directionality View" in any 67 Function screen will display a graphical representation of the entered Maximum Sensitivity Angle(s).

■**NOTE:** MSA #1 cannot be deselected, but the value may be changed.
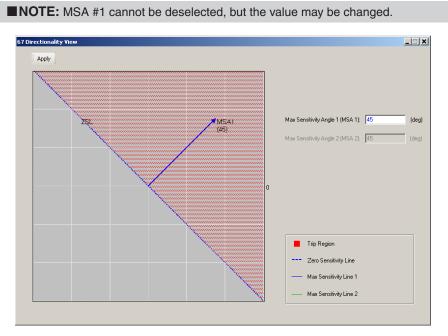
Figure 5-42   Function 67 Directionality View Default MSA #1
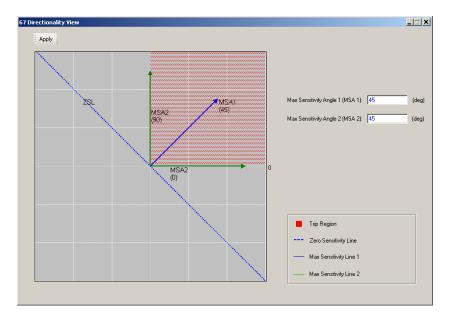
Figure 5-43   Function 67 Directionality View Default MSA #1 and MSA #2

67N   RESIDUAL DIRECTIONAL OVERCURRENT

Each Residual Directional Overcurrent element can be configured as Directional or Non-Directional. Forward or Reverse looking operation depends upon the setting for the Maximum Sensitivity Angle. Figure 5-46 "Residual Directional Overcurrent – Directional Characteristic" illustrates setting an element to be forward looking for ground faults on a distribution feeder. 60 to 70 degrees is a typical line angle for a distribution feeder. Figure 5-47 shows the phase relationship between the residual voltage and current for a single line-to-ground fault in the forward direction with respect to the recloser control on a purely reactive system.

Up to five independent Residual Directional Overcurrent elements can be enabled, 67N #1 through 67N #5. Each directional element has two Maximum Sensitivity Angles. Figure 5-39 illustrates the directional characteristic when the second Maximum Sensitivity Angle is enabled. This is the umbrella characteristic and adds security to the directional decision.

The choice of polarizing voltage is positive-sequence voltage, negative-sequence voltage, zero-sequence voltage or the single phase auxiliary voltage Vz_1. Typically the zero-sequence voltage is the best choice.

The operate current is the arithmetic sum of the three phase currents ($I_N = I_A + I_B + I_C$). Ranges and increments are presented in Figure 5-44.

Minimum Polarization Voltage

The directional element can be selected to either trip or block trip when the polarizing voltage drops below a settable level (i.e., 2.0–10.0 percent of the nominal voltage). Use this option to prevent unwanted operation for cases such as heavy load coupled with standing system unblance. Choose settings for reliability (trip) if the recloser control is located in a weak area of the power system (i.e., low magnitude residual voltage during ground faults).

Definite/Inverse Time Characteristic

Each element can be configured to operate on a Definite or an Inverse Time Overcurrent characteristic. Refer to Function 51N, Residual Inverse Time Overcurrent, earlier in this section, for detailed information regarding the Inverse Time Overcurrent settings.

*Figure 5-44   67N Residual Directional Overcurrent **Definite Time** Setpoints Screen*

*Figure 5-45   67N Residual Directional Overcurrent **Inverse Time** Setpoints Screen*
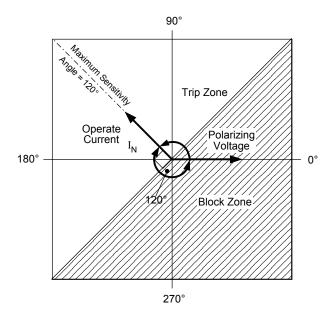
Figure 5-46   67N Residual Directional Overcurrent – Directional Characteristic
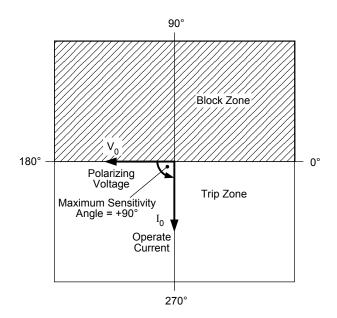
Figure 5-47   67N Residual Directional Overcurrent – Polarizing Voltage (V₀) and Operate Current (I₀) for Forward Single Line-To-Ground Fault – Pure Reactive System

67G   GROUND DIRECTIONAL OVERCURRENT

Each Ground Directional Overcurrent element can be configured as Directional or Non-Directional. Forward or Reverse looking operation depends upon the setting for the Maximum Sensitivity Angle. Figure 5-48 "Ground Directional Overcurrent – Directional Characteristic" illustrates setting an element to be forward looking for ground faults on a distribution feeder. 60 to 70 degrees is a typical line angle for a distribution feeder. Figure 5-49 shows the phase relationship between the polarizing voltage and ground current for a single line-to-ground fault in the forward direction with respect to the recloser control on a purely reactive system.

Up to five independent Ground Directional Overcurrent elements can be enabled, 67G #1 through 67G #5. Each directional element has two Maximum Sensitivity Angles. Figure 5-39 illustrates the directional characteristic when the second Maximum Sensitivity Angle is enabled. This is the umbrella characteristic and adds security to the directional decision.

The choice of polarizing voltage is positive-sequence voltage, negative-sequence voltage, zero-sequence voltage or the single phase auxiliary voltage Vz_1. Typically the zero-sequence voltage is the best choice. Vz_1 is also suitable if there is a three-phase VT with a broken delta secondary. Refer to Figure 5-50 "Broken Delta Polarizing Source".

The operate current is the single phase current input I_G. Ranges and increments are presented in Figure 5-51.

Minimum Polarization Voltage

The directional element can be selected to either trip or block trip when the polarizing voltage drops below a settable level (i.e., 2.0–10.0 percent of the nominal voltage). Use this option to prevent unwanted operation for cases such as heavy load coupled with standing system unblance. Choose settings for reliability (trip) if the recloser control is located in a weak area of the power system (i.e., low magnitude residual voltage during ground faults).

Definite/Inverse Time Characteristic

Each element can be configured to operate on a Definite or an Inverse Time Overcurrent characteristic. Refer to Function 51G, Ground Inverse Time Overcurrent, earlier in this section, for detailed information regarding the Inverse Time Overcurrent settings.

Figure 5-48   67G Ground Directional Overcurrent – Directional Characteristic
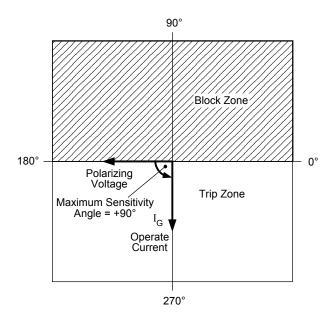
Figure 5-49   67G Ground Directional Overcurrent – Polarizing Voltage and Operate Current (I_G) for Forward Single Line-To-Ground Fault – Pure Reactive System

$$V_{z1} = V_A + V_B + V_C$$
$$= 3V_0$$

(Refer to Figure 7-2)
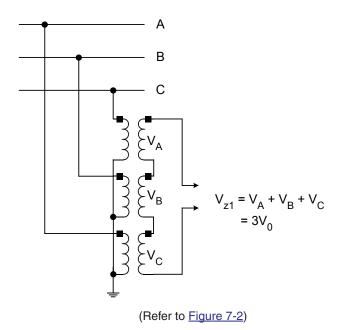
Figure 5-50   67G Broken Delta Polarizing Source

*Figure 5-51   67G Ground Directional Overcurrent **Definite Time** Setpoints Screen*

*Figure 5-52   67G Ground Directional Overcurrent **Inverse Time** Setpoints Screen*

67Q   NEGATIVE-SEQUENCE DIRECTIONAL OVERCURRENT

Each Negative-Sequence Directional Overcurrent element can be configured as Directional or Non-Directional. Forward or Reverse looking operation depends upon the setting for the Maximum Sensitivity Angle. Figure 5-55 "Negative-Sequence Directional Overcurrent – Directional Characteristic" illustrates setting an element to be forward looking for unbalanced faults on a distribution feeder. 60 to 70 degrees is a typical line angle for a distribution feeder. Figure 5-56 shows the phase relationship between the polarizing voltage and negative sequence current for an unbalanced fault in the forward direction with respect to the recloser control on a purely reactive system.

Up to five independent Negative Sequence Directional Overcurrent elements can be enabled, 67Q #1 through 67Q #5. Each directional element has two Maximum Sensitivity Angles. Figure 5-39 illustrates the directional characteristic when the second Maximum Sensitivity Angle is enabled. This is the umbrella characteristic and adds security to the directional decision.

The choice of polarizing voltage is positive-sequence voltage, negative-sequence voltage, zero-sequence voltage or the single phase auxiliary voltage Vz_1. Negative-sequence voltage is the best choice.

The operate current is the negative-sequence current I_2. Ranges and increments are presented in Figure 5-53.

Minimum Polarization Voltage

The directional element can be selected to either trip or block trip when the polarizing voltage drops below a settable level (i.e., 2.0–10.0 percent of the nominal voltage). Use this option to prevent unwanted operation for cases such as heavy load coupled with standing system unblance. Choose settings for reliability (trip) if the recloser control is located in a weak area of the power system (i.e., low magnitude negative-sequence voltage during unbalanced faults).

Definite/Inverse Time Characteristic

Each element can be configured to operate on a Definite or an Inverse Time Overcurrent characteristic. Refer to Function 51Q, Negative-Sequence Inverse Time Overcurrent, earlier in this section, for detailed information regarding the Inverse Time Overcurrent settings.

*Figure 5-53   67Q Negative-Sequence Directional Overcurrent **Definite Time** Setpoints Screen*

*Figure 5-54   67Q Negative-Sequence Directional Overcurrent **Inverse Time** Setpoints Screen*
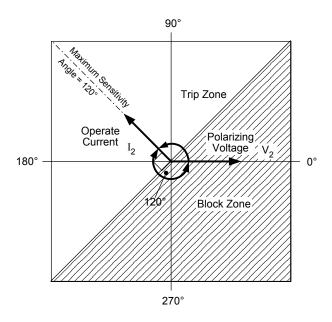
Figure 5-55   67Q Negative-Sequence Directional Overcurrent – Directional Characteristic
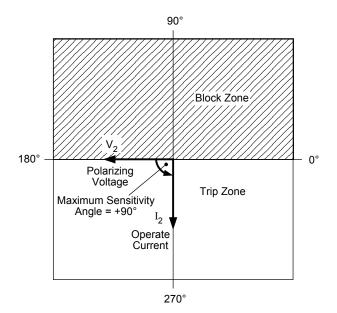
*Figure 5-56   67Q Negative-Sequence Directional Overcurrent – Polarizing Voltage (V₂) and
Operate Current (I₂) for Forward Unbalanced Fault – Pure Reactive System*

67GS   SENSITIVE GROUND DIRECTIONAL OVERCURRENT

Each Sensitive Ground Directional Overcurrent element can be configured as Directional
or Non-Directional. Forward or Reverse looking operation depends upon the setting for the
Maximum Sensitivity Angle. 60 to 70 degrees is a typical line angle for a distribution feeder.

Up to five independent Sensitive Ground Directional Overcurrent elements can be enabled,
67GS #1 through 67GS #5. Each directional element has two Maximum Sensitivity Angles.
Figure 5-39 illustrates the directional characteristic when the second Maximum Sensitivity
Angle is enabled. This is the umbrella characteristic and adds security to the directional
decision.

The choice of polarizing voltage is positive-sequence voltage, negative-sequence voltage,
zero-sequence voltage or the single phase auxiliary voltage Vz_1. Typically the zero-sequence
voltage is the best choice. Vz_1 is also suitable if there is a three-phase VT with a broken delta
secondary. Refer to Figure 5-50 "Broken Delta Polarizing Source".

The operate current is the single phase current input I_G. Ranges and increments are
presented in Figure 5-57.

Minimum Polarization Voltage

The directional element can be selected to either trip or block trip when the polarizing voltage
drops below a settable level (i.e., 2.0–10.0 percent of the nominal voltage). Use this option
to prevent unwanted operation for cases such as heavy load coupled with standing system
unblance. Choose settings for reliability (trip) if the recloser control is located in a weak area
of the power system (i.e., low magnitude residual voltage during ground faults).

Definite/Inverse Time Characteristic

Each element can be configured to operate on a Definite or an Inverse Time Overcurrent
characteristic. Refer to Function 51GS, Sensitive Ground Inverse Time Overcurrent, earlier
in this section, for detailed information regarding the Inverse Time Overcurrent settings.

*Figure 5-57   67GS Sensitive Ground Directional Overcurrent **Definite Time** Setpoints Screen*

*Figure 5-58   67GS Sensitive Ground Directional Overcurrent **Inverse Time** Setpoints Screen*

81   FREQUENCY

Frequency protection (81) provides overfrequency and underfrequency protection. This function has four independent elements with their own pickup and time delay settings. The overfrequency mode is automatically selected when the frequency setpoint is programmed higher than the nominal frequency (50 or 60 Hz). The underfrequency mode is selected when the setpoint is programmed below the nominal frequency. Ranges and increments are presented in Figure 5-60. Sample settings of the 81 function are shown in Figure 5-61.

Undervoltage Block
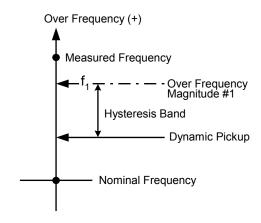
When Undervoltage Blocking is enabled, the frequency protection is automatically disabled when the measured positive-sequence voltage is less than the pickup setting.
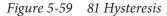
Minimum Load

When Minimum Load is enabled, the frequency protection is automatically disabled when the measured current is less than the pickup setting.

Hysteresis

Hysteresis makes the frequency protection more sensitive once it has picked up, as illustrated in Figure 5-59 for the case of an overfrequency operation. The effective pickup is dynamically adjusted to prevent contact chatter.

Figure 5-59   81 Hysteresis

In order to prevent mis-operation during switching transients, the time delay should be set to greater than five (5) cycles. 81 #2 through 81 #4 Screens are identical to 81 #1.

■**NOTE:** When the Auto Restoration function is enabled, select "Auto Restore" to include the 81 Frequency function in the Auto Restoration logic.

Figure 5-60   Function 81 Frequency Setpoints Screen
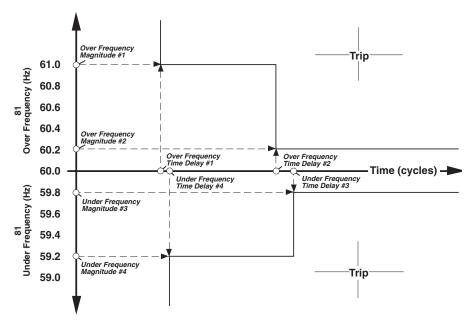
Figure 5-61   Example of (81) Frequency Trip Characteristics

81R   RATE-OF-CHANGE OF FREQUENCY

The Rate-of-Change of Frequency function (81R) can be used for load shedding or tripping applications. The function is automatically disabled during unbalanced system events such as faults and other disturbances when the function detects negative-sequence voltage (2.5 V or greater). The pickup and definite time delay settings should be based on simulation studies. The ranges and increments are shown in Figure 5-62.

Minimum Voltage

The positive-sequence voltage (V_1) measured by the recloser must be equal to or greater than this threshold to enable 81R.

Figure 5-62   81R Rate-of-Change of Frequency Setpoints Screen

CLP   COLD LOAD PICKUP

The Cold Load Pickup Setpoints dialog screen (Figure 5-65) contains alternate settings for the 50P, 50N, 50G/GS, 51P, 51N, 51G/GS and High Current Lockout functions. These alternate settings override the existing settings of any enabled function after the recloser is tripped open and the lockout condition has been active for a period greater than the user programmed period (Time Locked out to Activate Cold Load).

> ■**NOTE:** The Cold Load Pickup overrides the existing settings for ALL elements of 50P, 50G(GS), 50N, 51P, 51G(GS) or 51N when selected. High Current Lockout "Override Phase HCL" overrides the existing HCL settings for 50P. High Current Lockout "Override Ground/Neutral HCL" overrides the existing HCL settings for 50G(GS) or 50N.

As illustrated in Figure 5-63, I_{rst} (Percentage of the existing Minimum Trip Phase Current Setting) and I_{grst} (Percentage of the existing Minimum Trip Ground Current Setting) are the phase and ground settings below which the recloser control will revert to the existing settings prior to any CLP override. I_{rst} and I_{grst} comparisons are performed independently.

Pickup time is the minimum time period the measured ground current (I_g) or phase current (I_{ph}) must be less than the I_{grst} and I_{rst} settings respectively before exiting the Cold Load Pickup period. The Active Duration setting is the maximum period for the Cold Load Pickup logic. Cold Load Time is the maximum duration of the Cold Load Pickup session.

In addition, when Cold Load Pickup is in effect, all 46 and 67 functions (46DT, 46IT, 67P, 67G/GS, 67N, 67Q) are de-activated as long as the cold load condition is in effect.

Minimum Trip is defined as the minimum pickup setpoint value of all the participating overcurrent functions in Trip Sequence #1. In the example shown in Figure 5-64, for Phase current it will be the minimum pickup value for 50P#1, 51P#1, 46IT#1, 67P#4 and 67Q#2. Note sequence component is treated as a phase function. For Ground/Residual current it will be the minimum of 50N#2, 50GS#5, 51GS#4. If no overcurrent elements are selected for phase current protection, then Phase current restore evaluation is disabled. Similarly if there are no Residual and/or Ground Overcurrent functions selected, then the Ground/Residual restore evaluation is disabled.
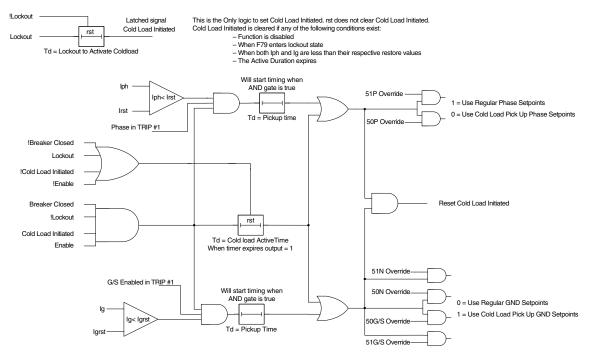
Figure 5-63   Cold Load Pickup Logic Diagram

Figure 5-64   Cold Load Pickup Minimum Trip Example

Figure 5-65   Function CLP Cold Load Pickup Setpoints Screen

RESTORE   AUTO RESTORATION

The Auto Restoration feature recloses the breaker after a loadshed caused by a non-overcurrent function (under/overvoltage or under frequency). Auto Restoration will ONLY occur when the trip is caused by the user selected F27 undervoltage, F59 overvoltage and/or F81 frequency functions.

Auto Restoration is initiated when the following conditions exist:

- The function is enabled.
- The breaker has been tripped by the user selectable function 27, 59 or 81.
- No overcurrent faults occurred.

Both voltage and frequency restoration can be enabled simultaneously and can work independently of each other, or BOTH restoration conditions must exist before the load is restored (i.e., CLOSE command is issued).

When the frequency (or both the frequency AND the voltage if "Use Voltage AND Frequency Restoration Limits" is enabled) meets the restoration limits, the recloser starts the Schedule Timer.

When the frequency (or both the frequency AND the voltage) no longer meets the restoration limits, the schedule timer will stop counting, but does **not** reset. The accumulated schedule time to this point is retained and when the frequency (or both the frequency AND the voltage) is back within the set limits, the Schedule Timer resumes its count.

When the Schedule Timer times out and the frequency (or both the frequency AND the voltage) meets the restoration limits for the period defined by the transient Time Delay, auto restoration is permitted and the CLOSE command issued.

The restoration attempt is abandoned if the recloser is not able to successfully restore the load within the user-defined restoration Abort Time following a loadshed event. Restoration is cancelled when an external CLOSE command is received. If an External command is received when the fault is not yet cleared, the control will close the breaker which will cause a protection function to trip again. The abort timer is reset when the CLOSE command is received. Therefore, when it trips again the abort timer will also re-start.

Auto Restoration Settings:

Mode – The undervoltage Mode can be set to either "Three-Phase" or "Single-Phase".

High Voltage Limit – The High Voltage Limit setting is a secondary value expressed in volts. The setting should be less than the lowest overvoltage pickup setting. This setting should be set at a value that the measured voltage must not exceed to allow restoration. This setting is applicable to both voltage and frequency elements.

Low Voltage Limit – The Low Voltage Limit setting is a secondary value expressed in volts. The setting should be greater than the highest undervoltage pickup setting. This setting should be set at a value that the measured voltage must exceed to allow restoration. This setting is applicable to both voltage and frequency elements.

High Frequency Limit – The setting should be less than the highest High Frequency pickup setting. This setting should be set at a value that the measured frequency must not exceed to allow restoration.

Low Frequency Limit – The setting should be greater than the lowest Low Frequency pickup setting. This setting should be set at a value that the measured frequency must exceed to allow restoration.

Schedule Time – The setting in seconds, delays the restoration. If an instantaneous restoration is desired, then a setting of zero should be entered. This setting is applicable to both voltage and frequency elements. When a restoration is authorized and the Schedule Timer begins timing, if the restoration is rescinded then the timing of the Schedule Timer will halt and resume from that point when restoration is re-started.

Abort Time – The Abort Time setting is the time period (seconds) that the control will abandon the restoration attempt if the restoration has not been completed within the Schedule Time. This setting is applicable to both voltage and frequency elements.

Time Delay – The Time Delay setting is the time period that the measured voltage and/or frequency must be within the High and Low Voltage and High and Low Frequency settings to authorize a restoration sequence.

Figure 5-66   Auto Restoration Setpoints Screen
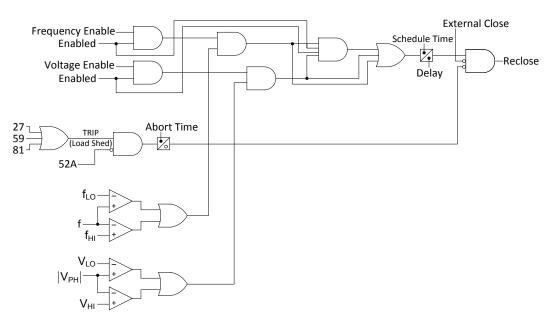
Figure 5-67   Auto Restoration Conceptual Logic Diagram

HLT   HOT LINE TAG

When the recloser control is put into the Hot Line Tag mode utilizing the front panel pushbutton, the following occurs:

- The Hot Line Tag LED illuminates
- The Recloser Disable LED illuminates
- The settings for the selected overcurrent functions (50P, 51P, 50G/GS, 51G/GS)* are loaded
- Auto-Reclose is blocked and goes to lockout following the first trip
- Sequence coordination is bypassed
- Block closing via the front panel HMI
- Block remote closing (e.g., SCADA)
- Hot Line Tag has precedence over Cold Load Pickup

*These overcurrent settings are loaded into whichever profile is active when the recloser control is in the Hot Line Tag mode.

Figure 5-68   HLT – Hot Line Tag Setpoints Screen

IPSlogic

The recloser control provides eight logic functions and associated IPSlogic. These functions can be used in conjunction with IPSlogic to expand the capability of the unit by allowing the user to define customized operating logic.

The IPSlogic Function can be programmed to perform any or all of the following tasks:

- Change the Active Setting Profile
- Activate Hot Line Tag
- Trip/Lockout All Phases, Phase A, Phase B or Phase C
- Activate a front panel HMI Custom Message
- Close an Output Contact
- Be assigned as a Virtual Input

Since there are eight IPSlogic Functions per setting profile, depending on the number of different relay settings defined, the scheme may provide up to 64 different logic schemes.

IPSlogic Setpoints

To setup the IPSlogic Setpoints perform the following:

1. From the IPScom Main Menu, select **Setup/Setpoints** or select the Setpoints icon from the quick access toolbar. IPScom will display the Setpoints dialog screen (Figure 5-1).
2. Select "IPS–IPSlogic". IPScom will display the "IPSlogic Setpoints" dialog screen (Figure 5-69).
3. Assign the Time Delay, Virtual IPSlogic Outputs, Outputs, Blocking Inputs and Virtual Inputs as desired.

Figure 5-69   IPSlogic Setpoints Screen

IPSlogic Custom Messages

IPSlogic allows the user to setup Custom Messages to be displayed on the HMI at the top level main screen (where user lines and alarms are displayed).

The order in which the messages are displayed is as follows:

- Display Alarms
- Display sequential Custom Messages, or User Lines when the Custom Messages buffer is empty.

There are 8 Custom Messages available from IPSlogic. Each message can have two lines. The 8 Custom Messages are shared among all 8 profiles.

Select the **Edit IPSlogic Messages** box to display Figure 5-70 which allows the user to edit the Custom Message text.
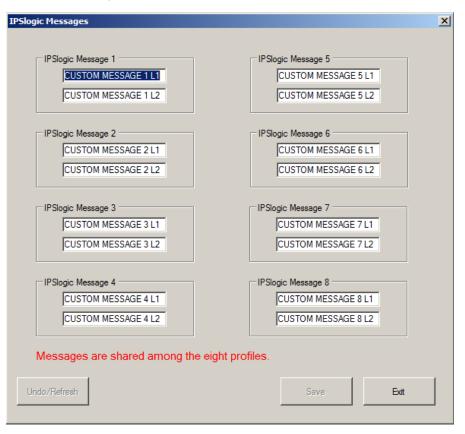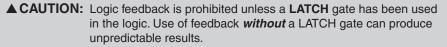
Figure 5-70   Edit IPSlogic Messages Dialog Screen

Programming IPSlogic

> ▲ **CAUTION:** Logic feedback is prohibited unless a **LATCH** gate has been used in the logic. Use of feedback *without* a LATCH gate can produce unpredictable results.

1. From the IPSlogic Setpoints dialog screen, select "IPSlogic". IPScom will activate the IPSlogic Editor Screen (Figure 5-71) which provides an interactive worksheet for programming the desired IPSlogic.

2. Use the various elements of the IPSlogic Editor interactive worksheet to program the IPSlogic.
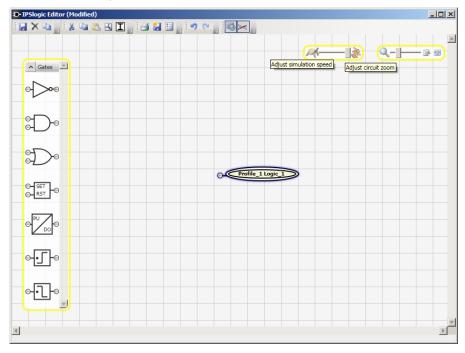
Figure 5-71   IPSlogic Editor Screen

IPSlogic Editor Main Toolbar

Hovering the mouse over the Main Toolbar icons will display a tootip and keyboard shortcut (if applicable). Refer to the following diagram for icon definitions (Figure 5-72).
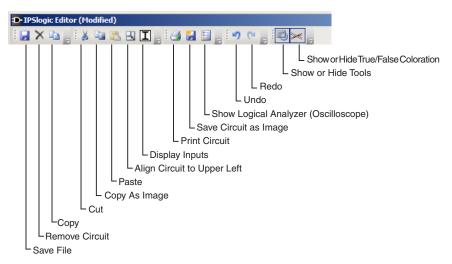
Figure 5-72   IPSlogic Editor Main Toolbar Icons Diagram

Add Inputs

Select the "Display Inputs" icon from the IPSlogic Editor toolbar to display the Input Selection dialog screen (Figure 5-73). Use this tool to filter, select and insert inputs onto the worksheet.

Figure 5-73   IPSlogic Editor Input Selection Dialog Screen

Add Logic Gates

Use the "Gates" tool to drag and drop logic gates onto the worksheet. Hovering over a Gate will display a Tooltip with the Gate description.
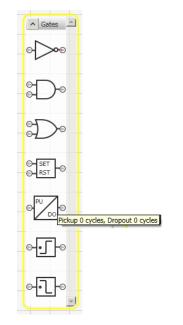
Figure 5-74   IPSlogic Editor "Gates" Tool

Show Logical Analyzer (Oscilloscope)

Use this tool to display the Oscilloscope for the currently selected IPSlogic circuit.
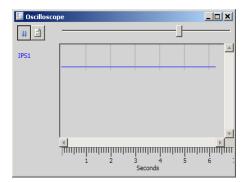
Figure 5-75   IPSlogic Editor Oscilloscope Tool

LEL   LOAD ENCROACHMENT LOGIC

Load encroachment logic (LEL) is a built in logic that when enabled, will supervise the 51P Time Overcurrent elements. Select "Use LEL" from the 51P Setpoints dialog screen to enable LEL supervision as defined in the LEL Setpoints dialog screen (Figure 5-77). When Supervision Output is "false", all enabled 51P functions with "Use LEL" selected are effectively deactivated.

The Directional Element is provided by one of the 67P functions. Positive Sequence Voltage and Current are used to calculate the impedance.
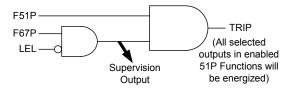
Figure 5-76   Load Encroachment Logic Diagram

Figure 5-77   Load Encroachment Logic Setpoints Screen
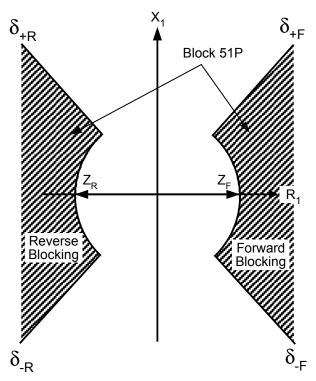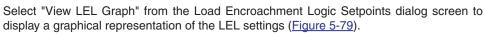
Figure 5-78   Load Encroachment Logic Application

Load Encroachment Logic Graph

Select "View LEL Graph" from the Load Encroachment Logic Setpoints dialog screen to display a graphical representation of the LEL settings (Figure 5-79).
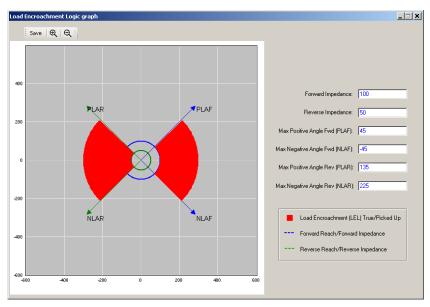
Figure 5-79   Load Encroachment Logic Graph

LEL Directional Element F67

The LEL Directional Element setting selects which F67 Element is to be used to detect directionality. When "is asserted" is selected, this means that no directionality exists for the supervision gate.

When one directional element is chosen, the corresponding F67 function is not available for other protective functionality.

As shown in the following example, the Directional Element "is from F67 #1" (Figure 5-80) is selected. The corresponding F67P #1 Setpoints dialog screen (Figure 5-81) will reflect the following restrictions and behavior:

- F67#1 is automatically enabled.
- Outputs and Blocking Inputs have all the checkboxes unchecked and grayed out to avoid accidental user selection.
- The "Action if below" setting is "Block Trip" and grayed out.
- Definite Time is zero and Curve Selection Option is Definite Time by default.
- Enabled Direction is set to directional and grayed out.
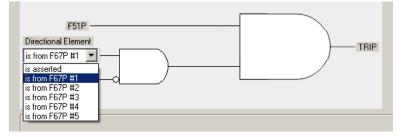
Figure 5-80   LEL Directional Element F67P #1 Selected

Figure 5-81   LEL Directional Element F67P #1 Resultant Setpoints Screen

BM   BREAKER MONITOR

The control records the amount of current carried in each phase each time the breaker trips. The control's operational logic employs an algorithm integrating the amount of unfiltered AC current at the time of each trip and the number of operations (close to open) as a method of calculating wear. The control uses this information to establish wear setpoints derived in accordance with ANSI C37.61-1973, and initiates a signal to assert an alarm or modify the recloser operation parameters, such as reducing the total number of reclose operations.

The Breaker Monitor feature calculates an estimate of the per-phase wear on the breaker contacts by measuring and integrating the current through the breaker contacts as an arc. The pickup value (kA$^{1.5}$, kA, kA^2 cycles) is based on the Timing Selection Method chosen in the Breaker Accumulator Status window. The per-phase values are added to an accumulated total for each phase, and then compared to a user-programmed threshold value. When the threshold is exceeded in any phase, the relay can set a programmable output contact.

The accumulated value for each phase can be displayed. The Breaker Monitoring feature requires an initiating contact to begin accumulation, and the accumulation begins after the set time delay.

Figure 5-82   Breaker Monitor Setpoints Screen

Breaker Accumulator Status – Monitor Submenu

When the Breaker Monitor function is enabled, the Breaker Accumulator Status screen (Figure 5-83) will display the Accumulator Status based on the Breaker Monitor Timing selection of the active profile. Preset Accumulator values for each phase may also be set.

Figure 5-83   Breaker Accumulator Status Screen

5.2   Common Setpoints

The following setpoints are NOT part of the individual profile. These are independent setpoints common to all profiles. These setpoints are located in the "Common Setpoints" tab of the Setpoints dialog screen.

Figure 5-84   Common Setpoints Screen

When the Interface Type has been selected to "M-2411" in the System Setup Dialog Screen, the Common Setpoints screen will include an additional selection box for the M-2411 Monitor ().

Figure 5-85   Common Setpoints with M-2411 Interface Type

PSBC   IED POWER SUPPLY/BATTERY CHARGER MONITOR

IED Power Supply Monitor

The Power Supply Monitor alarms on delay when the input voltage to the Power Supply is too high or too low. Table 5-3 lists the setting ranges.

■**NOTE:** The measured Power Supply Voltage is an internal signal produced by the internal power supply of the unit.

Power Supply	Low Voltage	High Voltage
Low Voltage DC	18.0 – 60.0 Volts	18.0 – 100.0 Volts
High Voltage DC	60.0 – 250.0 Volts	60.0 – 315.0 Volts
High Voltage AC	60.0 – 250.0 Volts	60.0 – 280.0 Volts

Table 5-3   Power Supply Monitor Voltage Setting Ranges

Battery Charger Monitor

Select the installed Battery Charger Model from the dropdown list:

- M-2032A
- G & W VRC
- BECO Drive (M-2034)

The Battery Charger Monitor function must be enabled to access the IPScom "Battery Charger Monitoring" screen in the Monitor menu. The Monitoring parameters are determined by the selected Battery Charger Model.

Figure 5-86   PSBC – IED Power Supply/Battery Charger Monitor Setpoints Screen

TCCM   TRIP/CLOSE CIRCUIT MONITORING

Trip Circuit Monitor

The physical connections for this circuit are shown in . A selectable opto-isolated input monitors the dc trickle current flowing through the trip circuit. If the trip coil fails as an open circuit, then continuity is interrupted. An alarm occurs when there is no dc trickle current and the recloser is closed. If a trip occurs or the recloser is open, then the monitoring is disabled.

■**NOTE:** The input selected for Trip Coil Monitor should be configured when the active state is Open.

Figure 5-87   TCM/CCM – Trip/Close Circuit Monitor Setpoints Screen
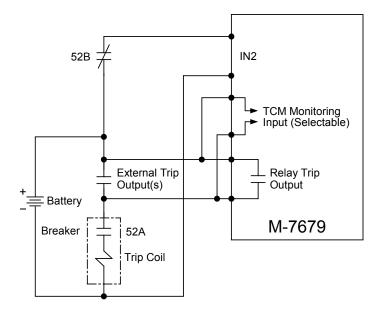
Figure 5-88   Trip Circuit Monitoring Input

Close Circuit Monitor

Figure 5-87 displays the settings for the CCM function.

The CCM inputs are provided for monitoring the continuity of the close circuits. Close circuit monitoring is performed in the active breaker status only. Both the DC supply and continuity for the close circuit is monitored. If a close coil is detected as being open for the time delay then transfers are blocked.

This function is blocked when the breaker is open, as indicated by 52b Contact Input. If the CCM is monitoring a lockout relay, a 86 Contact Input should be used to block when the lockout relay is tripped. This function is also blocked when any output contact is closed.

The output of the Close Circuit Monitoring function can be programmed as an alarm to alert maintenance personnel.

CCM Connection Considerations

External connections for the Close Circuit Monitoring function are shown in Figure 5-89 and Figure 5-90. Beckwith Electric Co., Inc. recommends that the M-7679 CCM circuit be connected directly to the close coil, bypassing the anti-pump "Y" relay portion of the close circuit as illustrated in Figure 5-89.

The type of anti-pump "Y" relay that is often found within the close coil circuit is generally a high impedance type, such as an IDEC RR Series Power Relay. The relay coil resistance is high (approximately 8.5 to 10K Ohms), and it's rated pickup current is 11 to 13 mA, ±15% at 20° C. However, the relay's dropout voltage is approximately 10 to 15% of rated 110 Vdc voltage. Therefore, the anti-pump relay may be held up and would not drop out until the leakage current is reduced to approximately 2 mA.

> ▲ **CAUTION:** Connecting the M-7679 Close Coil Monitor (CCM) in parallel with other relay CCMs in the close coil circuit where the anti-pump "Y" relay is not bypassed may not provide reliable breaker closing operations.

If the close coil circuit configuration does not support connecting the CCM directly to the close coil (Figure 5-90), then Beckwith Electric Co., Inc. does not recommend connecting the M-7679 CCM in parallel with other relay CCMs. If two or more CCMs are connected to the close coil circuit, there is a high probability that the anti-pump "Y" coil will not drop out. Therefore, only one CCM, either a M-7679 or other relay should be used in the close coil circuit to provide reliable breaker closing operation.
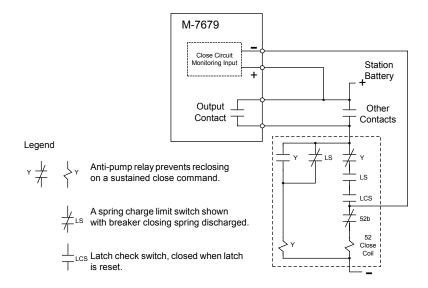
Figure 5-89   Recommended Close Circuit Monitoring Input Configuration
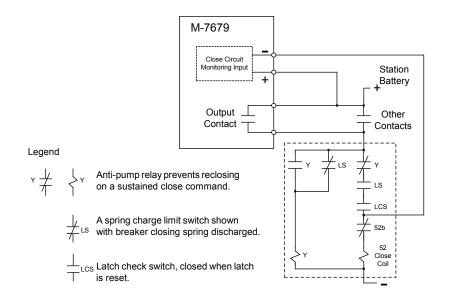
Figure 5-90   Close Circuit Monitoring Input Configuration with Anti-pump Relay Not Bypassed

60FL VT FUSE LOSS

Some functions may operate inadvertently when a VT fuse is blown or an event causes a loss of one, two, or all three potentials to the relay. Provisions are incorporated for both internal and external potential loss detection and blocking of user defined functions. The logic scheme and options are illustrated in <u>Figure 5-91</u>.

Internal Fuse Loss Detection Logic

The internal logic scheme available will detect a loss of one, two, or all three potentials.

For the loss of one or two potentials, positive and negative-sequence quantities are compared. The presence of negative-sequence voltage in the absence of negative-sequence current is considered to be a fuse loss condition. An additional supervising condition includes a minimum positive-sequence voltage to assure voltage is being applied to the recloser.

For the loss of all three phase potentials, a comparison of the three-phase voltage is made to the three-phase current. If all three potentials are less than 0.05 V_{nom}, all three currents are less than 1.25 I_{nom}, and I_1 is greater than 0.33A, then a three-phase loss of potential is declared. A seal-in circuit is provided to ensure a three-phase fuse loss condition is not declared during a three-phase fault if the fault current should decay below 1.25 I_{nom}.
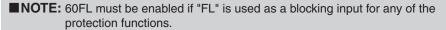
Protection functions in the recloser control may be blocked by assertion of the fuse failure logic (FL), in each function's respective setting screen. Typical functions to block on a loss of potential event are 27, 32, 59, 67, 79 and 81.

60FL is enabled to alarm. The internal FL logic is always enabled and available to block selected protection functions.

A frequency check element is included in the fuse loss detection logic to avoid erroneous alarms. The 60FL alarm will be inhibited if the measured frequency is greater than 55.12 Hz (F_U) or less than 44.88 Hz (F_L) for a 50 Hz system. The 60FL alarm will be inhibited if the measured frequency is greater than 65.12 Hz (F_U) or less than 54.88 Hz (F_L) for a 60 Hz system. The Frequency Band Detector does not inhibit the 60FL three-phase loss of potential logic since it is not possible to calculate the frequency during this condition.

External Fuse-Loss Function

For the specific application where the preceding logic cannot be considered reliable (such as when current inputs to the recloser control are not connected, or sustained positive-sequence current during fault conditions is minimal), an external fuse failure function can be used as an input to the recloser control. The external 60FL function contact is connected across any control/status input. The recloser protection functions are then blocked by an assertion of the control/status input (INx), as a blocking function in each function's respective setting screen.

■ **NOTE:** 60FL must be enabled if "FL" is used as a blocking input for any of the protection functions.
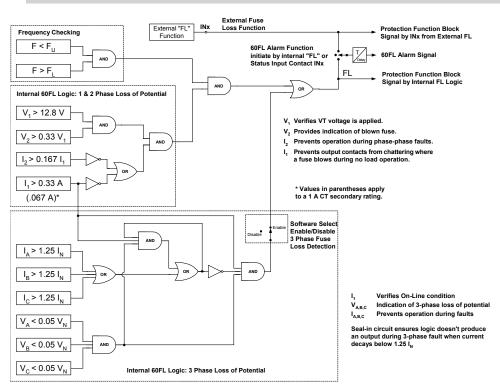
Figure 5-91   Fuse Loss (60FL) Function Logic

Figure 5-92   Function 60FL Fuse Loss Setpoints Screen

THD/TDD   TOTAL HARMONIC DISTORTION/TOTAL DEMAND DISTORTION

The THD/TDD feature consists of two setpoints that can be used for alarm or tripping. Selecting THD or TDD will apply the selection to the entire element even when Individual Phase is enabled. For example, Element #1 can use TDD and Element #2 can operate on THD or both elements can use TDD or THD. When Individual Phase is enabled in an element the TDD or THD selection will apply to all three phases.

THD/TDD includes the ability to trigger the Sequence of Events recorder (when selected), trigger the Oscillograph (when selected), and display alarm messages on the HMI. The THD setting can be selected to either Current or Voltage, while the TDD setting is only available in Current. Also, individual phases may be selected. The TDD value is also displayed in the SOE viewer and Harmonics display and also can be used as a Smart Button function block.

THD calculation

$$V\ THD = \frac{\sqrt{V_2^2 + v_3^2 + v_4^2 + v_5^2 + ...}}{V_1} \times 100\ \%$$

$$I\ THD = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + I_5^2 + ...}}{I_1} \times 100\ \%$$

TDD calculation

$$I\ TDD = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + I_5^2 + ...}}{I_L} \times 100$$

Where I_L is the maximum demand load current which is a user programmable setting in the **Demand Metering** screen. Only the Total Demand Distortion for current will be calculated for each phase.
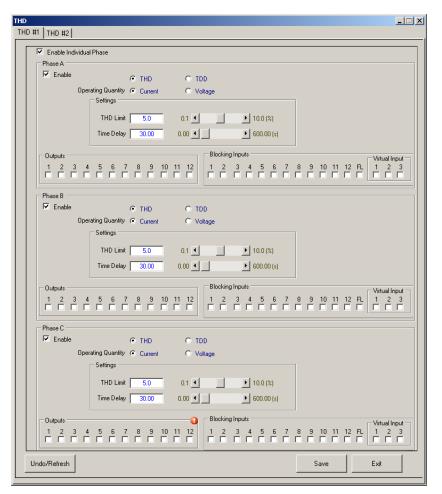
Figure 5-93   THD/TDD Setpoints Screen with Individual Phase Enabled

M2411   M2411 MONITOR

When the Interface Type has been selected to "M-2411" in the System Setup Dialog Screen as shown below, the Common Setpoints screen will include an additional selection box for the M-2411 Monitor. M-2411 is the adapter chassis for the SEL 351P-3/Panacea for HSS reclosers which makes retrofitting simple and easy.

Figure 5-94   M-2411 Interface Type Selected

M-2411 SF6 Pressure Feature

The SF6 pressure sensor provides A/D values of pressure. The M-7679 converts the values to equivalent PSI units. This pressure metering is compared to a Gas Pressure Limit setting, and if the metered value is less than the setting, an alarm will be asserted.

Boost Power Switch

When an AC power loss is detected from the M-2032A, the boost power switch will turn on. When AC is restored, the boost power switch will turn off. The switch stays active for about 2 minutes even if AC is restored sooner.

The boost power switch will also activate during the following conditions:

- Trip
- Close
- Reclose

When any of the above events occur, the boost power switch stays active for the duration of time specified in the Boost Switch Duration setpoint.

Capacitor Voltage Monitor and Charger Control

There are two signals provided from the hardware to monitor trip capacitor charge level and close capacitor charge level:

1. Trip Cap Charge > 80V
2. Close Cap Charge >20 V

When the Trip Cap Charge signal is ON, then both trip and close capacitors are charged above 80V. When Close Cap Charge signal is ON, then the voltage is above 20V, then the firmware will turn on the Charge Control signal, so that the capacitors are charged at a higher charge rate. When the Close Cap Charge signal is OFF, the firmware will turn OFF the Charge Control signal.

Running on Battery During AC Power Loss

The unit will run on 24 Vdc battery when an AC power loss is detected, until the battery voltage drops below the "Minimum battery voltage to turn OFF IED (Vmin Batt)" setting. or the "Power Off Delay After AC Loss" timer setting expires. When any of these conditions are met, the unit will shut itself off.

■ **NOTE:** These settings are available in the PSBC (IED Power Supply/Battery Charger Monitor) Setpoints screen (Figure 5-86).

Figure 5-95   M-2411 Monitor Setpoints Screen

5.3   79 Recloser Function

TRIP AND CLOSE LOGIC

The breaker is tripped independently by any protective function. The 79 automatic recloser function is executed every quarter of a cycle after all the enabled protective functions have been executed at least once. The algorithm of the 79 recloser function is state machine driven. The state machine consists of 12 states distributed within the 4 states outlined in the the IEEE C37.104 [1] standard. Each state is run after the occurrence of a specific event.

As cited from the IEEE C37.104 standard [1], the four states are:

"**Reset State** – the circuit breaker is closed and the auto reclose function is waiting to receive an initiate to start timing to reclose after the breaker opens."

"**Cycle State** – the circuit breaker is open and the auto reclose function is timing toward its set time to close the circuit breaker, OR, the circuit breaker is closed following a successful auto reclose, timing toward its set time to return to the reset state."

"**Lockout State** – the auto reclosing function has advanced through its programmed or set sequence of circuit breaker close operations, and in each case the protective relay has detected a fault and tripped the circuit breaker open again. The circuit breaker is now open and "locked out", meaning that the circuit breaker must now be closed by some other means (local-manual or remote manual)."

"**Power-Up State** – may be used in some auto reclosing relays when the relay is powered up. In this state the auto reclose relay assesses its inputs to determine the state of the breaker and the auto reclose initiate and supervision inputs. After assessing these inputs, the auto reclose relay typically changes to the Reset State if the breaker is closed and no other inputs are active, or to the Lockout State if the breaker is open or if drive-to-lockout inputs are active."

Figure 5-96 shows the transition state diagram of the recloser.
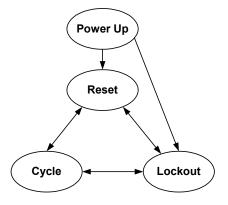
Figure 5-96   Recloser Transition State Diagram

79 Lockout Feature

Prior to entering any state in the state machine (meaning this is executed ahead of every state); the selected functions in the 79 Drive To Lockout are evaluated. The 79 Drive To Lockout functions selection is shown in Figure 5-97.

If the 79 Drive To Lockout detects any lockout condition (any one of the functions selected in the "79 Drive To Lockout" dialog screen has tripped)then the recloser state is set to state 11 (pre lockout state). In state 11 the OPEN command is sent to the breaker and the recloser state is moved to state 12 which is the lockout state.

[1]   *IEEE Guide for Automatic Reclosing of Circuit Breakers for AC Distribution and Transmission Lines*, IEEE Standard C37.104-2012

The High Current Lockout (HCL) applies to the individual Trip Sequence. For example, the #1 HCL when selected will only lockout Trip Sequence #1. The protective element applies to the entire Trip Sequence regardless of which element is chosen. Only one element can be chosen in each protective function. As shown in Figure 5-97, the 27 #3 element will apply to all Trip Sequences, similarly for 32 #1 and 81 #4. For 27 and 32 protective functions, any phase that has operated will lockout the 79 function when selected.
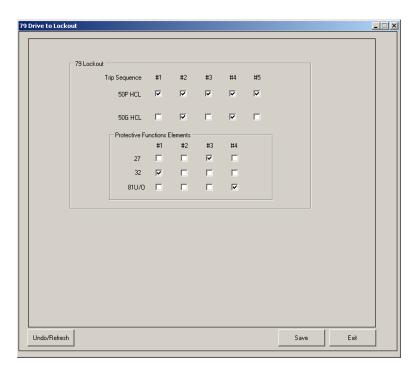
Figure 5-97   79 Drive To Lockout Function Selection Screen

79 Supervision Feature

The 79 Supervisory Functions allow the user to select those functions that when tripped will cause the 79 reclosing operation to be blocked and eventually lockout if the selected supervision functions are still tripped after the supervision time has elapsed. For example, one of the functions that can be selected for supervision is the Undervoltage Bus Side Supervision (27 BSVS). If any undervoltage condition is detected based on the 27BSVS setting, then the recloser will remain in its present state, consequently blocking the close command transmission to the breaker. The recloser state will be set to lockout after the supervision timer expires if the undervoltage condition still exists. Figure 5-98 shows the Supervision Functions selection dialog screen.

The supervision algorithm is executed only during the cycle state. The control will evaluate the condition of the selected supervision functions and determine whether to allow a close operation to occur. The supervision algorithm is executed after the Reclose Timer has expired and before the reclose command is sent to the breaker. If **any** of the selected supervisory functions has tripped, the 79 recloser state will remain the same, thus blocking the reclose operation. For the recloser state to advance, all selected supervisory functions must be in normal state (or dropout) then the recloser state will advance to the next cycle state after sending a close command or the supervision timer has expired, which in this case will cause the recloser state to be driven to lockout. The supervision timer is started when any selected supervisory function has picked up during a given cycle state. The supervision timer is reset after all supervisory functions have gone to dropout in that same given cycle state or after the timer has expired.
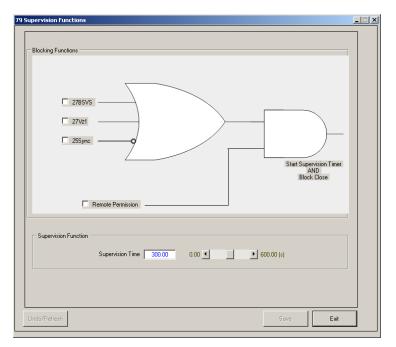
Figure 5-98   Supervision Functions Dialog Screen

Terminology

Important Terminology: The word **deactivate** in the context of the 79 function means that although a protective function is enabled by the user, it is not permitted to run. Vice versa the word activate means the opposite of deactivate.

Breaker Status Truth Table

Breaker status 52A and 52B are used to determine whether the breaker circuit is open or closed. Input 1 is dedicated to monitor 52A and Input 2 is dedicated to 52B or common 52B/69 Lockout. Failure to do so will result in the relay displaying the wrong status and also some protective functions will not perform correctly.

The truth table (Table 5-4) shows how the relay decodes the input levels when Input 2 is configured as 52B.

52A	52B	Breaker Status
Logic 1	Logic 0	CLOSE
Logic 0	Logic 1	OPEN
Logic 0	Logic 0	error
Logic 1	Logic 1	error

Table 5-4   Relay Status Input Levels

The truth table (Table 5-5) shows how the relay decodes the input levels when Input 2 is configured as common 52B/69 Lockout.

52A	52B/69	Breaker Status
Logic 1	Logic 0	CLOSE
Logic 0	Logic 1	OPEN
Logic 0	Logic 0	LOCKOUT
Logic 1	Logic 1	error

Table 5-5   Relay Status Input Levels with Common 52B/69 Lockout

F79 Automatic Recloser Function State Machine

The following describes the actions performed in each state and how they are distributed within the four states described in the IEEE C37.104 standard:

State 1 (Reset State/Power Up)

This state is an initial transitional state. This state is run to initialize the state machine. The following actions are performed:

1. Activation of selected functions in the Trip Sequence #1 setting.
2. Initialization of all 79 function timers to known values.
3. If the control just powered up, then check if breaker is open. If open then lockout. Else proceed to next state.
4. If control not just powered up, then check for lockout condition.

State 2 (Reset State)

The following actions are performed in this state:

1. Check for Hot Line Tag, if active skip check for Sequence coordination.
2. Check sequence coordination if enabled then evaluate any selected protective function (Trip Sequence #1) for dropout. If sequence coordination function generates an event, then skip next state to keep pace with the downstream recloser. The next state to be executed is state 4.
3. Check if any activated functions have timed out. If true advance to next state. Else remain in same state.

State 3 (Cycle State with Reclose Count = 1)

This state produces the first reclose attempt after the Reclose delay (phase fault or ground fault delay) has expired. The following actions are performed:

1. If Hot Line Tag command was received, then the next state will be the lockout state. Note: Lockout will happen in the next quarter cycle.
2. Check if the Phase count or Ground count has been exceeded. See "Phase Count and Ground Count Exceeded Lockout Algorithm" later in this section. If this check is true, then relay will lockout within the next quarter cycle.
3. When the reclose timer expires then perform Reclose Supervision as described above and if permitted, then send the CLOSE command. Advance to the next state and also activate selected functions defined in Trip Sequence #2 setting.
4. If CLOSE operation is blocked, remain in state 3 until either supervision timer has expired.

State 4 (Cycle State)

This state is run a quarter of a cycle after the CLOSE command has been sent. The following actions are performed:

1. If there is no prior pending overcurrent fault, then run the reset timer and check it against the reset time (auto) setting. If expired reset state to initial state 2. This means there is no longer any fault.
2. Check sequence coordination if enabled, then evaluate any selected protective function (Trip Sequence #2) for dropout. If sequence coordination function generates an event then skip next state.
3. Check if any activated protective functions have timed out and tripped. If true advance to next state. Else remain in same state.

State 5 (Cycle State with Reclose Count = 2)

The following actions are performed:

1. If sequence coordination is enabled, then check if there is any on-going selected overcurrent operation.
2. Check if the Phase Count or Ground Count has been exceeded. See "Phase Count and Ground Count Exceeded Lockout Algorithm" later in this section. If this check is true, then relay will lockout within the next quarter cycle.

3. When the reclose timer expires then perform Reclose Supervision as described above and if permitted, then send the CLOSE command. Advance to the next state and also activate selected functions defined in Trip Sequence #3 setting.

4. If CLOSE operation is blocked, remain in state 5 until either supervision timer has expired.

State 6 (Cycle State)

This state is run a quarter of a cycle after the CLOSE command has been sent. The following actions are performed:

1. If there is no prior pending overcurrent fault, then run the reset timer and check it against the reset time (auto or manual) setting. If expired reset state to initial state 2.

2. Check sequence coordination if enabled, then evaluate any selected protective function (Trip Sequence #3) for dropout. If sequence coordination function generates an event then skip next state.

3. Check if any activated functions have timed out. If true advance to next state. Else remain in same state.

State 7 (Cycle State with Reclose Count = 3)

The following actions are performed:

1. If sequence coordination is enabled then check if there is any on-going selected overcurrent operation.

2. Check if the Phase Count or Ground Count has been exceeded. See "Phase Count and Ground Count Exceeded Lockout Algorithm" later in this section. If this check is true, then relay will lockout within the next quarter cycle.

3. When the reclose timer expires then perform Reclose Supervision as described above and if permitted, then send the CLOSE command. Advance to the next state and also activate selected functions defined in Trip Sequence #4 setting.

4. If CLOSE operation is blocked, remain in state 7 until either supervision timer has expired.

State 8 (Cycle State)

This state is run a quarter of a cycle after the CLOSE command has been sent. The following actions are performed:

1. If there is no prior pending overcurrent fault, then run the reset timer and check it against the reset time (auto or manual) setting. If expired reset state to initial state 2.

2. Check sequence coordination if enabled then evaluate any selected protective function (Trip Sequence #4) for dropout. If sequence coordination function generates an event then skip next state.

3. Check if any activated functions have timed out. If true advance to next state. Else remain in same state.

State 9 (Cycle State with Reclose Count = 4)

The following actions are performed:

1. If sequence coordination is enabled then check if there is any on-going selected overcurrent operation.

2. Check if the Phase Count or Ground Count has been exceeded. See "Phase Count and Ground Count Exceeded Lockout Algorithm" later in this section. If this check is true, then relay will lockout within the next quarter cycle.

3. When the reclose timer expires then perform Reclose Supervision as described above and if permitted, then send the CLOSE command. Advance to the next state and also activate selected functions defined in Trip Sequence #5 setting.

4. If CLOSE operation is blocked, remain in state 9 until either supervision timer has expired.

State 10 (Cycle State)

This state is run a quarter of a cycle after the CLOSE command has been sent. The following actions are performed:

1. If there is no prior pending overcurrent fault, then run the reset timer and check it against the reset time (auto or manual) setting. If expired reset state to initial state 2.

2. Check if any activated functions have timed out. If true advance to next state. Else remain in same state.

State 11 (pre Lockout)

This is an intermediate lockout state. For safety purposes an OPEN command is always sent to the breaker. Advance to the final lockout state (state 12).

State 12 (Lockout)

The 79 function will remain in this state indefinitely waiting for a RESET command. Upon receiving the RESET command, the state machine is reset to state 2. After receiving the RESET signal the Reset from Lockout Timer is ready to be started by the manual close operation.
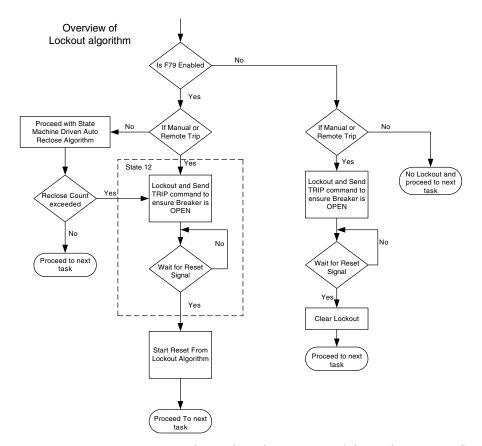
Figure 5-99   Function 79 Lockout Algorithm Diagram (Three-Phase Ganged)
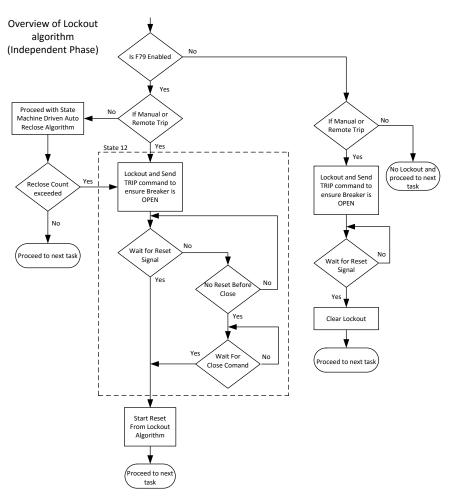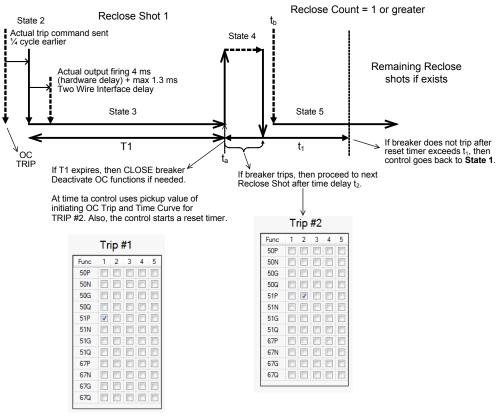
Figure 5-100   Function 79 Lockout Algorithm Diagram (Independent Phase)
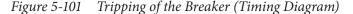
STAGE	DESCRIPTION	CLOSE LED	LED A	LED B	LED C	TRIP LED
1	RECLOSER IS CLOSED AND READY	RED	RED*	RED*	RED*	OFF
2	RECLOSER IS OPEN AND LOCKOUT	OFF	AMBER*	AMBER*	AMBER*	GREEN
3	RECLOSER OPEN	OFF	GREEN*	GREEN*	GREEN*	GREEN
4	RECLOSE CLOSED AND RESET AFTER LOCKOUT TIMER STARTS	RED	RED*	RED*	RED*	OFF
5	AFTER AUTO RECLOSE RESET TIMER STARTS	RED	RED*	RED*	RED*	OFF

* In Independent Phase Operation, the LED is phase dependent and can be Green, Red or Amber.

Table 5-6   Default Front Panel LED Display During a Reclose Cycle

Figure 5-101   Tripping of the Breaker (Timing Diagram)

Phase Count and Ground Count Exceeded Lockout Algorithm

The 79 function is driven to lockout if the following logic is true:

Regardless of ground precedence setting, if the reclose count exceeds both the phase count and the ground count, then the relay will initiate LOCKOUT sequence. If Ground Precedence is selected then the relay will follow the following logic:

If reclose count exceeds only the ground count AND a ground overcurrent function has operated, then initiate LOCKOUT sequence. If reclose count exceeds only the phase count AND an overcurrent phase function has operated AND no ground overcurrent function has operated, then initiate LOCKOUT sequence.
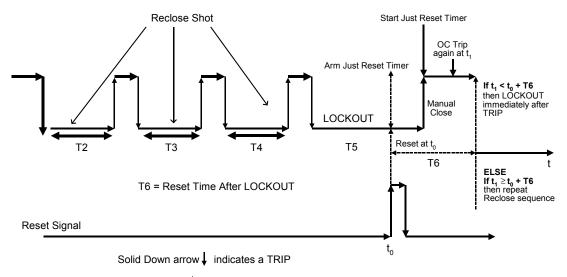
If ground precedence is not selected, then the following logic is applied:

If reclose count exceeds only the ground count AND no overcurrent phase function has operated AND ground overcurrent function has operated, then initiate LOCKOUT sequence. If reclose count exceeds only the phase count AND phase overcurrent has operated, then initiate LOCKOUT sequence.

Sequence Coordination

In case there are multiple reclosers which operate in serial connections, the Sequence Coordination feature prevents unnecessary trip of source-side recloser by Overcurrent element due to load-side fault. When this feature is enabled and the fault is restored to normal state by load-side recloser during source-side recloser time-delayed operation, source-side recloser only increments the reclosing counts without tripping. However, source-side recloser performs tripping at the last reclosing count. If the reclosing function is disabled, Sequence Coordination function is no longer carried out.

A sequence coordination event is generated when a selected overcurrent function has pickup and then dropped out before the delay timer has expired (before the function operates).

Reclose Shot

Start Just Reset Timer

OC Trip again at t_1

Arm Just Reset Timer

If $t_1 < t_0 + T6$ then LOCKOUT immediately after TRIP

Manual Close

LOCKOUT

T2   T3   T4   T5

Reset at t_0

T6   t

T6 = Reset Time After LOCKOUT

ELSE If $t_1 \geq t_0 + T6$ then repeat Reclose sequence

Reset Signal

t_0

Solid Down arrow ↓ indicates a TRIP

Solid Up arrow ↑ indicates a CLOSE

Figure 5-102   Reset Time from Lockout after Manual Close
(Replace Reset Time after Manual Close)

The Table 5-4 timing diagram explains how the Reset Time from lockout after manual close works. When the Recloser function is in LOCKOUT state, a reset signal is necessary to reset the state machine to state 1. When the reset signal is received, the M-7679 will arm a timer (Just Reset) which is defined by the "Reset Time After Lockout" setting. The actual manual closure of the breaker will cause the timer to start counting. If an overcurrent (OC) trips after a manual close, and if this event happens within the Reset Time after lockout setting, the 79 will LOCKOUT immediately. Else if the trip event happens after the timer has expired, the entire programmed trip sequence will be repeated accordingly.

External Commands

■**NOTE:** This feature must be enabled in the System Setup screen (Figure 5-126).

When enabled, the M-7679 can detect external commands (external close or external trip) and will take action similar to Trip-Lockout and Close front panel commands to its lockout state based on the received external command.

External Close Command

To detect an external close, the relay has to be in trip and lockout state. In this trip and lockout state, if the relay detects an external close (a state change on 52a/52b inputs), then it will reset the lockout.

External Trip Command

To detect an external trip, the relay has to be in close state and in any of the following Reclose States: 0, 1, 3, 5, 7 or 9. In this close state, if the relay detects an external trip (a state change on 52a/52b inputs), then it will issue a Trip and Lockout Command.

The relay can be configured as:
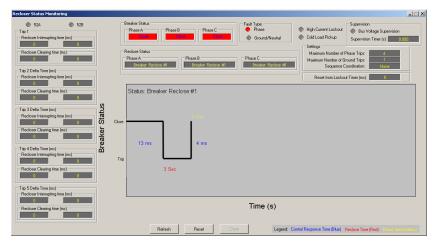
- Both 52a – 52b
- Only 52a
- Only 52b

Only the configured input state change dictates the external Trip/Close command algorithm.

F79 RECLOSER STATUS MONITORING

Selecting **Monitor/Recloser Monitoring** from the IPScom main menu displays the Recloser Status Monitoring screen which allows real time monitoring of the recloser. See Figure 5-103 and Figure 5-104 for situational examples of the status monitoring screen.

Example #1: First reclose sequence with an overcurrent current function timing to operate. Fault type is a phase fault as indicated.

Figure 5-103   Recloser Status Monitoring Screen – Example #1

Example #2: All 4 reclose sequence occurred and LOCKOUT condition.
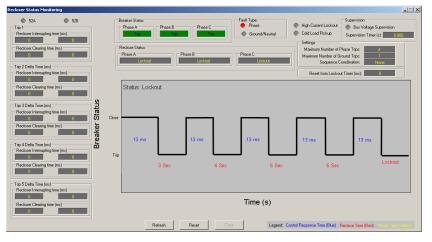
Figure 5-104   Recloser Status Monitoring Screen – Example #2

79 RECLOSER RELAY SETPOINTS

The Recloser Relay dialog screen allows the user to set the Reclosing Sequence and Reclose Interval. The Reclosing Sequence is an extension of the single Reclosing Operation. When a breaker opens and closes automatically, it will continue until the specified count is reached. Any overcurrent fault will cause a trip after the trip time expires, at which time the 79 function will start the Reclose Interval.

At the end of the Reclose Interval the control will automatically send a close command to the breaker. This process will continue until the maximum number of trips is reached or until the fault clears, whichever occurs first. Once the maximum number of trips is reached, the control will automatically be placed in Lockout and prevent further operation until the unit is reset.

The Recloser Control has sequence coordination available to prevent fast curve trips due to faults beyond downstream reclosers. Ranges and increments are presented in Figure 5-105 through Figure 5-109.

Figure 5-105   79 Recloser Relay (Three-Phase Ganged Operation) Setpoints Screen

Figure 5-106   79 Recloser Relay (Independent Phase Operation) Setpoints Screen

79 Trip Reclose Sequence
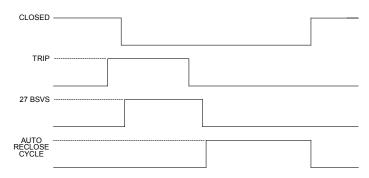
The Trip Reclose Sequence dialog screen (Figure 5-107) allows the user to select the protection functions which will increment the Auto-Reclose cycle for up to 5 Reclose Trips.

Figure 5-107   Function 79 Sequence – Trip Reclose Sequence

27 Bus Side Voltage Supervision Setpoints

Bus Side Voltage Supervision blocks reclosing until the bus voltage rises above the pickup setting. Figure 5-108 illustrates how the Bus Side Voltage Supervision works. If the voltage does not come back before the supervision timer expires, then the reclosing logic automatically goes to lockout.

Figure 5-108   Auto Reclose Single Shot Timing with 27BSVS Enabled

Figure 5-109   Recloser Relay Function 27 Bus Side Voltage Supervision Setpoints

5.4   Recloser Wizard

The M-7679 includes both advanced setup dialog screens and a Recloser Wizard to setup the 79 Recloser Functions. Each method provides both the advanced users and less frequent users with an intuitive user friendly interface.

■**NOTE:** See **Section 5.5 Independent Phase Operation** for detailed information regarding the Recloser Wizard with Independent Phase Capable Option.

The Recloser Wizard feature is a tool to help novice users setup the M-7679 and configure the 79 Automatic Recloser functions with the minimum necessary settings to allow the recloser to function properly.

The Recloser Wizard is launched from the Setup/Recloser Wizard menu selection which displays the first Recloser Wizard "Common Settings" dialog screen (Figure 5-111). The Common Settings dialog screen is the first in a series of seven successive dialog screens that when completed result in a basic recloser Settings Profile. The Recloser Wizard dialog screens include:

- Recloser Common Settings
- Description of Profile
- Phase Overcurrent Settings
- Ground Overcurrent Settings
- Cold Load Settings
- Automatic Reclosing Timing
- Navigation Panel

If the cancel button is selected while in any Recloser Wizard screen, IPScom will display a "Settings for the current profile will not be saved" Warning screen (Figure 5-110). Select "Yes", IPScom will not save any changes and will revert back to the existing Function 79 settings that were saved in the Setpoint Profile that was being edited.

Figure 5-110   Recloser Wizard "Cancel" Warning Screen

Recloser Wizard Common Settings Dialog Screen

The Recloser Wizard Common Settings dialog screen (Figure 5-111) allows the user to configure the common system settings of the M7679 Recloser Control. This is equivalent to the Setup/Configuration/Relay/System settings.

Figure 5-111   Recloser Wizard Common Settings Screen

Recloser Wizard Profile Dialog Screen

The Recloser Wizard Profile dialog screen (Figure 5-112) provides the user with the capability to edit the User Lines associated with each individual profile defined by the "Setting Profile to Create" entry. The User Lines can be used for a circuit description or a settings description. the "Setting Profile to Create" selection indicates which profile the user is currently configuring.

Figure 5-112   Recloser Wizard Profile Screen
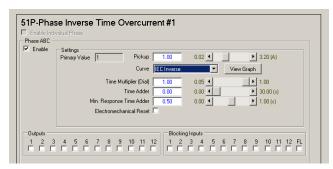
Recloser Wizard Phase Overcurrent Settings Screen

The Recloser Wizard Phase Overcurrent Settings dialog screen (Figure 5-113) allows the user to select the Overcurrent Functions that initiate a Recloser Trip signal when the Minimum Trip Setting is exceeded. Each Trip sequence includes dedicated overcurrent protective function such as 50P and 51P and a High Current Lockout (HCL) function. Each 50P and 51P is an element of the recloser protective functions and the HCL function is internal to the F79 Automatic Recloser function.

For example, Trip Sequence 1 is dedicated to 50P#1 and 51P#1 elements and so on. Therefore in the example illustrated in Figure 5-113, the 51P will be enabled and the 50P will be disabled (Figure 5-114 and Figure 5-115 respectively).

Figure 5-113   Recloser Wizard Phase Overcurrent Settings Screen
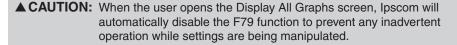
Figure 5-114   51P Function Settings Screen

Figure 5-115   50P Function Settings Screen

Depending on the number of Phase Counts (Figure 5-113), the equivalent number of Trip Sequences are available to the user. The "Enable" check box, when unchecked, will deactivate all of the Overcurrent protective functi"ns.

■**NOTE:** "Deactivate" is defined as the Recloser Wizard software internally disabling the function although the user has enabled the function.

The "Trip Graph" and "Display all Graphs" selections display the individual or collectively, the selected curves in a graphical logarithmic format as shown in Figure 5-116, Display All Graphs.

▲**CAUTION:** When the user opens the Display All Graphs screen, Ipscom will automatically disable the F79 function to prevent any inadvertent operation while settings are being manipulated.
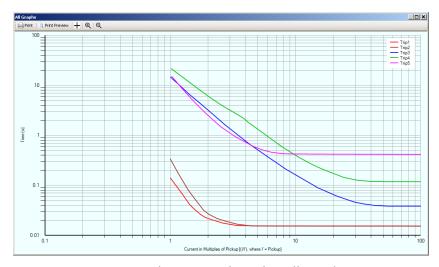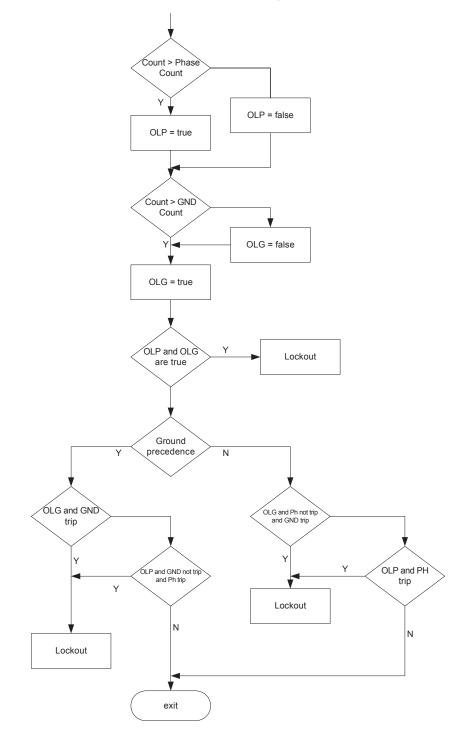
Figure 5-116   Recloser Wizard Display All Graphs Feature

Recloser Wizard Ground Overcurrent Settings Dialog Screen

The Recloser Wizard Ground Overcurrent Settings dialog screen (Figure 5-117) is dedicated to the ground functions and its behavior is similar to the Phase Overcurrent Settings dialog screen.

Figure 5-117   Recloser Wizard Ground Overcurrent Settings Screen

When Ground Precedence is selected, the following flowchart controls the lockout conditions.

Figure 5-118   Ground Precedence Flowchart

Recloser Wizard Residual Overcurrent Settings Dialog Screen

The Recloser Wizard Residual Overcurrent Settings dialog screen (Figure 5-119) is dedicated to the residual functions and its behavior is similar to the Phase Overcurrent Settings dialog screen.
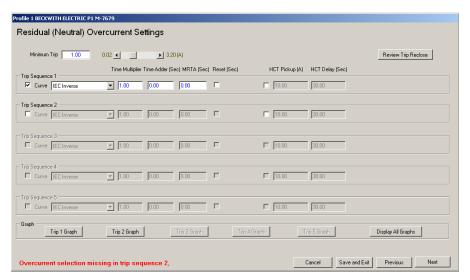
Figure 5-119   Recloser Wizard Residual Overcurrent Settings Screen

Recloser Wizard Cold Load Settings Dialog Screen

The Recloser Wizard Cold Load Pickup Setpoints dialog screen (Figure 5-120) contains alternate settings for the 50P, 50N, 50G/GS, 51P, 51N, 51G/GS and High Current Lockout functions. These alternate settings override the existing settings of any enabled function after the recloser is tripped open and the lockout condition has been active for a period greater than the user programmed period (Time Locked out to Activate Cold Load).

As illustrated in Figure 5-121, I_{rst} (Percentage of the existing Minimum Trip Phase Current Setting) and I_{grst} (Percentage of the existing Minimum Trip Ground Current Setting) are the phase and ground settings below which the recloser control will revert to the existing settings prior to any CLP override. I_{rst} and I_{grst} comparisons are performed independently.

Pickup time is the minimum time period the measured ground current (I_g) or phase current (I_{ph}) must be less than the I_{grst} and I_{rst} settings respectively before exiting the Cold Load Pickup period. The Active Duration setting is the maximum period for the Cold Load Pickup logic. Cold Load Time is the maximum duration of the Cold Load Pickup session.

Figure 5-120   Recloser Wizard Cold Load Settings Screen
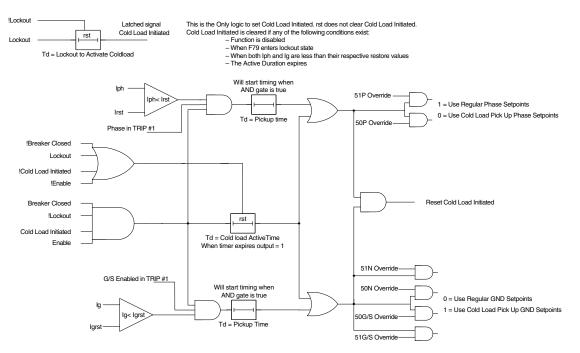
Figure 5-121   Cold Load Pickup Function Logic

Automatic Reclosing Dialog Screen

The Automatic Reclosing Dialog Screen (Figure 5-122) allows the user to modify the time delay between trip and automatic reclose of the breaker. Each type of fault has its own Reclose Interval. Also, the Cold Load Pickup interval can also be configured.
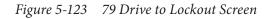
Sequence Coordination can also be configured for the number of desired trips. Note that the trip is consecutive. In cases where there are multiple Reclosers which operate utilizing serial connections, the Sequence Coordination feature prevents unnecessary tripping of source-side Reclosers by instantaneous elements due to a load-side fault. When this feature is enabled, and the detected fault is restored to normal state by the load-side Recloser during the source-side Recloser's time delayed operation, the source-side Recloser will only increment the reclosing counts without tripping. However, the source-side Recloser performs tripping at the last reclosing count. If the reclosing function is disabled, the Sequence Coordination function is no longer carried out.

Selecting the "79 Drive to Lockout" button displays Figure 5-123 which allows the user to configure the 79 Lockout feature. Selecting the "Supervision Functions" button displays Figure 5-124 which allows the user to configure the 79 Drive to Lockout Blocking Functions logic and Supervision Time.

Figure 5-122   Automatic Reclosing Screen

Figure 5-123   79 Drive to Lockout Screen
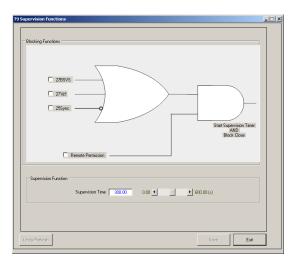
Figure 5-124   79 Supervision Functions Screen

Navigation Panel Dialog Screen

The Navigation Panel Dialog screen (Figure 5-125) allows the user to perform the following:

- Duplicate Function 79 settings
- Configure Function 79 in other profiles
- Review and edit previously configured Function 79 settings

Figure 5-125   Navigation Panel Screen

5.5   Independent Phase Operation Mode

The M-7679 Recloser Control includes (when purchased) three Independent Phase operation modes:

- Three-Phase Trip and Three-Phase Lockout (3T3LO)
- Single-Phase Trip and Three-Phase Lockout (1T3LO)
- Single-Phase Trip and Single-Phase Lockout (1T1LO)
- Disabled

The Independent Phase operation mode selection is available in the 79 Function settings dialog screen (Figure 5-127) and is available in all settings profiles. The Independent Phase operation mode selections are available when the "Recloser Type" has been selected to "Independent Phase Capable" in the Configuration/System Setup dialog screen (Figure 5-126).

Only single-phase settings are available in Independent Phase operation mode with the exception of the 67 and 32 Functions which are not available for individual phases in any of the Independent Phase operation modes. They are three-phase settings only. The directionality in the 67 Function is disabled if single-phase tripping is active.

With the Independent Phase Capable Recloser Type, 69 Switch Operation can be selected in the Configuration/System Setup dialog screen (Figure 5-126) to either "Three Phase" or "Single Phase". When Three Phase is selected, if any one phase is issued a 69 Lockout, then all three phases are Locked Out. If the selection is Single Phase, then the issue of a 69 Lockout on any phase will lockout only that corresponding phase.

Populate Values to All Three Phases Settings

When Independent Phase operation mode is selected to 1T3LO or 1T1LO the user can select "Populate values to all three Phases settings" **before** entering any common settings such that any setting change in one of the phase tabs will be copied to the other two phase tabs. Once all common settings have been entered, deselect this checkbox to enter specific settings for Phases A, B or C.

The "Populate values to all three Phases settings" selection state is remembered until IPScom is closed. If the user closes and re-opens IPScom, the "Populate values to all three Phases settings" state is not remembered. The "Populate values to all three Phases settings" state is not stored in the control.

...

Figure 5-126   System Setup Screen (Independent Phase Capable)

Figure 5-127   Function 79 Recloser Relay Setpoints Screen with Independent Phase Operation

3T3LO – Three-Phase Trip and Three-Phase Lockout

- Any Single Phase Trip will trip all three phases. A Three-Phase Lockout will be initiated if any Phase Count exceeds it's corresponding "Maximum Number of Phase or Ground Trips" setting.

- The 79 Function includes three settings groups internally, one for each phase. The user will see only one setting for the 79 Function and the protective functions, similar to Three-Phase Ganged operation. When settings are entered, the setting will be internally written to all three phases.

- The Trip/Reclose Sequence includes three different internal settings, one for each phase. When settings are entered, the setting will be internally written to all three phases. For example, there are five check boxes in Trip Sequence 1 for 51P (Figure 5-128) which will apply to Phase A, B and C.

- Only three-phase settings are available in all setpoints (such as 27, 59, 50, 51). Individual phase settings are not available.

- When the 69 Lockout input is energized, it will trip all 3 phases and lockout all 3 phases. Some reclosers have 3 separate 69 Lockout handles, one for each phase. If one of the phase handles is pulled to lockout that phase, the relay will send a command to the other two phases to go to lockout.

Figure 5-128   Trip Recloser Sequence with Independent Phase Operation 3T3LO

1T3LO – Single-Phase Trip and Three-Phase Lockout
1T1LO – Single-Phase Trip and Single-Phase Lockout

- **Operation:**
  - **1T3LO** – A single phase trip will trip the corresponding assigned output to trip, and if one phase exceeds the maximum number of trips it was assigned, the control will lockout all three phases. For example, if phase A trips, it will energize Output 1 (Trip Phase A), but also lockout phases A, B and C, if the trip count for any individual phase exceeds its assigned maximum number of trips.
  - **1T1LO** – A single phase trip will trip the corresponding assigned output to trip and lockout that phase, if the trip count for that phase exceeds its maximum trip count setting. For example, if phase A trips, it will trip Output 1 and lockout phase A, when the phase A maximum trip count is exceeded.

- The F79 function includes three individual settings groups, one for each phase. The dialog screen displays three tabs, one for each phase, allowing individual phase settings for the F79 function.
- The Trip Recloser Sequence allows individual phase settings. For example, there are 5 check boxes in Trip sequence 1 for 51P phase A, 5 check boxes for 51P phase B, and 5 check boxes for 51P phase C.
- Only individual phase settings are available in all setpoints (such as 27, 59, 50, 51). Three-phase settings are not available.
- All ground (G or GS) and residual (N) elements are disabled when any phase has tripped in a recloser sequence.
- If Ground Precedence is enabled, then the "Ground Trips to Lockout" setting is used for lockout sequence.
- The Cold Load Pickup function includes the 50, 51 function settings and High Current Lockout. These are three-phase settings.

Synchronized Phase Sequence for 1T3LO

Select this option to enable Synchronized Phase Sequence, which advances the trip sequence of each phase element, for a trip on any phase, so that all elements remain in step. Recloser times of all phases are overridden by the recloser time of the phase that started the sequence. For example, if Phase A trips faster than B and C; and Phase A has a recloser time of 2 seconds, while B and C recloser time = 1 second, then the sequence overrides the recloser times of B and C to 2 seconds.

It is important to note with Synchronized Phase Sequence, if Phase A is assigned 4 trips, Phase B = 3 trips and Phase C = 1 trip; and if Phase A timeout is faster than B and C, then all phases will lockout after the 1st trip, due to Phase C trip count = 1. Therefore, 1T3LO will lockout all three phases.

Synchronized Phase Sequence for 1T1LO

Select this option to enable Synchronized Phase Sequence, which advances the trip sequence of each phase element, for a trip on any phase, so that all elements remain in step. Recloser times of all phases are overridden by the recloser time of the phase that started the sequence. For example, if Phase A trips faster than B and C; and Phase A has a recloser time of 2 seconds, while B and C recloser time = 1 second, then the sequence overrides the recloser times of B and C to 2 seconds.

It is important to note with Synchronized Phase Sequence, if Phase A is assigned 4 trips, Phase B = 3 trips and Phase C = 1 trip; and if Phase A timeout is faster than B and C, then Phase B and C will follow Phase A only until their trip count is reached. In this case, Phase B will follow Phase A until 3 trips and then lockout. Phase C will lockout in 1 Trip. Phase A will continue until it reaches 4 trips.

Ground/Neutral Deactivate

When "Deactivate G/N Functions" is selected in the 79 Function Setpoints Screen (Figure 5-127), the disabling and enabling of protection elements is done during the period that the reclose timer is active. When the reclose timer starts after a phase trip, it will disable the ground/residual elements until the reclose timer expires. Before enabling the ground/residual elements, all three phases must be in the Closed state (Figure 5-129).
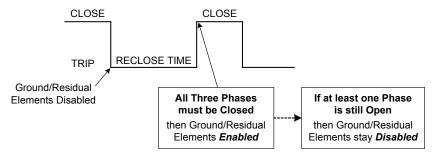
Figure 5-129   Ground Function Active Feature

Phase Identification

If a ground function has tripped and no Phase Overcurrent fault exists, then all three phases will be tripped (no phase information). However, if phase information is available when a ground function has tripped for that phase, then the phase is tripped.

For example, if the 51P Phase A pickup setting is 0.5 A and the fault current is 0.6 A, the 51G Function using a faster curve will trip first. In this case, Phase A will be tripped leaving Phase B and Phase C closed. This condition defines phase identification.

In the previously described scenario, IPScom will automatically set Outputs 1, 5 and 7 to the 51G Function. The 51G Function will apply the above rule for phase identification before issuing a trip command (firing the outputs). Output 1 is for Phase A, Output 5 is for Phase B and Output 7 is for Phase C. Using phase identification, if more than one phase is identified at fault condition, then IPScom wil trip all 3 phases.

Phase and ground sequences advance together. If a ground fault occurs and a phase trips (using phase identification) then both phase and ground count will be same, so they advance in a sequence together.

Trip All Phases for Multi-Phase Faults

■**NOTE:** This option is **ONLY** available with **1T1LO** selection.

Although each phase operates independently and individually; when this option is selected, a phase fault such as 51P or 50P, will monitor the other phases before tripping the output it was assigned. If any other phase is at fault, then all 3 phases are tripped.

Recloser Wizard Independent Phase Mode

The Recloser Wizard is also available with Independent Phase operation. The initial Wizard "Common Settings" screen will indicate the Recloser Type is "Independent Phase Capable" (Figure 5-130). The Wizard "Settings" screen will allow the user to specify the desired Independent Phase operation mode (Figure 5-131). This selection is then displayed in the window title in each subsequent Wizard screen.

The Independent Phase Recloser Wizard copies any settings to ALL three phases. If individual phase settings are required, do not use the Recloser Wizard. Individual phase specific settings must be entered utilizing the 79 Function screen.
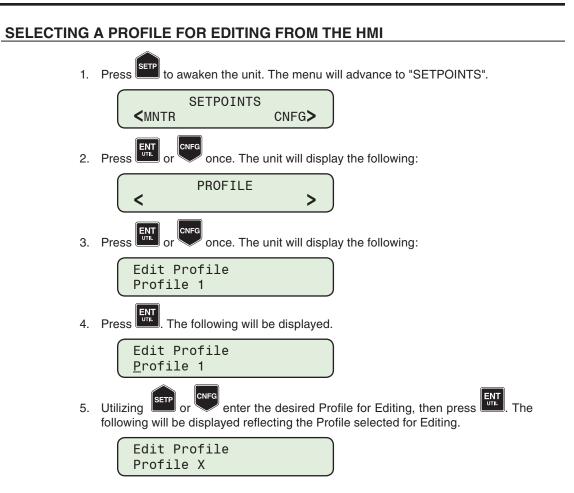
Figure 5-130   Recloser Wizard Common Settings – Independent Phase Capable Recloser Type

Figure 5-131   Recloser Wizard Settings – Independent Phase Capable Recloser Type

5.6   Configuring Setpoints from the HMI

SELECTING A PROFILE FOR EDITING FROM THE HMI

1. Press [SETP] to awaken the unit. The menu will advance to "SETPOINTS".

    ```
              SETPOINTS
       ◄MNTR              CNFG►
    ```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

    ```
               PROFILE
       ◄                      ►
    ```

3. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

    ```
       Edit Profile
       Profile 1
    ```

4. Press [ENT UTIL]. The following will be displayed.

    ```
       Edit Profile
       Profile 1
    ```

5. Utilizing [SETP] or [CNFG] enter the desired Profile for Editing, then press [ENT UTIL]. The following will be displayed reflecting the Profile selected for Editing.

    ```
       Edit Profile
       Profile X
    ```

SETTING OVERCURRENT FUNCTIONS FROM THE HMI
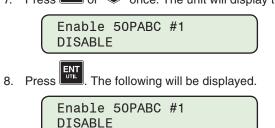
The following Overcurrent function settings are available from the HMI:

- **Phase Functions** – Elements #1 through #5
  - 50P ABC (Three-Phase Ganged) or 50PA, 50PB, 50PC (Independent Phase)
  - 51P ABC (Three-Phase Ganged) or 51PA, 51PB, 51PC (Independent Phase)
  - High Current Lockout – HCLPABC (Three-Phase Ganged) or HCLPA, HCLPB, HCLPC (Independent Phase)

- **Ground (or Sensitive Ground) Functions** – Elements #1 through #5
  - 50G (50GS)
  - 51G (51GS)
  - HCLG (HCLGS) – High Current Lockout, when HCL Operating Current Reference is set to "G"

- **Residual Functions** – Elements #1 through #5
  - 50N
  - 51N
  - HCLN – High Current Lockout, when HCL Operating Current Reference is set to "3I0"
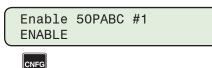
Example: Setting 50P, Element #1, Three-Phase Ganged Operation Mode

The following steps outline the setup of Function 50P, Element #1, Three-Phase Ganged Operation mode. The steps to setup Elements #2 through #5 are similar. The steps to setup Functions 51P, 50G(GS), 51G(GS), 50N, 51N and High Current Lockout are similar.

■**NOTE:** When the Independent Phase Operation Mode is 1T3LO or 1T1LO, functions 50P and 51P are settable for individual Phases A, B and C.

1. Press **SETP** to awaken the unit. The menu will advance to "SETPOINTS".

```
         SETPOINTS
    <MNTR           CNFG>
```

2. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
          PROFILE
    <                   >
```

3. Press **MNTR** or **COMM** as necessary, until the "Overcurrent" screen is displayed.

```
     Overcurrent      P1
    <                   >
```

Ensure that the correct Profile to be edited is displayed in the upper right corner of the screen. If not, refer to the previous section "Selecting a Profile for Editing From the HMI".

4. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
         PHASE ABC
    <                   >
```

5. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
         Element #1
    <                   >
```

6. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
         50PABC #1
    <                   >
```

7. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
    Enable 50PABC #1
    DISABLE
```

8. Press **ENT UTIL**. The following will be displayed.

```
    Enable 50PABC #1
    DISABLE
```

9. Utilizing the arrow pushbuttons select "ENABLE", then press [ENT UTIL]. The following will be displayed.

```
Enable 50PABC #1
ENABLE
```

10. Press [CNFG] as necessary, until the "Pickup 50PABC #1" screen is displayed.

```
Pickup 50PABC #1
 10.00 A
```

11. Press [ENT UTIL]. The following will be displayed.

```
Pickup 50PABC #1
 10.00 A
```
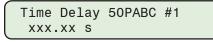
12. Utilizing the arrow pushbuttons enter the desired Pickup, then press [ENT UTIL]. The following will be displayed reflecting the setting that was entered.

```
Pickup 50PABC #1
 xx.xx A
```

13. Press [CNFG] as necessary, until the "Time Delay 50PABC #1" screen is displayed.

```
Time Delay 50PABC #1
  30.00 s
```

14. Press [ENT UTIL]. The following will be displayed.

```
Time Delay 50PABC #1
  30.00 s
```

15. Utilizing the arrow pushbuttons enter the desired Time Delay, then press [ENT UTIL]. The following will be displayed reflecting the setting that was entered.

```
Time Delay 50PABC #1
  xxx.xx s
```
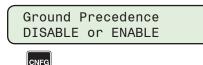
16. Press [EXIT WAKE] as necessary to navigate back through the menu hierarchy. Repeat these steps as necessary to set additional Overcurrent functions.

SETTING 79 RECLOSER RELAY (THREE-PHASE GANGED) FROM THE HMI

1. Press **SETP** to wake the unit. The menu will advance to "SETPOINTS".

```
            SETPOINTS
    <MNTR              CNFG>
```

2. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
            PROFILE
    <                      >
```

3. Press **MNTR** or **COMM** as necessary, until the "F79 Recloser" screen is displayed.

```
        F79 Recloser    P1
    <                      >
```

Ensure that the correct Profile to be edited is displayed in the upper right corner of the screen. If not, refer to the previous section "Selecting a Profile for Editing From the HMI".

4. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
            F79 ABC
    <                      >
```

5. Press **ENT UTIL** or **CNFG** once. The unit will display the following:

```
    Enable
    DISABLE
```

6. Press **ENT UTIL**. The following will be displayed.

```
    Enable
    DISABLE
    ‾
```

7. Utilizing the arrow pushbuttons select "ENABLE" then press **ENT UTIL**. The following will be displayed.

```
    Enable
    ENABLE
```

8. Press **CNFG** as necessary, until the "Ground Precedence" dialog screen is displayed.

```
    Ground Precedence
    DISABLE
```

9. Press **ENT UTIL**. The following will be displayed.

```
    Ground Precedence
    DISABLE
    ‾
```
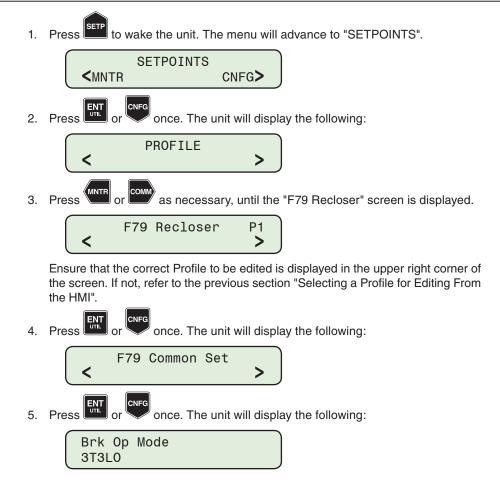
10. Utilizing the arrow pushbuttons select ENABLE or DISABLE, then press [ENT UTIL]. The following will be displayed reflecting the setting that was entered.

```
Ground Precedence
DISABLE or ENABLE
```

11. Press [CNFG] as necessary, to access the remaining F79 ABC settings screens. Follow the above procedure to setup the following:

- Sequence Coordination (None, 1, 2 or 3)
- Maximum Number of Phase Trips (1 to 5)
- Maximum Number of Ground Trips (1 to 5)
- Reset Time after Auto Reclose (1 to 1800 seconds)
- Reset Time from Lockout (0 to 1800 seconds)
- Phase Fault Time Delay for Reclose #1 through #4 (0.01 to 600.00 seconds)
- Ground Fault Time Delay for Reclose #1 through #4 (0.01 to 600.00 seconds)

12. Press [EXIT WAKE] as necessary to navigate back through the menu hierarchy.

SETTING 79 RECLOSER RELAY COMMON SETTINGS (INDEPENDENT PHASE MODE) FROM THE HMI

1. Press [SETP] to wake the unit. The menu will advance to "SETPOINTS".

```
        SETPOINTS
<MNTR              CNFG>
```

2. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
       PROFILE
<                     >
```

3. Press [MNTR] or [COMM] as necessary, until the "F79 Recloser" screen is displayed.

```
    F79 Recloser    P1
<                     >
```

Ensure that the correct Profile to be edited is displayed in the upper right corner of the screen. If not, refer to the previous section "Selecting a Profile for Editing From the HMI".

4. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
    F79 Common Set
<                     >
```

5. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
Brk Op Mode
3T3LO
```

6. Press **ENT UTIL**. The following will be displayed.

```
Brk Op Mode
3T3LO
```

7. Utilizing the arrow pushbuttons select the desired Breaker Operation Mode, either 3T3LO, 1T3LO or 1T1LO.
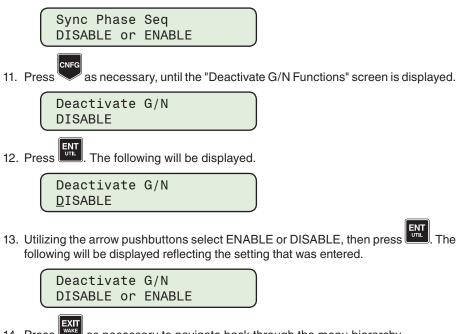
   Press **ENT UTIL**. The following will be displayed reflecting the Breaker Operation Mode that was selected.

8. Press **CNFG** as necessary, until the "Synchronized Phase Sequence" screen is displayed.

```
Sync Phase Seq
DISABLE
```

9. Press **ENT UTIL**. The following will be displayed.

```
Sync Phase Seq
DISABLE
```
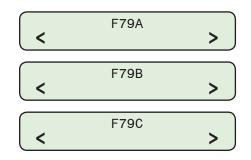
10. Utilizing the arrow pushbuttons select ENABLE or DISABLE, then press **ENT UTIL**. The following will be displayed reflecting the setting that was entered.

```
Sync Phase Seq
DISABLE or ENABLE
```

11. Press **CNFG** as necessary, until the "Deactivate G/N Functions" screen is displayed.

```
Deactivate G/N
DISABLE
```

12. Press **ENT UTIL**. The following will be displayed.

```
Deactivate G/N
DISABLE
```

13. Utilizing the arrow pushbuttons select ENABLE or DISABLE, then press **ENT UTIL**. The following will be displayed reflecting the setting that was entered.

```
Deactivate G/N
DISABLE or ENABLE
```

14. Press **EXIT WAKE** as necessary to navigate back through the menu hierarchy.

SETTING 79 RECLOSER RELAY (INDEPENDENT PHASE MODE) FROM THE HMI

The steps to setup the F79 Function in Independent Phase operation mode are the same as described previously "Setting 79 Recloser Relay (Three-Phase Ganged) From The HMI". The F79 Recloser menu will contain additional screens which allow setting 79 function parameters for individual Phases A, B and C:

```
┌─────────────────────────────┐
│           F79A              │
│  <                     >    │
└─────────────────────────────┘

┌─────────────────────────────┐
│           F79B              │
│  <                     >    │
└─────────────────────────────┘

┌─────────────────────────────┐
│           F79C              │
│  <                     >    │
└─────────────────────────────┘
```

■**NOTE:** When Breaker Operation Mode is **3T3LO**, all settings must be identical for Phases A, B and C for proper control operation.

Follow the steps as previously illustrated to setup the F79A, F79B and F79C parameters:

- Ground Precedence
- Sequence Coordination
- Maximum Number of Phase Trips
- Maximum Number of Ground Trips
- Reset Time after Auto Reclose
- Reset Time from Lockout
- Phase Fault Time Delay for Reclose #1 through Reclose #4
- Ground Fault Time Delay for Reclose #1 through Reclose #4

6 Installation

6.1   General Information

> ■**NOTE:** Prior to installation of the equipment, it is essential to review the contents of this manual to locate data which may be of importance during installation procedures. The following is a quick review of the contents in the chapters of this manual.

The person or group responsible for the installation of the relay will find herein all mechanical information required for physical installation, equipment ratings, and all external connections in this chapter. For reference, the Three-Line Connection Diagrams are repeated from **Chapter 4, System Settings**. Tests which may be desirable at the time of installation are described in **Chapter 7, Testing**.

If during the commissioning of the M-7679 Recloser Control, additional tests are desired, **Chapter 7, Testing**, may be consulted.

Chapter 4, System Setup details the setup procedure. This includes details necessary for input of the communications data, unit setup data, configure relay data, and oscillograph recorder setup information. **Chapter 2 Operation**, guides the operator through the status and metering screens, including monitoring the status and information on viewing the target history.

Generally, the M-7679 is installed in a M-2979 Recloser Cabinet paired with the appropriate interface connector and internal wiring harnesses to support the application. This chapter contains the technical information that supports the various applications.

However, the M-7679 is also available in recloser specific replacement Adapter Chassis which include:

- M-2410/M-7679 replaces the SEL 351R-2
- M-2411/M-7679 replaces the SEL 351P-3 Panacea
- M-2413/M-7679 replaces the Cooper Form 6

The installation instructions and technical data for the Adapter Chassis interface and connection information is contained in Adapter Chassis specific Application Guides.

6.2   Mechanical/Physical Dimensions

Figure 6-1 and Figure 6-2 contain the physical dimensions of the control that are required for mounting.
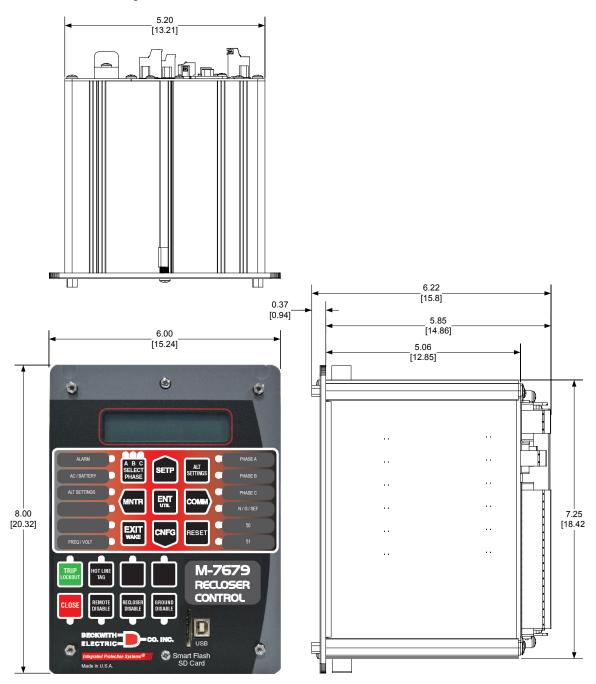
Figure 6-1   M-7679 Vertical Model Mounting Dimensions
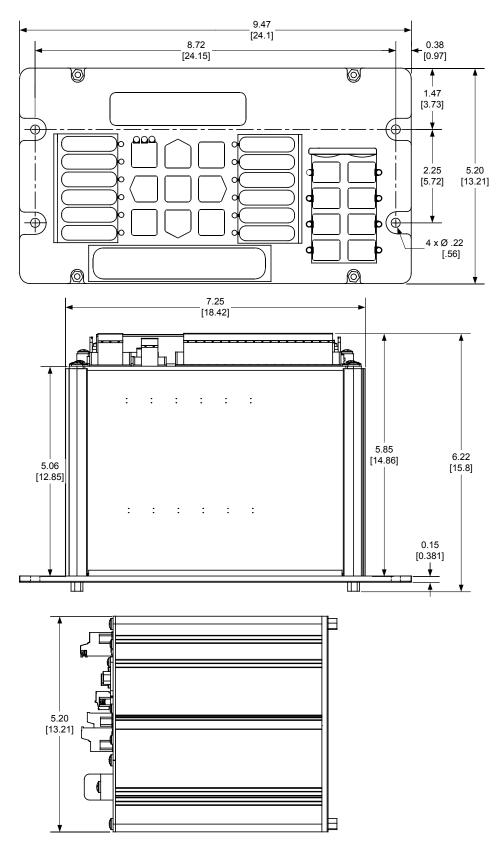
Figure 6-2   M-7679 Horizontal Model Mounting Dimensions

Minimum Clearance For Case Mounting Latch

0.38
[0.97]

2.50
[6.35]

5.00
[12.7]

Optional, for mounting
with #6 screws
instead of latch

Ø 0.16 X 4

5.30
[13.46]

2.65
[6.73]

2.65
[6.73]

3.81
[9.68]

3.67
[9.32]

7.35
[18.64]

7.62
[19.36]

3.67
[9.32]

0.38
[0.97]

Minimum Clearance For Case Mounting Latch
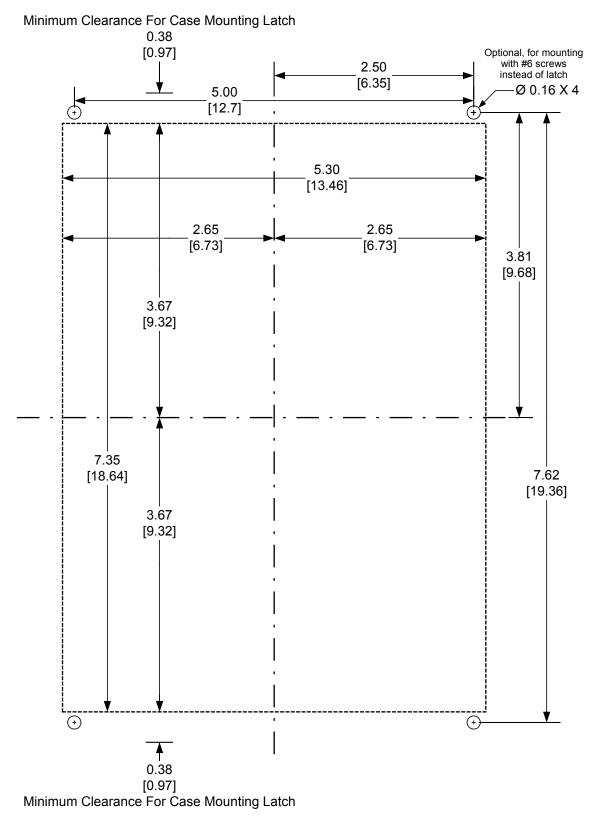
Figure 6-3   M-7679 Vertical Panel Cutout Dimensions
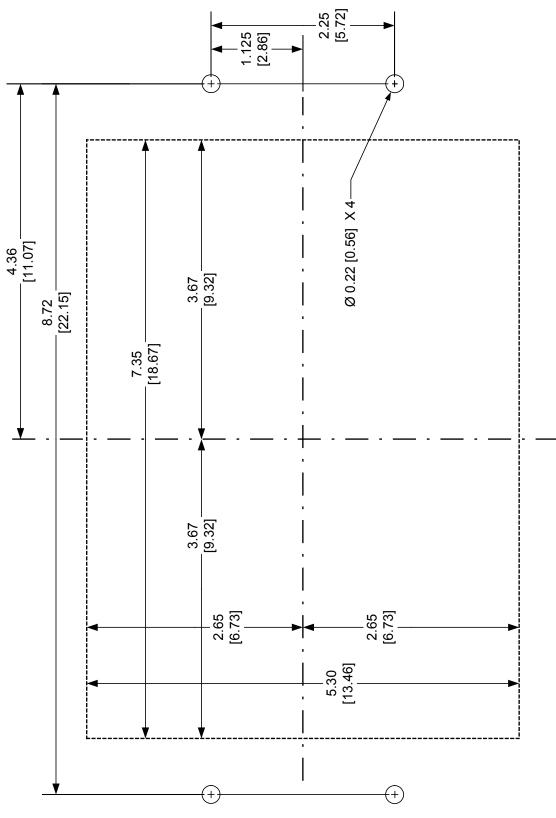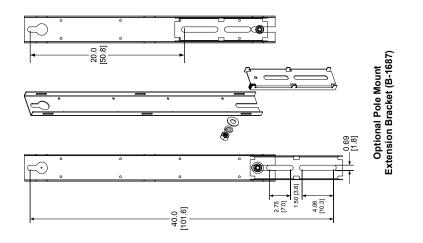
Figure 6-4   M-7679 Horizontal Panel Cutout Dimensions

Figure 6-5   M-2979 Recloser Cabinet

Figure 6-6   M-2979 Recloser Cabinet Internal

Optional Pole Mount
Extension Bracket (B-1687)
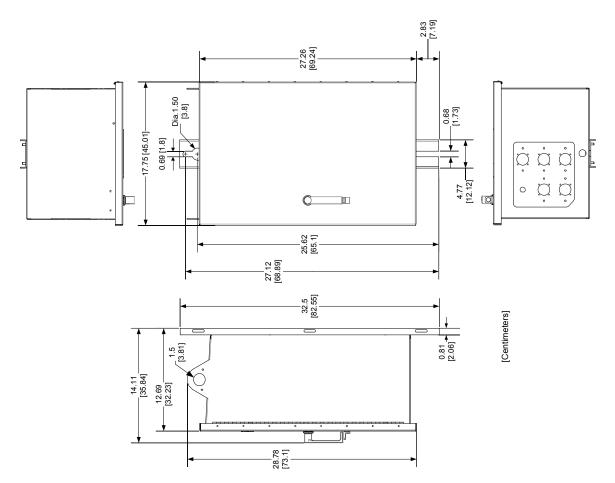
Figure 6-7   M-2979 Recloser Cabinet Dimensions

6.3   External Connections

● **WARNING: The protective grounding terminal must be connected to an earthed ground anytime external connections have been made to the unit.**

● **WARNING: Do not open live CT circuits. Live CT circuits should be shorted prior to disconnecting CT wiring to the M-7679. Death or severe electrical shock may result.**

POWER SUPPLY

Main Power Supply

One of two power supply input ranges are available when the M-7679 is purchased. The low voltage range is 18 to 60 Vdc 12 VA. The high voltage range is 90 to 280 Vac or 90 to 315 Vdc 15 VA. The power source should supply a minimum of 15 watts. The power source should be fused. The low voltage range fuse should be 3 AG 1.0 A or equivalent. The high voltage fuse should be 3 AG 0.5 A or equivalent.

The power supply connects to TB-3; polarity is indicated on the rear panel of the M-7679.

Backup Power Supply Input

This input is used to provide backup power to the M-7679 in case of loss of the Main Power Supply. The input range of this supply is 11 to 14 Vdc. The power source used to supply this power should be isolated, filtered, and well regulated. The power source should supply a minimum of 15 watts.

The power supply connects to TB-2; polarity is indicated on the rear panel of the M-7679.

Grounding Requirements

The M-7679 is designed to be mounted in an adequately grounded panel, using ground bonding techniques (metal-to-metal mounting) and hardware that assures a low impedance ground.

Unit Isolation

Sensing inputs should be equipped with test switches and shorting devices where necessary to isolate the unit from external potential or current sources.

A switch/fuse for the M-7679's power shall be included in the installation, and shall be in close proximity to the relay and within easy reach of the operator, and shall be plainly marked as being the power disconnect device for the relay.

Insulation Coordination

Sensing Inputs: 60 V to 300 V, Installation Category IV, Transient Voltages not to exceed 5,000 V.
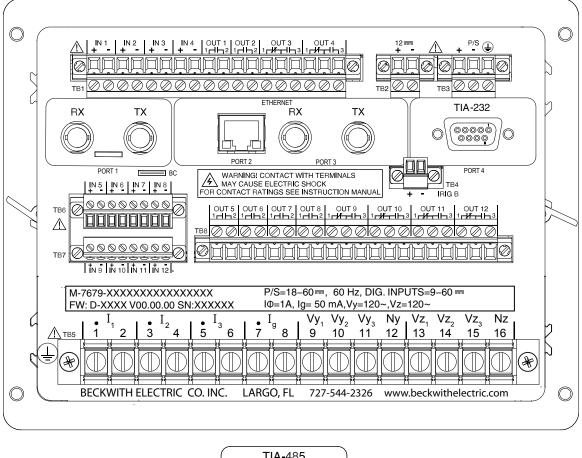
Torque Requirements

- TB-1, 2, 3, 8   4.4–5.3 in-lbs
- TB-5*   7–8 in-lbs
- TB-4, 6, 7   2–2.2 in-lbs

*TB-5 terminal block connections must be made with No. 22-12 AWG solid or stranded copper wire inserted in an AMP #324915 (or equivalent) connector and wire insulation used must be rated at 75° C minimum.

Relay Outputs
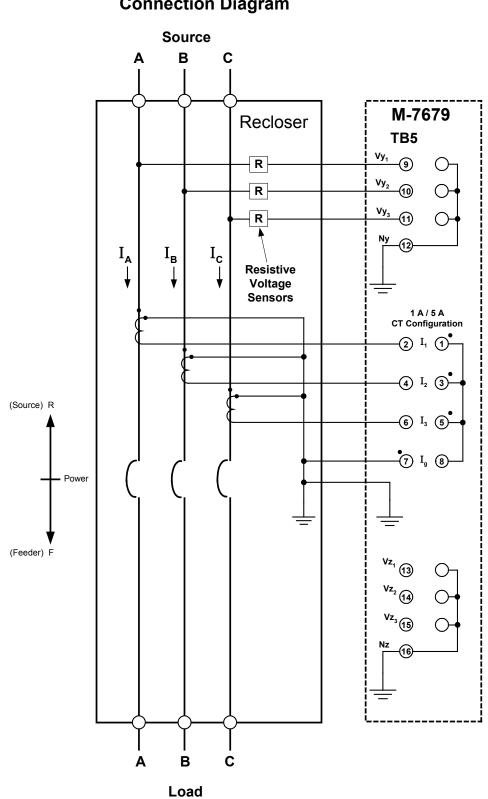
All outputs are shown in the de-energized state for standard reference. Relay standard reference is defined as protective elements in the non-trip, reconnection and sync logic in the non-asserted state, or power to the relay is removed. Output contacts are high speed operation contacts.
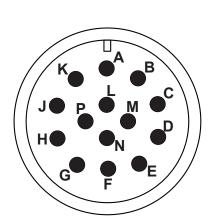
● WARNING: The protective grounding terminal must be connected to an earthed ground any time external connections have been made to the unit.
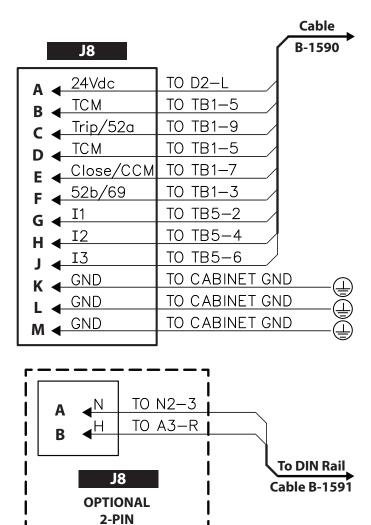
Figure 6-8   External Connections

**M-7679 Typical
Connection Diagram**

Source

A   B   C

Recloser

M-7679

TB5

Vy$_1$ (9)

Vy$_2$ (10)

Vy$_3$ (11)

Ny (12)

I$_A$ I$_B$ I$_C$

**Resistive
Voltage
Sensors**

**1 A / 5 A
CT Configuration**

(2) I$_1$ (1)

(4) I$_2$ (3)

(Source) R

(6) I$_3$ (5)

Power

(7) I$_g$ (8)

(Feeder) F

Vz$_1$ (13)

Vz$_2$ (14)

Vz$_3$ (15)

Nz (16)

A   B   C

Load

Figure 6-9   Typical Three-Line Connection Diagram

6.4 14C, 14G Traditional/G&W Viper S Recloser Cabinet (14-Pin)

J8			Cable B-1590
A	24Vdc	TO D2–L	
B	TCM	TO TB1–5	
C	Trip/52a	TO TB1–9	
D	TCM	TO TB1–5	
E	Close/CCM	TO TB1–7	
F	52b/69	TO TB1–3	
G	I1	TO TB5–2	
H	I2	TO TB5–4	
J	I3	TO TB5–6	
K	GND	TO CABINET GND	
L	GND	TO CABINET GND	
M	GND	TO CABINET GND	

J8

OPTIONAL 2-PIN CONNECTOR

A	N	TO N2–3
B	H	TO A3–R

To DIN Rail Cable B-1591

KEY:

D2, N2, A3	DIN Rail Figure 6-10(B)
TB1, TB5	M-7679 Recloser Control Terminal Blocks Figure 6-10(A)

Figure 6-10   Cabinet Interface 14C, 14G – 14 Pin Control Cable Receptacle Pinouts
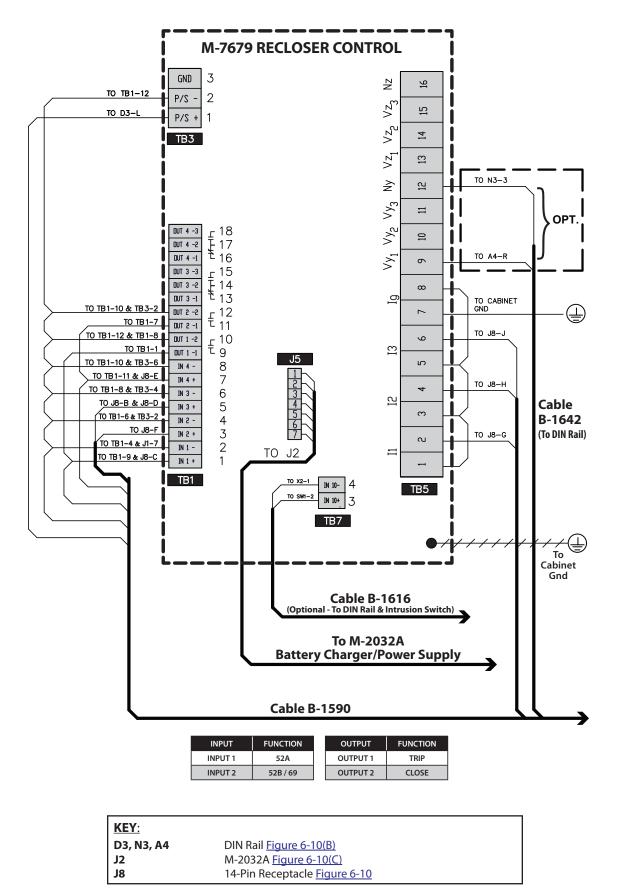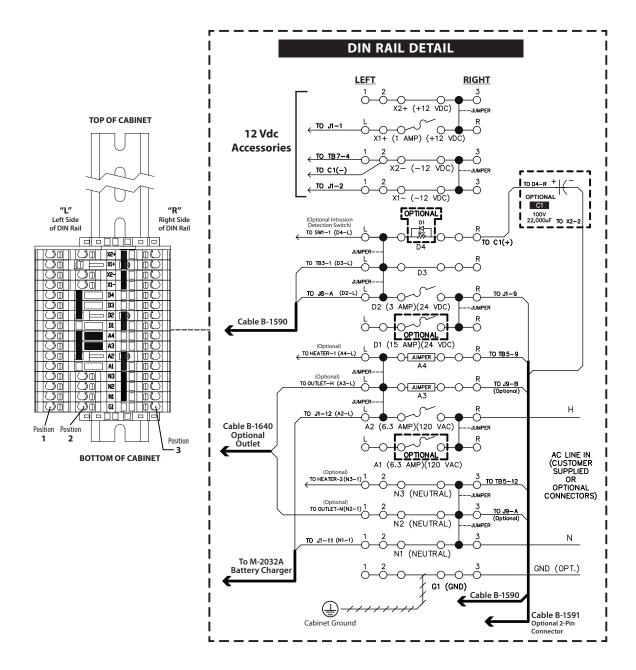
Figure 6-10(A)   Cabinet Interface 14C, 14G M-7679 Terminal Block (TB) Connections

Figure 6-10(B)   Cabinet Interface 14C, 14G DIN Rail Connections

KEY:

J2	M-2032A Figure 6-10(C)
J9	Optional 2-Pin Connector Figure 6-10
TB5, TB7	M-7679 Recloser Control Terminal Blocks Figure 6-10(A)
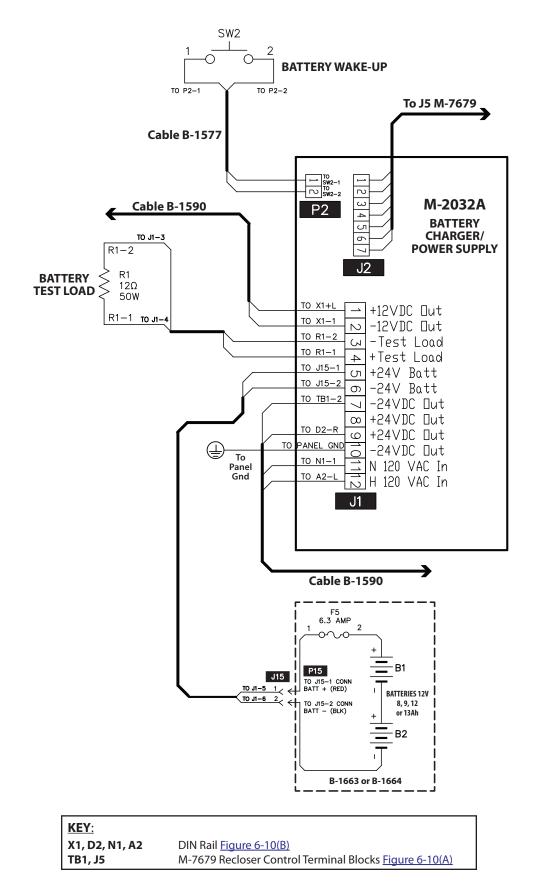
Figure 6-10(C)   Cabinet Interface 14C, 14G – M-2032A Battery Charger/Power Supply Connections

OPTIONAL OUTLET

N TO N2−1   H TO A3−L

G

Cable B-1640
To DIN Rail

To Panel Ground

Cable B-1616
To M-7679

2 TO TB 7−3   1 TO D4−L

To DIN Rail

OPTIONAL INTRUSION DETECTION SWITCH (SW1)

TO A4−L

1

OPTIONAL HEATER

To DIN Rail

2

TO N3−1

KEY:

N2, N3, A3, A4, D4	DIN Rail Figure 6-10(B)
TB7	M-7679 Recloser Control Terminal Blocks Figure 6-10(A)
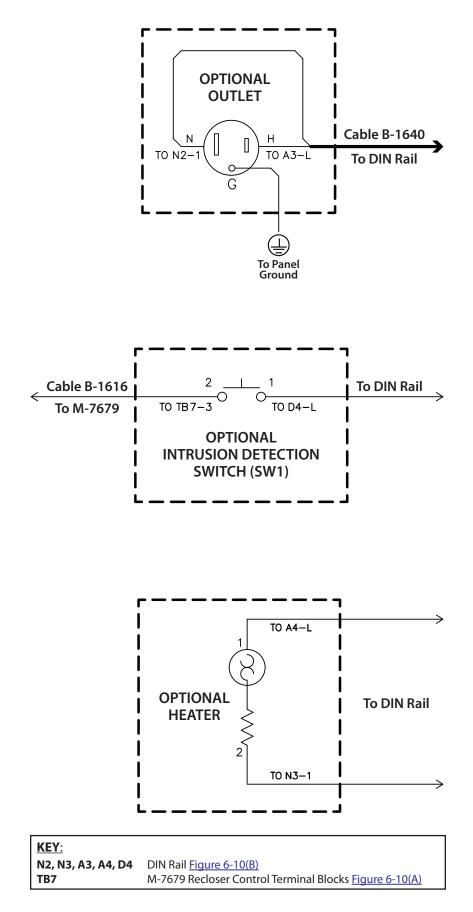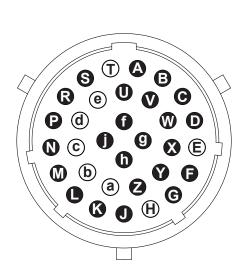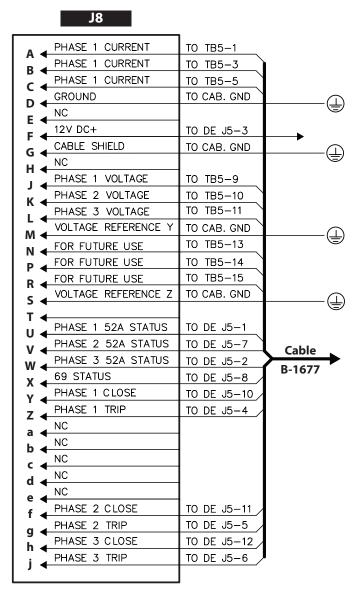
Figure 6-10(D)   Cabinet Interface 14C, 14G Optional Accessories Connections

6.5   32V G&W VRC Viper ST/LT Recloser Cabinet (32-Pin)

J8

Pin	Signal	Connection
A	PHASE 1 CURRENT	TO TB5–1
B	PHASE 1 CURRENT	TO TB5–3
C	PHASE 1 CURRENT	TO TB5–5
D	GROUND	TO CAB. GND
E	NC	
F	12V DC+	TO DE J5–3
G	CABLE SHIELD	TO CAB. GND
H	NC	
J	PHASE 1 VOLTAGE	TO TB5–9
K	PHASE 2 VOLTAGE	TO TB5–10
L	PHASE 3 VOLTAGE	TO TB5–11
M	VOLTAGE REFERENCE Y	TO CAB. GND
N	FOR FUTURE USE	TO TB5–13
P	FOR FUTURE USE	TO TB5–14
R	FOR FUTURE USE	TO TB5–15
S	VOLTAGE REFERENCE Z	TO CAB. GND
T		
U	PHASE 1 52A STATUS	TO DE J5–1
V	PHASE 2 52A STATUS	TO DE J5–7
W	PHASE 3 52A STATUS	TO DE J5–2
X	69 STATUS	TO DE J5–8
Y	PHASE 1 CLOSE	TO DE J5–10
Z	PHASE 1 TRIP	TO DE J5–4
a	NC	
b	NC	
c	NC	
d	NC	
e	NC	
f	PHASE 2 CLOSE	TO DE J5–11
g	PHASE 2 TRIP	TO DE J5–5
h	PHASE 3 CLOSE	TO DE J5–12
j	PHASE 3 TRIP	TO DE J5–6

Cable B-1677

32-Pin Control Cable Receptacle

KEY:

DE	Driving Electronics Figure 6-11(C)
TB5	M-7679 Recloser Control Terminal Blocks Figure 6-11(A)

Figure 6-11   Cabinet Interface 32V – 32 Pin Control Cable Receptacle Pinouts

M-7679 RECLOSER CONTROL

Cable B-1616 Optional
Intrusion Detection Switch

Cable B-1677

INPUT	FUNCTION	OUTPUT	FUNCTION
INPUT 1	52A-A	OUTPUT 1	TRIP A
INPUT 3	69	OUTPUT 2	CLOSE A
INPUT 6	52A-B	OUTPUT 5	TRIP B
INPUT 8	52A-C	OUTPUT 6	CLOSE B
INPUT 11	BATT ALARM	OUTPUT 7	TRIP C
INPUT 12	AC STATUS	OUTPUT 8	CLOSE C
		OUTPUT 12	BATT TEST

KEY:

DE	Driving Electronics Figure 6-11(C)
PS	Power Supply Figure 6-11(D)
X2, D3	DIN Rail Figure 6-11(B)
J8	32-Pin Receptacle Figure 6-11

Figure 6-11(A)   Cabinet Interface 32V M-7679 Terminal Block (TB) Connections

Figure 6-11(B)   Cabinet Interface 32V DIN Rail Connections
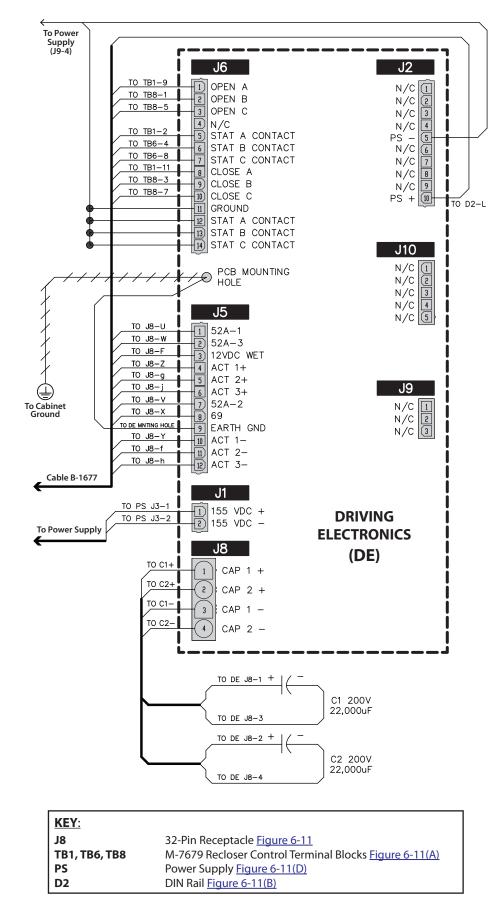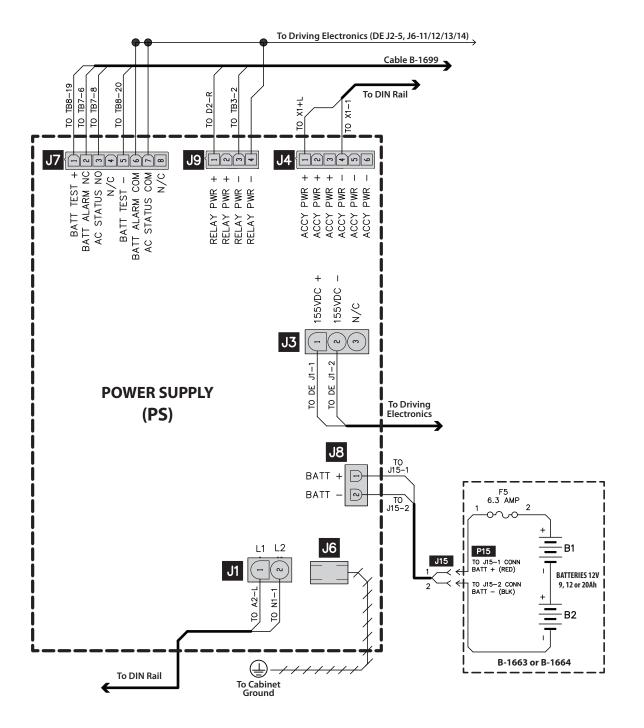
Figure 6-11(C)   Cabinet Interface 32V Driving Electronics (DE) Connections

KEY:

DE	Driving Electronics Figure 6-11(C)
TB3, TB7, TB8	M-7679 Recloser Control Terminal Blocks Figure 6-11(A)
X1, D2, A2, N1	DIN Rail Figure 6-11(B)

Figure 6-11(D)   Cabinet Interface 32V Power Supply (PS) Connections
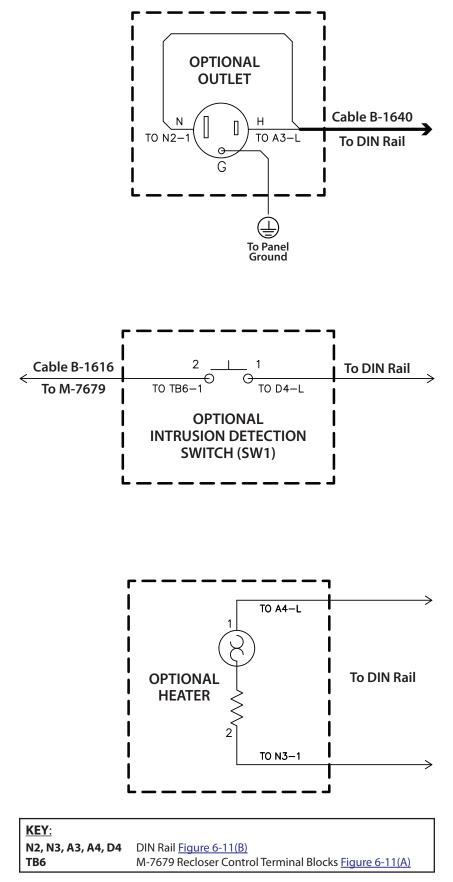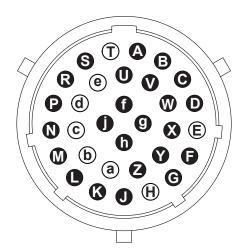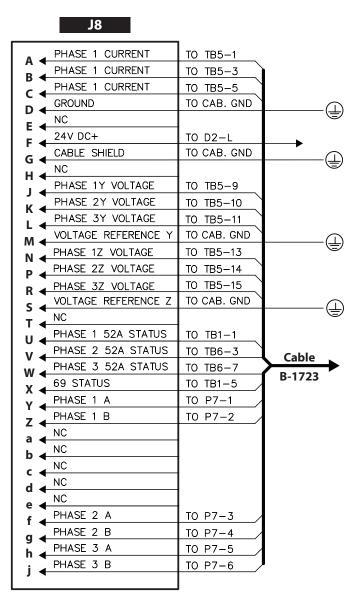
Figure 6-11(E)   Cabinet Interface 32V Optional Accessories Connections

6.6   32B Multi-Recloser Interface (32-Pin)

J8		
A	PHASE 1 CURRENT	TO TB5−1
B	PHASE 1 CURRENT	TO TB5−3
C	PHASE 1 CURRENT	TO TB5−5
D	GROUND	TO CAB. GND
E	NC	
F	24V DC+	TO D2−L
G	CABLE SHIELD	TO CAB. GND
H	NC	
J	PHASE 1Y VOLTAGE	TO TB5−9
K	PHASE 2Y VOLTAGE	TO TB5−10
L	PHASE 3Y VOLTAGE	TO TB5−11
M	VOLTAGE REFERENCE Y	TO CAB. GND
N	PHASE 1Z VOLTAGE	TO TB5−13
P	PHASE 2Z VOLTAGE	TO TB5−14
R	PHASE 3Z VOLTAGE	TO TB5−15
S	VOLTAGE REFERENCE Z	TO CAB. GND
T	NC	
U	PHASE 1 52A STATUS	TO TB1−1
V	PHASE 2 52A STATUS	TO TB6−3
W	PHASE 3 52A STATUS	TO TB6−7
X	69 STATUS	TO TB1−5
Y	PHASE 1 A	TO P7−1
Z	PHASE 1 B	TO P7−2
a	NC	
b	NC	
c	NC	
d	NC	
e	NC	
f	PHASE 2 A	TO P7−3
g	PHASE 2 B	TO P7−4
h	PHASE 3 A	TO P7−5
j	PHASE 3 B	TO P7−6

Cable B-1723

32-Pin Control Cable Receptacle

KEY:	
P7	Driver Actuator Figure 6-12(C)
D2	DIN Rail Figure 6-12(B)
TB1, TB5, TB6	M-7679 Recloser Control Terminal Blocks Figure 6-12(A)

Figure 6-12   Cabinet Interface 32B – 32 Pin Control Cable Receptacle Pinouts

M-7679 RECLOSER CONTROL

INPUT	FUNCTION
INPUT 1	52A-A
INPUT 3	69
INPUT 6	52A-B
INPUT 8	52A-C

OUTPUT	FUNCTION
OUTPUT 1	TRIP A
OUTPUT 2	CLOSE A
OUTPUT 5	TRIP B
OUTPUT 6	CLOSE B
OUTPUT 7	TRIP C
OUTPUT 8	CLOSE C

TB3
TB1
TB6
TB7
TB5
TB8
J5

TO D3–L
TO P1–3 (CLOSE A)
TO P1–4 (TRIP A)
TO J8–X (69)
TO J8–U (52a–A)
TO J8–W (52a–C)
TO J8–V (52a–B)
TO X2–1
TO SW1–2 (INTRUSION)

TO J8–R
TO J8–P
TO J8–N
TO J8–L
TO J8–K
TO J8–J
TO J8–C
TO J8–B
TO J8–A

(CLOSE C) TO P1–7
(TRIP C) TO P1–8
(CLOSE B) TO P1–5
(TRIP B) TO P1–6

**Cable B-1616 Optional
Intrusion Detection Switch**

To Cabinet Gnd

**To Power Supply J1
(430-00631)**

Cable B-1723

To DIN Rail

**Cable B-1728
Panel Ground Stud**

KEY:

P1	Driver Actuator Figure 6-12(C)
J1	Power Supply Figure 6-12(D)
X2, D3	DIN Rail Figure 6-12(B)
J8	32-Pin Receptacle Figure 6-12

Figure 6-12(A)   Cabinet Interface 32B M-7679 Terminal Block (TB) Connections

DIN RAIL DETAIL

LEFT   RIGHT

1   2   3

X2+ (+12 VDC) ——JUMPER

12 Vdc Accessories

TO P4—4   X1+ (1 AMP) (+12 VDC)   R

TO TB7—4   X2— (—12 VDC) ——JUMPER

TO P4—5   X1— (—12 VDC)

TOP OF CABINET

"L" Left Side of DIN Rail   "R" Right Side of DIN Rail

(Optional Intrusion Detection Switch)
TO SW1—1 (D4—L)   D4   R

TO TB3—1 (P/S +) (D3—L)   JUMPER   D3   R

To 32-Pin Connector   TO J8—F   JUMPER   D2 (3 AMP)(24 VDC)   TO P4—6 (+24 VDC)   JUMPER

OPTIONAL D1 (15 AMP)(24 VDC)   R

(Optional) TO HEATER—1 (A4—L)   JUMPER   A4   R

(Optional) TO OUTLET—H (A3—L)   JUMPER   A3   R

JUMPER—   A2 (6.3 AMP)(120 VAC) ——JUMPER   H

Cable B-1640 Optional Outlet

TO P16—1 (A1—L)   **OPTIONAL** A1 (6.3 AMP)(120 VAC)   R

AC LINE IN (CUSTOMER SUPPLIED OR OPTIONAL CONNECTORS)

(Optional) TO HEATER—2 (N3—1)   N3 (NEUTRAL) ——JUMPER

(Optional) TO OUTLET—N (N2—1)   N2 (NEUTRAL) ——JUMPER

TO P16—2 (N1—2)   N1 (NEUTRAL)   N

TO P16—3 (G1—2)   GND (OPT.)

G1 Cabinet Ground

To AC to DC Power Supply (B-1689)

X2+ X1+ X2— X1— D4 D3 D2 D1 A4 A3 A2 A1 N3 N2 N1 G1

Position 1   Position 2   Position 3

BOTTOM OF CABINET

KEY:

J8	32-Pin Receptacle Figure 6-12
TB3, TB7	M-7679 Recloser Control Terminal Blocks Figure 6-12(A)
P4, P16	Power Supply Figure 6-12(D)

Figure 6-12(B)   Cabinet Interface 32B DIN Rail Connections

KEY:

P4, P5	Power Supply B-1718 Figure 6-12(D)
TB1, TB8	M-7679 Recloser Control Terminal Blocks Figure 6-12(A)
J8	42-Pin Receptacle Figure 6-12
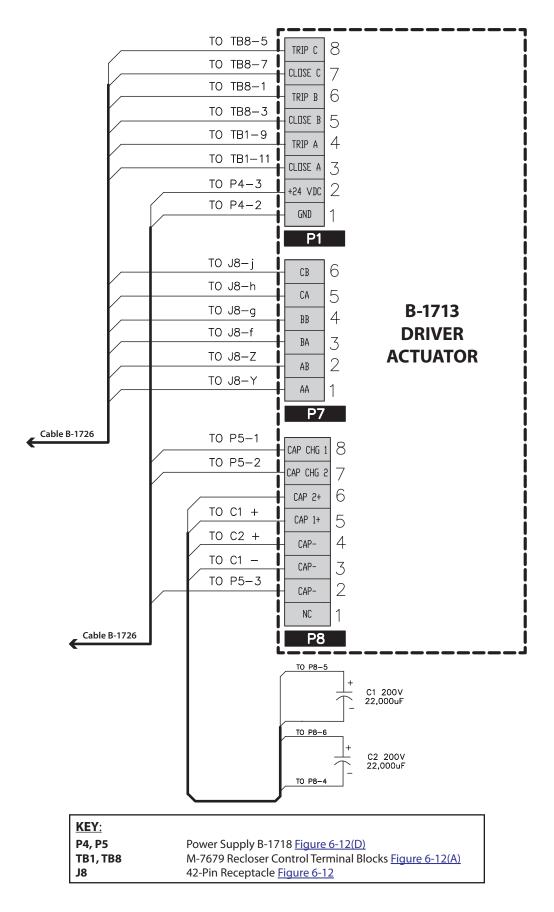
Figure 6-12(C)   Cabinet Interface 32B Driver Actuator B-1713 Connections
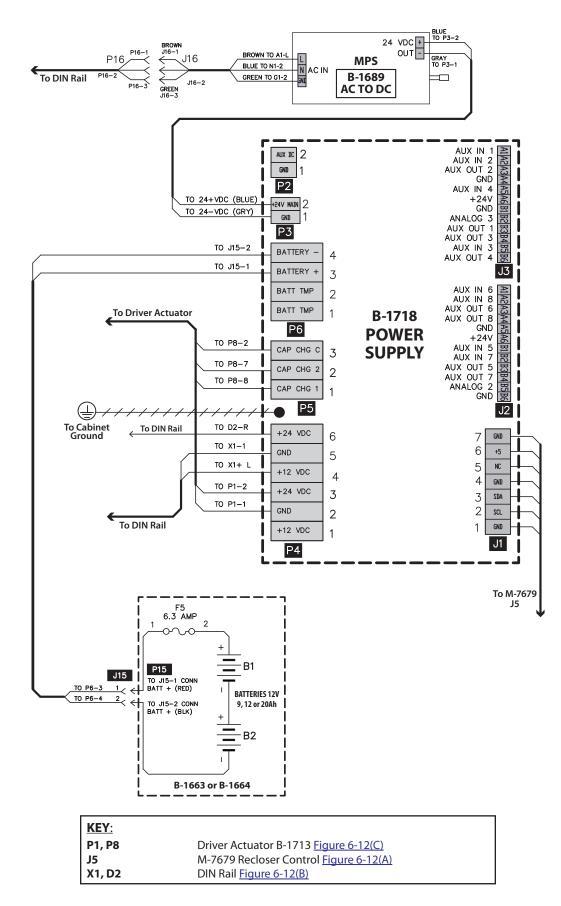
Figure 6-12(D)   Cabinet Interface 32B Power Supply B-1718 Connections

OPTIONAL
OUTLET

N
TO N2−1

H
TO A3−L

Cable B-1640
To DIN Rail

G

**To Panel
Ground**

Cable B-1616
To M-7679

2
TO TB 7−3

1
TO D4−L

To DIN Rail

OPTIONAL
INTRUSION DETECTION
SWITCH (SW1)

TO A4−L

1

OPTIONAL
HEATER

To DIN Rail

2

TO N3−1

KEY:	
N2, N3, A3, A4, D4	DIN Rail Figure 6-12(B)
TB7	M-7679 Recloser Control Terminal Blocks Figure 6-12(A)
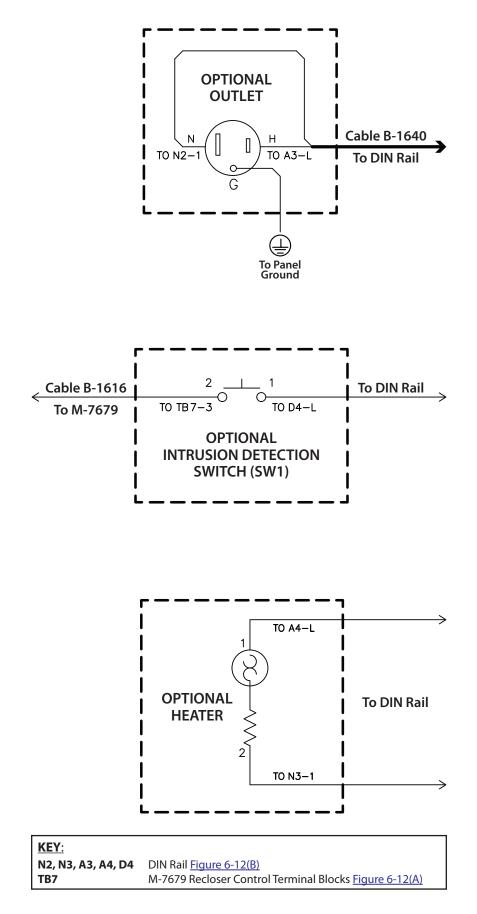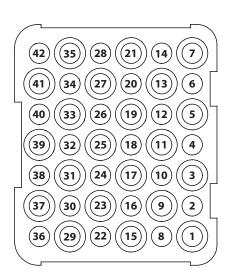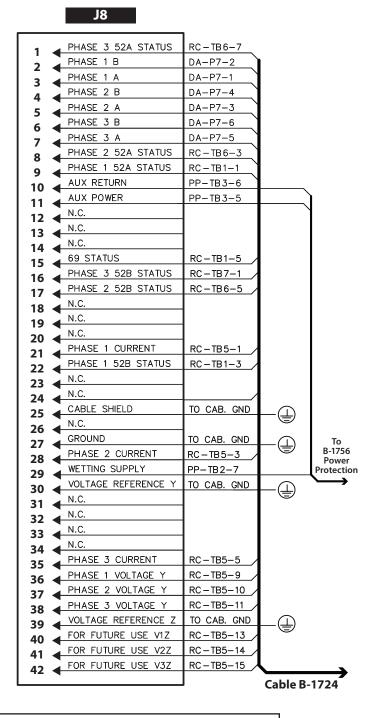
Figure 6-12(E)   Cabinet Interface 32B Optional Accessories Connections

6.7   42B Multi-Recloser Interface (42-Pin)

J8

Pin	Signal	Connection
1	PHASE 3 52A STATUS	RC−TB6−7
2	PHASE 1 B	DA−P7−2
3	PHASE 1 A	DA−P7−1
4	PHASE 2 B	DA−P7−4
5	PHASE 2 A	DA−P7−3
6	PHASE 3 B	DA−P7−6
7	PHASE 3 A	DA−P7−5
8	PHASE 2 52A STATUS	RC−TB6−3
9	PHASE 1 52A STATUS	RC−TB1−1
10	AUX RETURN	PP−TB3−6
11	AUX POWER	PP−TB3−5
12	N.C.	
13	N.C.	
14	N.C.	
15	69 STATUS	RC−TB1−5
16	PHASE 3 52B STATUS	RC−TB7−1
17	PHASE 2 52B STATUS	RC−TB6−5
18	N.C.	
19	N.C.	
20	N.C.	
21	PHASE 1 CURRENT	RC−TB5−1
22	PHASE 1 52B STATUS	RC−TB1−3
23	N.C.	
24	N.C.	
25	CABLE SHIELD	TO CAB. GND
26	N.C.	
27	GROUND	TO CAB. GND
28	PHASE 2 CURRENT	RC−TB5−3
29	WETTING SUPPLY	PP−TB2−7
30	VOLTAGE REFERENCE Y	TO CAB. GND
31	N.C.	
32	N.C.	
33	N.C.	
34	N.C.	
35	PHASE 3 CURRENT	RC−TB5−5
36	PHASE 1 VOLTAGE Y	RC−TB5−9
37	PHASE 2 VOLTAGE Y	RC−TB5−10
38	PHASE 3 VOLTAGE Y	RC−TB5−11
39	VOLTAGE REFERENCE Z	TO CAB. GND
40	FOR FUTURE USE V1Z	RC−TB5−13
41	FOR FUTURE USE V2Z	RC−TB5−14
42	FOR FUTURE USE V3Z	RC−TB5−15

42-Pin Control Cable Receptacle

To B-1756 Power Protection

Cable B-1724

KEY:

RC	M-7679 Recloser Control Terminal Blocks Figure 6-13(A)
DA	B-1713 Driver Actuator Figure 6-13(C)
PP	B-1756 Power Protection Figure 6-13(B)

Figure 6-13   Cabinet Interface 42B – 42 Pin Control Cable Receptacle Pinouts

INPUT	FUNCTION
INPUT 1	52A-A
INPUT 2	52B-A
INPUT 3	69
INPUT 6	52A-B
INPUT 7	52B-B
INPUT 8	52A-C
INPUT 9	52B-C

OUTPUT	FUNCTION
OUTPUT 1	TRIP A
OUTPUT 2	CLOSE A
OUTPUT 5	TRIP B
OUTPUT 6	CLOSE B
OUTPUT 7	TRIP C
OUTPUT 8	CLOSE C

KEY:

J8	42-Pin Receptacle Figure 6-13
PP	B-1756 Power Protection Figure 6-13(B)
DA	B-1713 Driver Actuator Figure 6-13(C)

Figure 6-13(A)   Cabinet Interface 42B M-7679 Recloser Control Connections

Figure 6-13(B)   Cabinet Interface 42B Power Protection B-1756 Connections

RC – TB8–5	TRIP C	8
RC – TB8–7	CLOSE C	7
RC – TB8–1	TRIP B	6
RC – TB8–3	CLOSE B	5
RC – TB1–9	TRIP A	4
RC – TB1–11	CLOSE A	3
PP – TB 2–1	+24 VDC	2
PP – TB 2–2	GND	1
	P1	

TO J8–6	CB	6
TO J8–7	CA	5
TO J8–4	BB	4
TO J8–5	BA	3
TO J8–2	AB	2
TO J8–3	AA	1
	P7	

**B-1713-155V3
DRIVER
ACTUATOR
DA**

Cable B-1724

C C – P5–1	CAP CHG 1	8
C C – P5–2	CAP CHG 2	7
TO C2 +	CAP 2+	6
TO C1 +	CAP 1+	5
TO C2 −	CAP−	4
TO C1 −	CAP−	3
C C – P5–3	CAP−	2
	NC	1
	P8	

**Cable B-1726
To Power
Protection (PP)**

**Cable B-1727
To Capacitor
Charger (CC)**

DA–P8–5

+
−
C1 200V
22,000uF

DA–P8–3

DA–P8–6

+
−
C2 200V
22,000uF

DA–P8–4

KEY:

RC	M-7679 Recloser Control Terminal Blocks Figure 6-13(A)
PP	B-1756 Power Protection Figure 6-13(B)
J8	42-Pin Receptacle Figure 6-13
CC	B-1718 Capacitor Charger Figure 6-13(D)

Figure 6-13(C)   Cabinet Interface 42B Driver Actuator B-1713 Connections
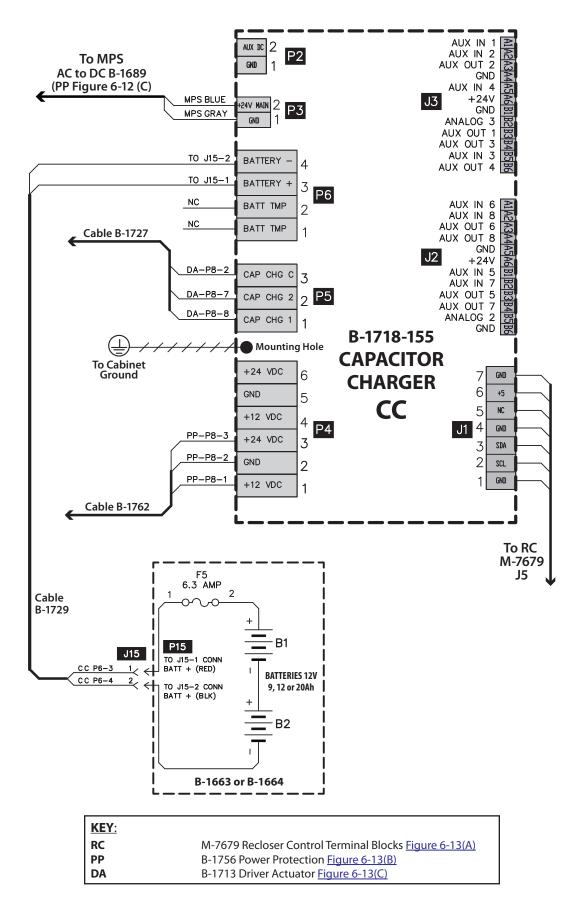
Figure 6-13(D)   Cabinet Interface 42B Capacitor Charger B-1718 Connections

OPTIONAL OUTLET
CO

PP–P14–3
N (WHT)

PP–P14–1
H (BLK)

PP–P14–2
G (GRN)

Cable B-1765
To Power Protection

To M-7679
Recloser Control

2

1

RC–TB7–3

PP–TB2–5

To Power
Protection

OPTIONAL
INTRUSION DETECTION
SWITCH (SW1)

PP–P12–1

1

PP–P12–2

2

OPTIONAL HEATER

To Power
Protection

KEY:
PP   B-1756 Power Protection Figure 6-13(B)
RC   M-7679 Recloser Control Terminal Blocks Figure 6-13(A)
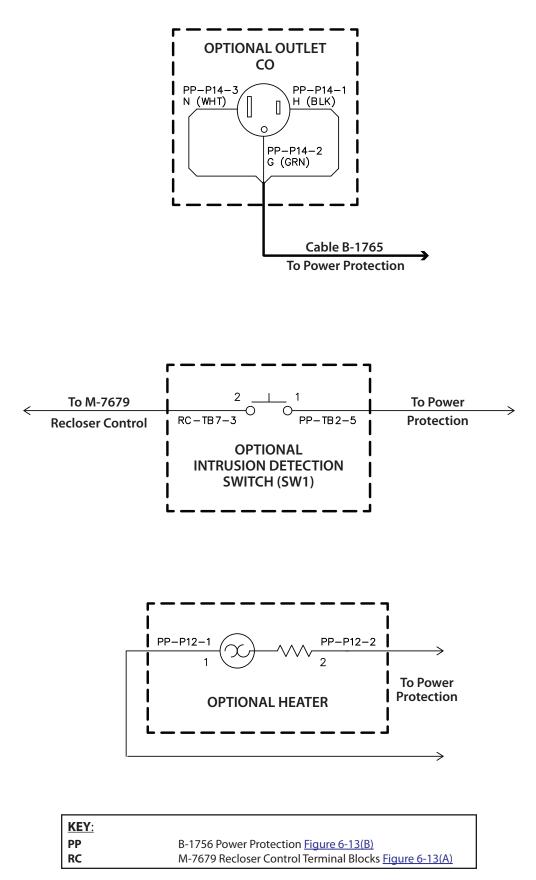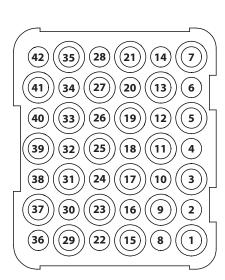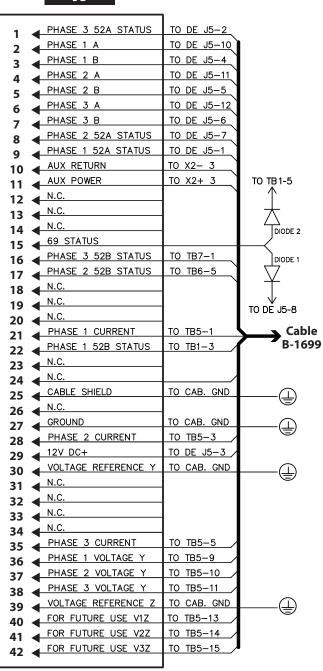
Figure 6-13(E)   Cabinet Interface 42B Optional Accessories Connections

6.8 42V G&W VRC Viper ST/LT Recloser Cabinet (42-Pin)

J8		
1	PHASE 3 52A STATUS	TO DE J5−2
2	PHASE 1 A	TO DE J5−10
3	PHASE 1 B	TO DE J5−4
4	PHASE 2 A	TO DE J5−11
5	PHASE 2 B	TO DE J5−5
6	PHASE 3 A	TO DE J5−12
7	PHASE 3 B	TO DE J5−6
8	PHASE 2 52A STATUS	TO DE J5−7
9	PHASE 1 52A STATUS	TO DE J5−1
10	AUX RETURN	TO X2− 3
11	AUX POWER	TO X2+ 3
12	N.C.	
13	N.C.	
14	N.C.	
15	69 STATUS	
16	PHASE 3 52B STATUS	TO TB7−1
17	PHASE 2 52B STATUS	TO TB6−5
18	N.C.	
19	N.C.	
20	N.C.	
21	PHASE 1 CURRENT	TO TB5−1
22	PHASE 1 52B STATUS	TO TB1−3
23	N.C.	
24	N.C.	
25	CABLE SHIELD	TO CAB. GND
26	N.C.	
27	GROUND	TO CAB. GND
28	PHASE 2 CURRENT	TO TB5−3
29	12V DC+	TO DE J5−3
30	VOLTAGE REFERENCE Y	TO CAB. GND
31	N.C.	
32	N.C.	
33	N.C.	
34	N.C.	
35	PHASE 3 CURRENT	TO TB5−5
36	PHASE 1 VOLTAGE Y	TO TB5−9
37	PHASE 2 VOLTAGE Y	TO TB5−10
38	PHASE 3 VOLTAGE Y	TO TB5−11
39	VOLTAGE REFERENCE Z	TO CAB. GND
40	FOR FUTURE USE V1Z	TO TB5−13
41	FOR FUTURE USE V2Z	TO TB5−14
42	FOR FUTURE USE V3Z	TO TB5−15

TO TB1-5
DIODE 2
DIODE 1
TO DE J5-8

Cable B-1699

42-Pin Control Cable Receptacle

KEY:
DE	Driving Electronics Figure 6-14(C)
X2	DIN Rail Figure 6-14(B)
TB1, TB5, TB6, TB7	M-7679 Recloser Control Terminal Blocks Figure 6-14(A)

Figure 6-14   Cabinet Interface 42V – 42 Pin Control Cable Receptacle Pinouts

Figure 6-14(A)   Cabinet Interface 42V M-7679 Terminal Block (TB) Connections

INPUT	FUNCTION		OUTPUT	FUNCTION
INPUT 1	52A-A		OUTPUT 1	TRIP A
INPUT 2	52B-A		OUTPUT 2	CLOSE A
INPUT 3	69		OUTPUT 5	TRIP B
INPUT 6	52A-B		OUTPUT 6	CLOSE B
INPUT 7	52B-B		OUTPUT 7	TRIP C
INPUT 8	52A-C		OUTPUT 8	CLOSE C
INPUT 9	52B-C		OUTPUT 12	BATT TEST
INPUT 11	BATT ALARM			
INPUT 12	AC STATUS			

KEY:

DE	Driving Electronics Figure 6-14(C)
PS	Power Supply Figure 6-14(D)
X2, D3	DIN Rail Figure 6-14(B)
J8	42-Pin Receptacle Figure 6-14

DIN RAIL DETAIL

TOP OF CABINET

"L" Left Side of DIN Rail

"R" Right Side of DIN Rail

X2+
X1+
X2−
X1−
D4
D3
D2
D1
A4
A3
A2
A1
N3
N2
N1
G1

Position **1** Position **2**

Position **3**

BOTTOM OF CABINET

LEFT **RIGHT**

12 Vdc Accessories

1 2 3 TO J8−11
X2+ (+12 VDC) ---JUMPER

TO PS J4−1 L R
X1+ (1 AMP) (+12 VDC)

TO TB6−2 1 2 3 TO J8−10
X2− (−12 VDC) ---JUMPER

TO PS J4−4 1 2 3
X1− (−12 VDC)

Cable B-1699

(Optional Intrusion Detection Switch)
TO SW1−1 (D4−L) L R
D4

JUMPER---
TO TB3−1 (D3−L) L R
D3

JUMPER---
TO DE J2−10 (D2−L) L R TO PS J9−1
D2 (3 AMP) (24 VDC) ---JUMPER

Cable B-1699

L R
OPTIONAL
D1 (15 AMP) (24 VDC)

(Optional)
TO HEATER−1 (A4−L) L JUMPER R
A4

JUMPER---
(Optional)
TO OUTLET−H (A3−L) L JUMPER R
A3

JUMPER---
TO PS J1−1 (A2−L) L R H
A2 (6.3 AMP) (120 VAC) ---JUMPER

Cable B-1640 Optional Outlet

L R
OPTIONAL
A1 (6.3 AMP) (120 VAC)

AC LINE IN (CUSTOMER SUPPLIED OR OPTIONAL CONNECTORS)

(Optional)
TO HEATER−2 (N3−1) 1 2 3
N3 (NEUTRAL) ---JUMPER

(Optional)
TO OUTLET−N (N2−1) 1 2 3
N2 (NEUTRAL) ---JUMPER

TO PS J1−2 (N1−1) 1 2 3 N
N1 (NEUTRAL)

To Power Supply

1 2 3 GND (OPT.)

G1
Cabinet Ground

KEY:

DE	Driving Electronics Figure 6-14(C)
PS	Power Supply Figure 6-14(D)
J8	42-Pin Receptacle Figure 6-14
TB3, TB6	M-7679 Recloser Control Terminal Blocks Figure 6-14(A)

Figure 6-14(B)   Cabinet Interface 42V DIN Rail Connections
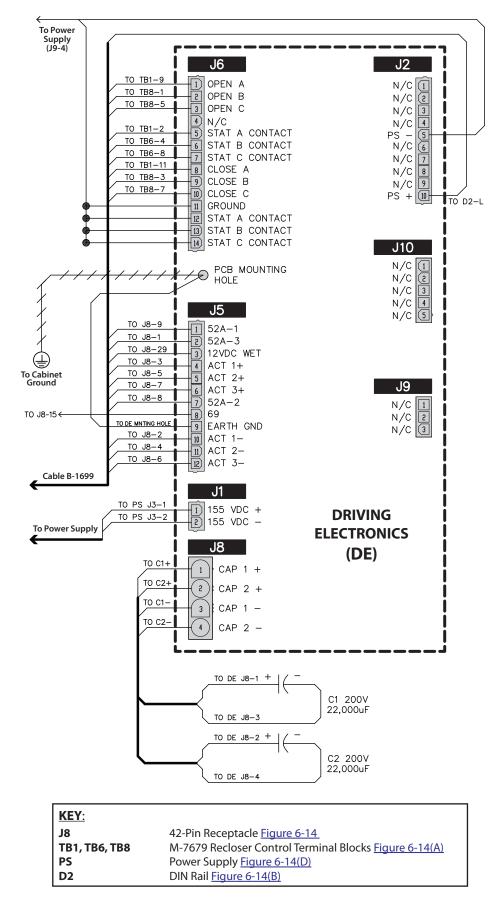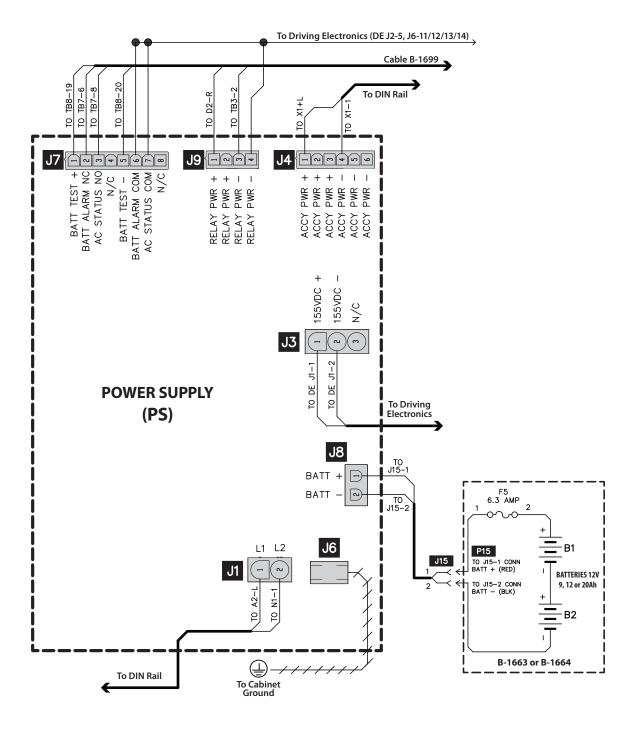
Figure 6-14(C)   Cabinet Interface 42V Driving Electronics (DE) Connections

Figure 6-14(D)   Cabinet Interface 42V Power Supply (PS) Connections

KEY:	
DE	Driving Electronics Figure 6-14(C)
TB3, TB7, TB8	M-7679 Recloser Control Terminal Blocks Figure 6-14(A)
X1, D2, A2, N1	DIN Rail Figure 6-14(B)
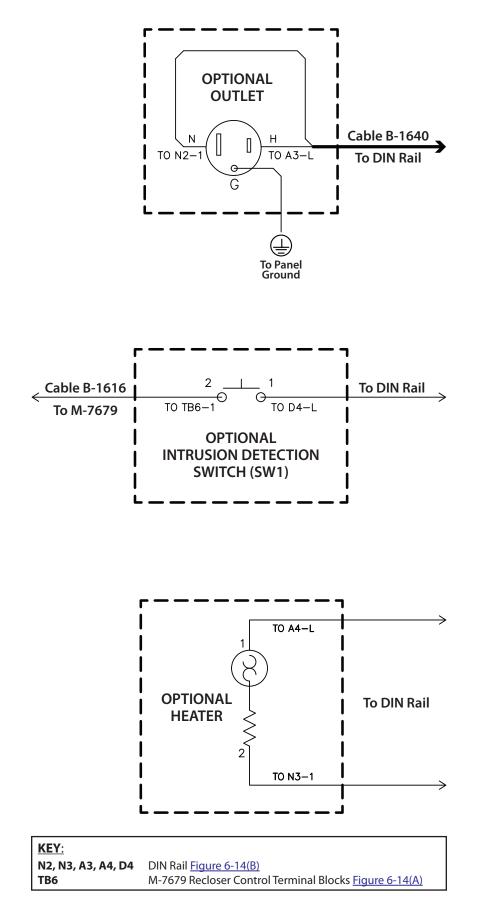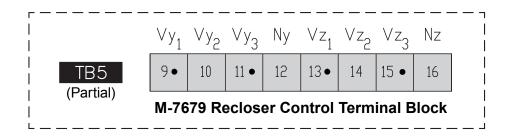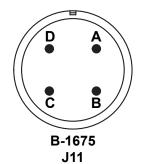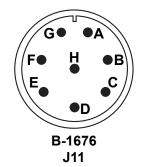
Figure 6-14(E)   Cabinet Interface 42V Optional Accessories Connections

6.9   Optional Connectors
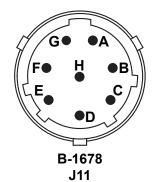
B-1675 4-Pin 120 Vac Voltage Sensing Cable

PIN	CONNECTION
A	TB5-9 (Vy_1)
B	TB5-10 (Vy_2)
C	TB5-11 (Vy_3)
D	TB5-12 (Ny)

B-1675
J11
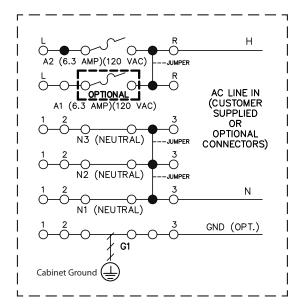
B-1676 8-Pin Multi-Turn, 120 Vac Voltage Sensing Cable

PIN	CONNECTION	PIN	CONNECTION
A	TB5-9 (Vy_1)	E	TB5-13 (Vz_1)
B	TB5-10 (Vy_2)	F	TB5-14 (Vz_2)
C	TB5-11 (Vy_3)	G	TB5-15 (Vz_3)
D	TB5-12 (Ny)	H	TB5-16 (Nz)

B-1676
J11
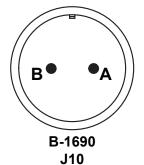
B-1678 8-Pin 1/4 Turn, LEA Voltage Sensing Cable

PIN	CONNECTION	PIN	CONNECTION
A	TB5-9 (Vy_1)	E	TB5-13 (Vz_1)
B	TB5-10 (Vy_2)	F	TB5-14 (Vz_2)
C	TB5-11 (Vy_3)	G	TB5-15 (Vz_3)
D	TB5-12 (Ny)	H	TB5-16 (Nz)

B-1678
J11
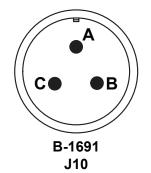
Figure 6-15   M-7679 Optional Voltage Sensing Connectors

**M-7679 Recloser Control Cabinet
DIN Rail (Partial)**

**B-1690
J10**

B-1690 2-Pin Cannon AC Input Cable	
PIN	**DIN RAIL CONNECTION**
A	A2-R (AC Input, Line)
B	N1-3 (AC Input, Neutral)

**B-1691
J10**

B-1691 3-Pin Cannon AC Input Cable	
PIN	**DIN RAIL CONNECTION**
A	A2-R (AC Input, Line)
B	N1-3 (AC Input, Neutral)
C	G1-3 (AC Input, Ground)

Figure 6-16   M-7679 Optional AC Power Input Connectors

6.10   Universal Radio Shelf

Figure 6-17   Universal Radio Shelf Dimensions
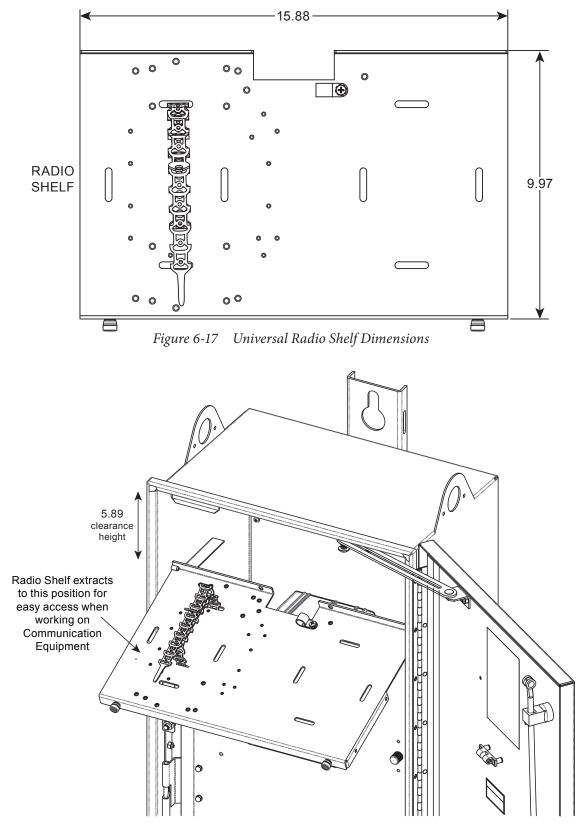
Figure 6-18   Radio Shelf Extended

RADIO MOUNTING DIAGRAMS QUICK REFERENCE	
RADIO	**FIGURE NUMBER**
Airlink Raven X or GS & GX Series	Figure 6-19
Airlink Raven XE, XT or RV50	Figure 6-20
Silver Springs	Figure 6-21
Sixnet 5XXX	Figure 6-22
Sixnet 6XXX	Figure 6-23
Utilinet/Gridstream	Figure 6-24
Zywan	Figure 6-25
MDS INET or entraNET	Figure 6-26
MDS SD	Figure 6-27
MDS TransNET	Figure 6-28
MDS X710	Figure 6-29

Table 6-1   Radio Mounting Diagrams Quick Reference Table

Figure 6-19   Airlink Raven X or GS & GX Series

Figure 6-20   Airlink Raven XE, XT or RV50

Figure 6-21   Silver Springs

Figure 6-22   Sixnet 5XXX

Figure 6-23   Sixnet 6XXX

Figure 6-24   Utilinet/Gridstream

Figure 6-25   Zywan

Figure 6-26   MDS INET or entraNET

Figure 6-27   MDS SD

Figure 6-28   MDS TransNET

Figure 6-29   MDS X710

7 Testing

7.1   Equipment/Test Setup

No calibration is necessary, as the M-7679 Recloser Control is calibrated and fully tested at the factory. If calibration is necessary because of a component replacement, follow the auto calibration procedure detailed in Section 6.3, Auto Calibration. These test procedures are based on the prerequisite that the functions are enabled and have settings as described in **Chapter 5, Setpoints**.

Equipment Required

The following equipment is required to perform the test procedures:

1. Two Digital Multimeters (DMM) with 10 A current range.
2. 120 Vac or 0 to 125 Vdc variable supply for system power.
3. Three-phase independent voltage sources (0 to 250 V) variable phase to simulate VT inputs.
4. Three-phase independent current sources (0 to 25 A) variable phase to simulate CT inputs.
5. Electronic timer accurate to at least 8 ms.

Setup

1. Connect system power to the power input terminals on TB3. The recloser control can be ordered with an input power supply of 90 to 280 Vac, *or* 90 to 315 Vdc.

■**NOTE:** The proper voltage for the recloser control is clearly marked on the power supply label affixed to the rear panel.

2. For each test procedure, connect the voltage and current sources according to the configuration listed in the test procedure and follow the steps outlined.

■**NOTE:** The phase angles shown here use leading angles as positive and lagging angles as negative. Some manufacturers of test equipment have used lagging angles as positive, in which case V_B=120 V $\angle$120° and V_C=120 V $\angle$240°. Similarly other voltages and currents phase angles should be adjusted. These test configurations are for ABC phase rotation. They must be adjusted appropriately for ACB phase rotation.

Figure 7-1   Voltage Inputs: Configuration V1

NOTE: If the Recloser Control is purchased with four voltage inputs, the Vz_1 is the Sync voltage input.

If the Recloser Control is purchased with six voltage inputs, then the user can select which Phase is for Sync. For example Vz_1, Vz_2, or Vz_3.
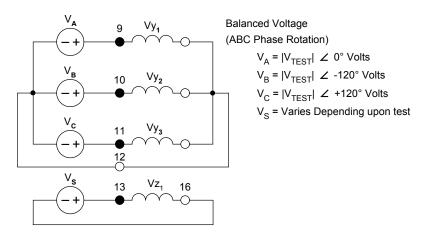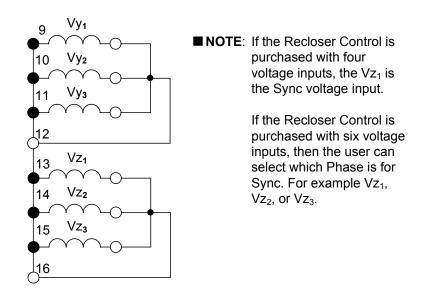
Figure 7-2   Voltage Inputs: Configuration V2

Balanced Current
(ABC Phase Rotation)

$I_a = |I_{TEST}| \angle 0°$ Amps

$I_b = |I_{TEST}| \angle -120°$ Amps

$I_c = |I_{TEST}| \angle +120°$ Amps

I_n = Varies Depending upon test
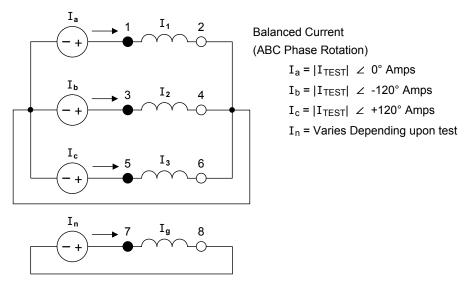
Figure 7-3   Current Inputs: Configuration C1

7.2   Functional Test Procedures

This section details the test quantities, inputs and procedures for testing each function of the recloser control. The purpose is to confirm the function's designated output operation, the accuracy of the magnitude pickup settings, and the accuracy of time delay settings. Whereas the first test described, "Power On Self Test," does not require electrical quantity inputs, all other functional tests require inputs, and the necessary connection configurations are shown. Time Current equations are illustrated in the individual function tests where applicable.

In all test descriptions, a process for calculating input quantities to test the actual settings of the function will be given if needed.

> ▲ **CAUTION:** Care must be taken to reset or re-enable any functions that have been changed from the intended application settings when the test procedures are complete. When a function is re-enabled, both output arrangements and blocking input designations must be reestablished.

In many test cases, it will be necessary to disable other functions not being tested at the time. This action is to prevent the operation of multiple functions.

The complete description of the method to disable/enable functions and the method to enter setting quantities is found in detail in **Chapter 5 Setpoints**.

It is desirable to *record and confirm* the actual settings of the individual functions before beginning test procedures. The Recloser Configuration Worksheet is contained in **Appendix B**. The worksheet is provided to define and record the blocking inputs and output configuration for the recloser control.

The tests are described in this section in ascending function number order as in **Chapter 5 Setpoints**.

During the lifetime of the recloser control, testing of individual functions due to changes in application settings will be more likely than an overall testing routine. An index of the individual test procedures is illustrated at the beginning of this chapter.

It may be desirable to program all test settings in an alternate settings profile, or to save the recloser control settings in IPScom to preserve a desired setup.

Many options for test sequences and methods are possible. As an example, the operation of the output contacts can be tested along with the operation of the LED's in the Diagnostic Test Procedures. The operation of the output contacts may also be confirmed with the LED and function operation during **Functional Test Procedures**, if desired.

If timer quantities are to be checked, the timer must be activated by the appropriate output contacts. The contact pin numbers are enumerated in Figure 6-8 External Connections.

POWER ON SELF TESTS

VOLTAGE INPUTS: **none**

CURRENT INPUTS: **none**

1. Apply proper power to the power input terminals.
2. The following sequence of actions will take place in the following order:

    a. Each time the control is powered up, it will briefly display a series of screens that include:

        • Initializing

        • Loading Configuration

        • Loading DSP

        • User Lines Screen Blanking

    b. Self-Diagnostic Tests:

        Both DSP and Host processors perform an entire sdram test upon booting up. The DSP will test the entire RAM. If any error is detected, the DSP processor will halt and prevent any further loading of the DSP program. This will be indicated by the host as a DSP communication error.

        The host processor performs a similar memory test over its entire RAM. Any error will stop the program loading processor. This will be indicated by the host displaying a memory error message on the LCD.

        An eeprom integrity test is also performed on power up.

        The host will also check if the internal flash drive is formatted. If it is not, it will display an error message on the LCD and also generate a communication error flag to indicate to IPScom or any client that an unformatted media drive exists.

    c. Run-time Diagnostic Tests:

        The host and the DSP compute the checksum over the settings space of each individual memory. The host will then compare its calculated checksum against that of the DSP calculated checksum. If an error is found, the host will display an appropriate alarm message on the LCD and also set an internal error flag that can be used to generate an event.

        Intraboard communications errors will be reported as soon as they are detected.

25   SYNC CHECK

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Undervoltage Permission

		Dead Line-Dead Bus (DLDB)	Dead Line-Live Bus (DLLB)	Live Line-Dead Bus (LLDB)	
Live Line Min. Voltage	**LM**		0.0 to 200.0 V	Volts	± 0.2 V or ± 0.5%
Live Bus Min. Voltage	**BM**		0.0 to 200.0 V	Volts	± 0.2 V or ± 0.5%
Sync Check Permission					
Max/Min Time Delay	**SD**		0.01 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Maximum Voltage	**25U**		10.0 to 300.0 V	Volts	± 0.2 V or ± 0.5%
Minimum Voltage	**25L**		10.0 to 300.0 V	Volts	± 0.2 V or ± 0.5%
Angle Difference	**PA**		0.00° to 90.00°	Degrees	± 0.3°
Magnitude Difference	**DV**		0.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Frequency Difference	**DF**		0.00 to 5.00 Hz	Hertz	± 0.02 Hz
Programmed Outputs	**Z**		(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 25 function.

> ■**NOTE:** The "Vz1 Usage" must be set to "Sync". This setting is set in IPScom
> **Setup/Configuration/Relay** under the System tab.

Test Setup:

1. Determine the 25 Sync Check settings to be tested. Refer to Sync Check Logic Diagram (<u>Figure 5-8</u>).

2. Enter the 25 Sync Check settings to be tested using the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in <u>Figure 7-1</u>, Voltage Inputs: Configuration V1.

5. The 25 function requires one voltage input for V_{sync} (Line) and one voltage input for the reference (Bus). The reference (Line) is either a Line-to-Ground or Line-to-Line voltage depending on the VT configuration.
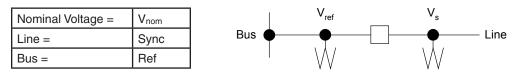
   This test procedure refers to V_{ref} (Bus) as the reference voltage and V_{sync} (Line) as the source voltage.

6. Apply nominal voltage to V_{ref} (Bus) and V_{sync} (Line).

Undervoltage Permission Tests:

> ■**NOTE:** Apply each of these tests for the permissions that are enabled.

Use IPScom Communications Software to monitor the 25 function status.

Nominal Voltage =	V_{nom}
Line =	Sync
Bus =	Ref

- **Dead Line-Dead Bus**

  1. Slowly decrease V_{ref} and V_{sync} magnitude until V_{ref} is less than **BM** and V_{sync} is less than **LM**. The **25 SYNC CHECK** green virtual LED will illuminate.

  2. Increase V_{ref} and V_{sync} to the nominal voltage. The 25 green virtual LED will extinguish.

  3. Press the **RESET** pushbutton to reset targets.

- **Dead Line-Live Bus**

  1. Slowly decrease V_{ref} magnitude until it is less than **BM**. The 25 green virtual LED will illuminate.

  2. Increase V_{ref} to the nominal voltage. The 25 green virtual LED will extinguish.

  3. Press the **RESET** pushbutton to reset targets.

- **Live Line-Dead Bus**

  1. Slowly decrease V_{sync} magnitude until it is less than **LM**. The 25 green virtual LED will illuminate.

  2. Increase V_{sync} to the nominal voltage. The 25 green virtual LED will extinguish.

  3. Press the **RESET** pushbutton to reset targets.

Phase Angle Limit Test:

1. Establish a Phase Angle Difference between V_{ref} and V_{sync} greater than **PA** +5°.

2. Use IPScom Communications Software to monitor the 25 function status. Slowly decrease the phase angle difference until the 25 green virtual LED illuminates. The phase angle difference should be equal to **PA** ±0.3°.

3. Increase the phase angle difference until the 25 green virtual LED extinguishes.

4. Press the **RESET** pushbutton to reset targets.

Upper and Lower Voltage Limit Test:

1. Establish a Phase Angle Difference between V_{ref} and V_{sync} that is less than **PA**.

2. Use IPScom Communications Software to monitor the 25 function status. The 25 green virtual LED will illuminate.

3. Slowly increase the voltage magnitude of V_{sync}. The 25 green virtual LED will extinguish when V_{sync} is greater than **25U**.

4. Return V_{sync} to the nominal voltage. The 25 green virtual LED will illuminate.

5. Slowly decrease the voltage magnitude of V_{sync}. The 25 green virtual LED will extinguish when V_{sync} is less than **25L**.

6. Return V_{syns} to the nominal voltage. The 25 green virtual LED will illuminate.

Magnitude Difference Test:

1. Set V_{ref} to a value greater than V_{nom} + **DV** and V_{sync} equal to V_{nom}.

2. The 25 green virtual LED will extinguish.

3. Slowly decrease the magnitude of V_{ref} until the 25 green virtual LED illuminates. The magnitude of V_{ref} should be equal to or less than V_{nom} + **DV**.

Frequency Difference Test:

1. Apply nominal voltage to V_{ref} and V_{sync}. The phase angle difference should be less than **PA** and the Function 25 green virtual LED will be illuminated.

2. Slowly increase the frequency of V_{sync} until the 25 green virtual LED extinguishes. The frequency of V_{sync} should be just greater than **DF**.

27 PHASE UNDERVOLTAGE

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Pickup	**P**	10.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 27 function (27 #1 through 27 #4) to be tested.

Test Setup:

1. Determine the 27 Phase Undervoltage settings to be tested.

2. Enter the 27 Phase Undervoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

Pickup Test:

1. Use IPScom Communications Software to monitor the 27 function status. Slowly decrease the Phase A input voltage until the **27 PHASE UNDERVOLTAGE** virtual LED illuminates. Repeat this step for Phase B and Phase C if the individual phase elements are enabled.

   The voltage level should be equal to **P** volts ± the accuracy range in the Test Settings above.

2. Increase the Phase A input voltage to the nominal voltage, the corresponding green Function 27 virtual LED in the Function Status Monitoring Screen will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply approximately (**P** – 1) volts and start timing.

   The contacts will close after **D** seconds ± the accuracy range in the Test Settings above.

3. Repeat the Pickup Test and Time Test if necessary for Phase B and C.

27PP   PHASE-TO-PHASE UNDERVOLTAGE

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Pickup	**P**	10.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 27PP function to be tested. This function can only be
> enabled when the VT configuration is Line-to-Ground.

Test Setup:

1. Determine the 27PP Phase-to-Phase Undervoltage settings to be tested.

2. Enter the 27PP Phase-to-Phase Undervoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in , Voltage Inputs: Configuration V1.

Pickup Test:

1. Use IPScom Communications Software to monitor the 27 function status. Slowly decrease V_{AB} until the **27PP PHASE-TO-PHASE UNDERVOLTAGE** virtual green LED illuminates.

   The voltage level should be equal to **P** volts ± the accuracy range in the Test Settings above.

2. Increase V_{AB} to the nominal voltage, the corresponding green 27PP virtual LED in the Function Status Monitoring Screen will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets

4. Repeat these steps for V_{BC} and V_{CA}.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply approximately (**P** – 1) volts and start timing.

   The contacts will close after **D** seconds ± the accuracy range in the Test Settings above.

3. Repeat the Pickup Test and Time Test if necessary for voltage inputs V_{BC} and V_{CA}.

27Vz1   UNDERVOLTAGE

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Pickup	**P**	10.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Enable only the 27Vz1 function to be tested.

Test Setup:

1. Determine the 27Vz1 Undervoltage settings to be tested.

2. Enter the 27Vz1 Undervoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1. Inject a single phase voltage into the Vz_1 voltage input.

Pickup Test:

1. Use IPScom Communications Software to monitor the 27Vz1 function status. Slowly decrease the Vz_1 input voltage until the **27Vz1 UNDERVOLTAGE** virtual green LED illuminates.

   The voltage level should be equal to **P** volts ± the accuracy range in the Test Settings above.

2. Increase the Vz_1 input voltage to the nominal voltage, the corresponding green 27Vz1 function virtual green LED in the Status Function Monitoring Screen will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply approximately (**P** – 1) volts and start timing.

   The contacts will close after **D** seconds ± the accuracy range in the Test Settings above.

32 DIRECTIONAL POWER

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup	**P**	−3.00 to +3.00 PU	Watts or VArs	± 0.02 PU or ± 6%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	
VT Configuration	V1			
Directional Power Sensing		(Real/Reactive)		

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 32 function to be tested.

Test Setup:

1. Determine the 32 Directional Power settings to be tested.

2. Enter the 32 Directional Power settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

5. Connect test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1.

POSITIVE REAL POWER:

Pickup Test:

1. Verify the pickup setting is positive and the operating power is real.

2. Inject balanced nominal three-phase voltage.

3. Calculate test current magnitude as follows: $I_{TEST} = \dfrac{Pickup}{3 \bullet V_{nom}}$

4. Apply balanced three-phase current in-phase with the voltage.

5. Use IPScom Communications Software to monitor the 32 function status. Slowly increase current until Phases A, B and C, **32 DIRECTIONAL POWER** green virtual LEDs illuminate.

   The power level should be equal to **P** Watts ± the accuracy range in the Test Settings above.

Time Test:

1. Connect a timer to output contact **(Z)** so that the timer stops timing when the output contact closes.

2. Apply (**P** + 1) Watts and start timing.

   The output contact will close after **D** seconds ± the accuracy range in the Test Settings above.

NEGATIVE REAL POWER:

Pickup Test:

1. Verify the pickup setting is negative and the operating power is reactive.

2. Inject balanced nominal three-phase voltage.

3. Calculate test current magnitude as follows: $I_{TEST} = \dfrac{Pickup}{3 \cdot V_{nom}}$

4. Apply balanced three-phase current 180 degrees out of phase with the voltage.

5. Use IPScom Communications Software to monitor the 32 function status. Slowly increase current until Phases A, B and C, **32 DIRECTIONAL POWER** green virtual LEDs illuminate.

   The power level should be equal to **P** Watts ± the accuracy range in the Test Settings above.

Time Test:

1. Connect a timer to output contact **(Z)** so that the timer stops timing when the output contact closes.

2. Apply (**P** + 1) Watts and start timing.

   The output contact will close after **D** seconds ± the accuracy range in the Test Settings above.

POSITIVE REACTIVE POWER:

Pickup Test:

1. Verify the pickup setting is positive and the operating power is real.

2. Inject balanced nominal three-phase voltage.

3. Calculate test current magnitude as follows: $I_{TEST} = \dfrac{Pickup}{3 \cdot V_{nom}}$

4. Apply balanced three-phase current 90 degrees lagging the voltage.

5. Use IPScom Communications Software to monitor the 32 function status. Slowly increase current until Phases A, B and C, **32 DIRECTIONAL POWER** green virtual LEDs illuminate.

   The power level should be equal to **P** VArs ± the accuracy range in the Test Settings above.

Time Test:

1. Connect a timer to output contact **(Z)** so that the timer stops timing when the output contact closes.

2. Apply (**P** + 1) VArs and start timing.

   The output contact will close after **D** seconds ± the accuracy range in the Test Settings above.

NEGATIVE REACTIVE POWER:

Pickup Test:

1. Verify the pickup setting is negative and the operating power is reactive.

2. Inject balanced nominal three-phase voltage.

3. Calculate test current magnitude as follows: $I_{TEST} = \dfrac{Pickup}{3 \cdot V_{nom}}$

4. Apply balanced three-phase current 90 degrees leading the voltage.

5. Use IPScom Communications Software to monitor the 32 function status. Slowly increase current until Phases A, B and C, **32 DIRECTIONAL POWER** green virtual LEDs illuminate.

   The power level should be equal to **P** VArs ± the accuracy range in the Test Settings above.

Time Test:

1. Connect a timer to output contact **(Z)** so that the timer stops timing when the output contact closes.

2. Apply (**P** + 1) VArs and start timing.

   The output contact will close after **D** seconds ± the accuracy range in the Test Settings above.

46DT   NEGATIVE-SEQUENCE DEFINITE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup				
1 A CT	**P**	0.02 to 20.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.10 to 100.00 A	Amps	± 0.1 A or ± 3%
Time Delay		0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

■**NOTE:** Only enable the 46DT function (46DT #1 through 46DT #5) to be tested.

Test Setup:

1.   Determine the 46DT Negative-Sequence Overcurrent settings to be tested.

2.   Enter the 46DT Negative-Sequence Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3.   Disable all other functions prior to testing.

4.   Connect test current inputs as shown in , Current Inputs: Configuration C1.

Pickup Test:

1   Use IPScom Communications Software to monitor the 46DT function status, then slowly increase Current Input 1 until the **46DT NEGATIVE-SEQUENCE OVERCURRENT** virtual LED illuminates.

■**NOTE:**   If current is injected into I_1 only, then the negative-sequence current is equal to one third of the magnitude.

The current level of operation will be (**P**) amps ± the accuracy range in the Test Settings above.

2.   Decrease the current input. The corresponding green 46DT virtual LED will extinguish.

3.   Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1.   Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2.   Apply approximately 110% of **P** amps and start timing. The operating time will be ± the accuracy range in the Test Settings above.

3.   Reduce Current Input 3, to 0 amps.

46IT   NEGATIVE-SEQUENCE INVERSE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup

1 A CT	**P**	0.02 to 3.20 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.10 to 16.00 A	Amps	± 0.1 A or ± 3%

Curve:

IEC – Inverse, Very Inverse, Extremely Inverse

Time Multiplier	**K**	0.05 to 1.00		± 2 cycles or ± 5%

IEEE – Moderately Inverse, Very Inverse, Extremely Inverse

Time Multiplier	**K**	0.10 to 25.00		± 2 cycles or ± 5%

US – Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse

Time Multiplier	**K**	0.05 to 15.00		± 2 cycles or ± 5%

Traditional Recloser – 101 to 202

Time Multiplier	**K**	0.10 to 2.00		± 2 cycles or ± 5%

Definite Time

Time Multiplier	**K**	0.10 to 100.00		± 2 cycles or ± 5%
Time Adder	**A**	0.00 to 30.00 s	Seconds	± 0.01 s* or ± 1%

Minimum Response

Time Adder	**B**	0.00 to 1.00 s	Seconds	± 0.01 s* or ± 1%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 46IT function (46IT #1 through 46IT #5) to be tested.

Test Setup:

> ■**NOTE:** If current is injected into only one phase, then the recloser control will operate at one third the value.

For example:

$I_A = I_{TEST}$

$I_B = I_C = 0$

$\therefore I_{OPERATE} = \dfrac{I_{TEST}}{3}$

If you inject single phase current, it will require three times pickup to operate.

1.   Determine the 46IT Negative-Sequence Inverse Time Overcurrent settings to be tested.

2.   Enter the 46IT Negative-Sequence Inverse Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3.   Disable all other functions prior to testing.

4.   Connect test current inputs as shown in <u>Figure 7-3</u>, Current Inputs: Configuration C1.

5.   Test levels may be chosen at any ampere values which are a minimum of 50% higher than the pickup amps, **P** amps. It is suggested that the user select 4 or 5 test points to verify curve. See the note above regarding injecting a single phase current.

Pickup Test:

1. Use IPScom Communications Software to monitor the 46IT function status. Slowly increase the Phase A Current Input until the **46IT NEGATIVE-SEQUENCE INVERSE TIME OVERCURRENT** green virtual LED illuminates on the IPScom function status screen.

   The current level of operation will equal **3P** amps ± the accuracy range in the Test Settings above.

2. Reduce the Phase A Current Input to 0 amps. The 46IT green virtual LED will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply current equal to the chosen test level calculated in Test Setup Step 5 to Phase A Current Input and start timing. Use S-7600 IPScom Communications Software to display the appropriate curve graph.

3. Select Setup/Setpoints/46IT and select "View Graph".

   Read the operating time from the appropriate Inverse Curve Family and **K** (Time Multiplier) setting graph. The accuracy specified is valid for currents above 1.5 times the pickup current.

4. Reduce Phase A Current Input to 0 amps.

5. Press the **TARGET RESET** pushbutton to reset targets.

6. Repeat Steps 2, 3 and 4 for each test level chosen.

47   NEGATIVE-SEQUENCE OVERVOLTAGE

VOLTAGE INPUTS:	As described			
CURRENT INPUTS:	None			

TEST SETTINGS:

Pickup	**P**	0.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Definite Time	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

Test Setup:

1. Determine the 47 Negative-Sequence Overvoltage function settings to be tested.

2. Enter the 47 Negative-Sequence Overvoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect balanced three-phase voltage as shown in Figure 7-1, Voltage Inputs: Configuration V1. Reverse the phase rotation (e.g., ACB if the recloser control is set for ABC phase rotation).

Pickup Test:

1. Use IPScom Communications Software to monitor the 47 function status. Apply balanced three-phase voltage.

2. Slowly increase the voltage magnitude until the **47 OVERVOLTAGE** virtual LED illuminates.

    The voltage level of operation should be equal to **P** volts ± the accuracy range in the Test Settings above.

3. Decrease the voltage magnitude until the corresponding green 47 virtual LED extinguishes.

4. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply balanced single-phase voltage with a magnitude equal to (**P**+1) volts and start timing. The contacts will close after **D** cycles ± the accuracy range in the Test Settings above.

3. Remove the voltage.

50P   PHASE INSTANTANEOUS/DEFINITE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup				
1 A CT	**P**	0.02 to 20.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.10 to 100.00 A	Amps	± 0.1 A or ± 3%
Time Delay		0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

■**NOTE:** Only enable the 50P function (50P #1 through 50P #5) to be tested.

Test Setup:

1. Determine the 50P Phase Instantaneous/Definite Time Overcurrent settings to be tested.

2. Enter the 50P Phase Instantaneous/Definite Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test current inputs as shown in <u>Figure 7-3</u>, Current Inputs: Configuration C1.

Pickup Test:

1 Use IPScom Communications Software to monitor the 50P function, then slowly increase Current Input 1 (Phase A) until the **50P PHASE OVERCURRENT** virtual LED illuminates.

   The current level of operation will be (**P**) amps ± the accuracy range in the Test Settings above.

2. Decrease the current input. The corresponding green 50P virtual LED will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply approximately 110% of **P** amps and start timing. The operating time will be ± the accuracy range in the Test Settings above.

3. Reduce Current Input 1 to 0 amps.

4. Test may be repeated using Current Inputs 1 (Phase A), 2 (Phase B), and 3 (Phase C) individually.

50N   RESIDUAL INSTANTANEOUS/DEFINITE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: As described

TEST SETTINGS:

Pickup

1 A CT	**P**	0.02 to 20.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.10 to 100.00 A	Amps	± 0.1 A or ± 3%
Time Delay		0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

■**NOTE:** Only enable the 50N function (50N #1 through 50N #5) to be tested.

Test Setup:

1. Determine the 50N Residual Instantaneous/Definite Time Overcurrent settings to be tested.

2. Enter the 50N Instantaneous/Definite Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1. The recloser control internally calculates I_N as follows: $I_N = I_1 + I_2 + I_3$. Therefore, if current is only injected into I_1 then $I_N = I_1$.

Pickup Test:

1. Use IPScom Communications Software to monitor the 50N Function, then slowly increase I_N until the **50N RESIDUAL OVERCURRENT** virtual LED illuminates.

    The current level of operation will be (**P**) amps ± the accuracy range in the Test Settings above.

2. Decrease the current input. The corresponding green 50N virtual LED will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply approximately 110% of **P** amps to I_N and start timing. The operating time will be **D** cycles ± the accuracy range in the Test Settings above.

3. Reduce the current input to 0 amps.

50G   GROUND INSTANTANEOUS/DEFINITE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: As described

TEST SETTINGS:

Pickup				
1 A Gnd CT	**P**	0.02 to 20.00 A	Amps	± 0.02 A or ± 3%
5 A Gnd CT	**P**	0.10 to 100.00 A	Amps	± 0.1 A or ± 3%
Time Delay		0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 50G function (50G #1 through 50G #5) to be tested.

The recloser control either provides ground or neutral overcurrent protection. This is selectable via the recloser control configuration. Ground current is measured from the recloser control current input I_G.

Test Setup:

   1.   Determine the 50G Ground Instantaneous/Definite Time Overcurrent settings to be tested.

   2.   Enter the 50G Ground Instantaneous/Definite Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

   3.   Disable all other functions prior to testing.

   4.   Connect I_G test current input as shown in Figure 7-3, Current Inputs: Configuration C1.

Pickup Test:

   1.   Use IPScom Communications Software to monitor the 50G function. Slowly increase the current input I_G until the **50G Ground Overcurrent** virtual LED illuminates. The current level of operation is (**P**) amps ± the accuracy range in the Test Settings above.

   2.   Decrease the current input. The corresponding green 50G virtual LED will extinguish.

   3.   Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

   1.   Connect a timer to output contacts (**Z**) so that the timer stops timing when the contacts (**Z**) close.

   2.   Apply approximately 110% of **P** Amps and start timing. The operating time will be ± the accuracy range in the Test Settings above.

   3.   Reduce the current to recloser control current input I_G to 0 Amps.

50GS SENSITIVE GROUND INSTANTANEOUS/DEFINITE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: As described

TEST SETTINGS:

Pickup

10 mA Gnd CT	**P**	0.001 to 0.160 A	Amps	(TBD)
50 mA Gnd CT	**P**	0.005 to 0.800 A	Amps	0.0015 A or ± 3%
200 mA Gnd CT	**P**	0.020 to 2.500 A	Amps	(TBD)
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 50GS function (50GS #1 through 50GS #5) to be tested.

The recloser control either provides ground or neutral overcurrent protection. This is selectable via the recloser control configuration. Ground current is measured from the recloser control current input I_G.

Test Setup:

1. Determine the 50GS Sensitive Ground Instantaneous/Definite Time Overcurrent settings to be tested.

2. Enter the 50GS Sensitive Ground Instantaneous/Definite Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect I_G test current input as shown in <u>Figure 7-3</u>, Current Inputs: Configuration C1.

Pickup Test:

1. Use IPScom Communications Software to monitor the 50GS function status. Slowly increase the current input I_G until the **50GS Sensitive Ground Overcurrent** virtual green LED illuminates. The current level of operation is (**P**) amps ± the accuracy range in the Test Settings above.

2. Decrease the current input. The corresponding green 50GS virtual green LED will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts (**Z**) so that the timer stops timing when the contacts (**Z**) close.

2. Apply approximately 110% of **P** Amps and start timing. The operating time will be ± the accuracy range in the Test Settings above.

3. Reduce the current to recloser control current input I_G to 0 Amps.

50BF   BREAKER FAILURE

VOLTAGE INPUTS: None

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup
Phase Current

1 A CT	**P**	0.02 to 2.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.10 to 10.00 A	Amps	± 0.1 A or ± 3%

Residual/ Ground Current

1 A CT	**R**	0.02 to 2.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**R**	0.10 to 10.00 A	Amps	± 0.1 A or ± 3%
Time Delay (BF)	**D2**	0.01 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Retrip Delay	**D1**	0.01 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Retrip Output	**RT**	(1 to 12)	OUT	
Breaker Failure Output	**BF**	(1 to 12)	OUT	
Input	**BFI**		IN	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ∎**NOTE:** Only enable the 50BF function.

Test Setup:

1. Determine the 50BF Breaker Failure settings to be tested.

2. Enter the 50BF Breaker Failure settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test current inputs as shown in , Current Inputs: Configuration C1.

Pickup Test:

1. Use IPScom Communications Software to monitor the 50BF function status. Apply balanced three-phase current and assert the **BFI** Input.

2. Slowly increase the current magnitude until the **50BF BREAKER FAILURE** green virtual LED illuminates.

    The current level of operation will be (**P**) amps ± the accuracy range in the Test Settings above.

3. Repeat this test injecting residual current if the residual overcurrent element (50R) is enabled.

Time Test:

RETRIP:

1. Connect a timer to output contact **(RT)** so that the timer stops timing when the contact **(RT)** closes.

2. Assert the **BFI** Input.

3. The Retrip output **(RT)** will close after **D1** Seconds ± the accuracy range in the Test Settings above.

BREAKER FAILURE:

1. Connect a timer to output contact **(BF)** so that the timer stops timing when the contact **(BF)** closes.

2. Assert the **BFI** Input.

3. Inject balanced current with a magnitude equal to **(P + 1)** Amps and start timing. The Breaker Failure output **(BF)** will close after **D2** Seconds ± the accuracy range in the Test Settings above.

51P   PHASE INVERSE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup

1 A CT	**P**	0.02 to 3.20 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.10 to 16.00 A	Amps	± 0.1 A or ± 3%

Curve:

IEC – Inverse, Very Inverse, Extremely Inverse

Time Multiplier	**K**	0.05 to 1.00	± 2 cycles or ± 5%

IEEE – Moderately Inverse, Very Inverse, Extremely Inverse

Time Multiplier	**K**	0.10 to 25.00	± 2 cycles or ± 5%

US – Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse

Time Multiplier	**K**	0.05 to 15.00	± 2 cycles or ± 5%

Traditional Recloser – 101 to 202

Time Multiplier	**K**	0.10 to 2.00	± 2 cycles or ± 5%

Definite Time

Time Multiplier	**K**	0.10 to 100.00	± 2 cycles or ± 5%

Time Adder	**A**	0.00 to 30.00 s	Seconds	± 0.01 s* or ± 1%
Minimum Response Time Adder	**B**	0.00 to 1.00 s	Seconds	± 0.01 s* or ± 1%
Voltage Control	**VC**	4.0 to 150.0	%	TBD
Voltage Restraint	**VR**	4.0 to 150.0	%	TBD

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 51P function (51P #1 through 51P #5) to be tested.

Test Setup:

1. Determine the 51P Phase Inverse Time Overcurrent settings to be tested.

2. Enter the 51P Phase Inverse Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test current inputs as shown in , Current Inputs: Configuration C1.

5. Test levels may be chosen at any ampere values which are a minimum of 50% higher than the pickup amps, **P Amps**. It is suggested that the user select 4 or 5 test points to verify curve.

Pickup Test:

1. Use IPScom Communications Software to monitor the 51P function status. Slowly increase the Phase A current input until the **51P PHASE INVERSE TIME OVERCURRENT** green virtual LED illuminates on the IPScom Function Status screen.

    The current level of operation will equal **P** amps ± the accuracy range in the Test Settings above.

2. Reduce the Phase A Current Input to 0 amps. The 51P green virtual LED(s) will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply current equal to the chosen test level calculated in Test Setup Step 5 to Phase A current input and start timing. Use IPScom Communications Software to display the appropriate curve graph.

3. Select Setup/Setpoints/51P and select "View Graph".

   The operating time will be as read from the appropriate Inverse Curve Family and **K** (Time Multiplier) setting graph. The accuracy specified is valid for currents above 1.5 times the pickup current.

4. Reduce Phase A current input to 0 amps.

5. Press the **TARGET RESET** pushbutton to reset targets.

6. Repeat Steps 2, 3 and 4 for each test level chosen.

51P with Voltage Control or Voltage Restraint

> ■**NOTE:** Only test Voltage Control or Voltage Restraint if either setting is enabled.

Voltage Control Test:

1. Enable 51P Voltage Control utilizing either the HMI or S-7600 IPScom Communications Software.

2. Apply balanced three-phase nominal voltage.

3. Press and hold the **TARGET RESET** pushbutton, then slowly increase the Phase Current Input until the **PHASE OVERCURRENT 51P** LED illuminates, or the pickup indicator illuminates on the IPScom Function Status screen.

4. Release the **TARGET RESET** pushbutton.

5. When the assigned **OUTPUT** LED(s) illuminates then decrease the Input Voltage to **VC** Volts. The assigned **OUTPUT** LED(s) will extinguish at **VC** Volts ± the accuracy range in the Test Settings above.

6. Press the **TARGET RESET** pushbutton to reset targets.

7. Reduce Phase Current Input to 0 amps.

8. Increase the Input Voltage to **Nominal Voltage**.

Voltage Restraint Test:

1. Enable 51P Voltage Restraint utilizing either the HMI or S-7600 IPScom Communications Software.

2. Apply balanced three-phase nominal voltage.

3. Set **P** Amps equal to 2 Amps utilizing either the HMI or IPScom Communications Software.

4. Apply current equal to 1.5 Amps to the Phase Current Input.

5. Decrease the Input Voltage to 75% of **Nominal Voltage**. The **PHASE OVERCURRENT 51P** LED will illuminate, or the pickup indicator will illuminate on the IPScom Function Status screen.

6. Repeat Steps 2, 3 and 4 with reduced input voltage values and current reduced by the same percentage as value (see Figure 5-26 51P Voltage Restraint Characteristic).

51P Load Encroachment Logic (LEL)

> ■**NOTE:** This procedure demonstrates how to test 51P when Load Encroachment Logic (LEL) is enabled.

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Forward Impedance	Z_F	1 to 200 Ohms
Reverse Impedance	Z_R	1 to 200 Ohms
Maximum Positive Angle Forward	δ_{+F}	-90 to 90 Degrees
Maximum Negative Angle Forward	δ_{-F}	-90 to 90 Degrees
Maximum Positive Angle Reverse	δ_{+R}	90 to 270 Degrees
Maximum Negative Angle Reverse	δ_{-R}	90 to 270 Degrees
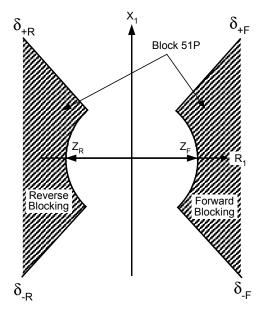
Figure 7-4   Load Encroachment Block Characteristic

> ■**NOTE:** Apply balanced three-phase voltage and current when testing LEL. LEL operates on the positive-sequence impedance (Z_1) measured by the relay. LEL will block 51P if Z_1 is within the forward or reverse blocking characteristics.
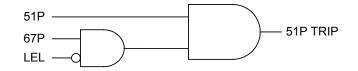
Figure 7-5   Load Encroachment Logic Diagram

> ■**NOTE:** When LEL is enabled, one level Phase Directional Overcurrent element (67P #1 – 67P #5) must be selected to supervise 51P. 51P will not trip unless the selected 67P element is picked up and has timed out. Refer to the 67P section later in this chapter, for detailed steps to test the 67P function.

51N   RESIDUAL INVERSE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup

1 A CT	**P**	0.02 to 3.20 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.10 to 16.00 A	Amps	± 0.1 A or ± 3%

Curve:

IEC – Inverse, Very Inverse, Extremely Inverse
Time Multiplier	**K**	0.05 to 1.00	± 2 cycles or ± 5%

IEEE – Moderately Inverse, Very Inverse, Extremely Inverse
Time Multiplier	**K**	0.10 to 25.00	± 2 cycles or ± 5%

US – Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse
Time Multiplier	**K**	0.05 to 15.00	± 2 cycles or ± 5%

Traditional Recloser – 101 to 202
Time Multiplier	**K**	0.10 to 2.00	± 2 cycles or ± 5%

Definite Time
Time Multiplier	**K**	0.10 to 100.00	± 2 cycles or ± 5%

Time Adder	**A**	0.00 to 30.00 s	Seconds	± 0.01 s* or ± 1%

Minimum Response Time Adder	**B**	0.00 to 1.00 s	Seconds	± 0.01 s* or ± 1%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** The neutral operating current must be selected to $3I_0$. The recloser control operates on the sum of the phase currents, that is, $I_N = I_A + I_B + I_C$.

> ■**NOTE:** Only enable the 51N function (51N #1 through 51N #5) to be tested.

Test Setup:

1. Determine the 51N Residual Inverse Time Overcurrent settings to be tested.

2. Enter the 51N Residual Inverse Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test current inputs as shown in , Current Inputs: Configuration C1. Only inject current in the Phase A current input.

5. Test levels may be chosen at any ampere values which are a minimum of 50% higher than the pickup amps, **P** amps. It is suggested that the user select 4 or 5 test points to verify curve.

Pickup Test:

1.   Use IPScom Communications Software to monitor the 51N function status. Slowly increase the Phase A current input until the **51N RESIDUAL INVERSE TIME OVERCURRENT** green virtual LED illuminates on the IPScom Function Status screen.

      The current level of operation will equal **P** amps ± the accuracy range in the Test Settings above.

2.   Reduce the Phase A current input to 0 amps. The 51N green virtual LED(s) will extinguish.

3.   Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1.   Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2.   Apply current equal to the chosen test level calculated in Test Setup Step 5 to Phase A current input and start timing. Use IPScom Communications Software to display the appropriate curve graph.

3.   Select Setup/Setpoints/51N and select "View Graph".

      Read the operating time from the appropriate Inverse Curve Family and **K** (Time Multiplier) setting graph. The accuracy specified is valid for currents above 1.5 times the pickup current.

4.   Reduce Phase A current input to 0 amps.

5.   Press the **TARGET RESET** pushbutton to reset targets.

6.   Repeat Steps 2, 3 and 4 for each test level chosen.

51G   GROUND INVERSE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup

1 A CT	**P**	0.02 to 3.20 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.10 to 16.00 A	Amps	± 0.1 A or ± 3%

Curve:

IEC – Inverse, Very Inverse, Extremely Inverse

Time Multiplier	**K**	0.05 to 1.00		± 2 cycles or ± 5%

IEEE – Moderately Inverse, Very Inverse, Extremely Inverse

Time Multiplier	**K**	0.10 to 25.00		± 2 cycles or ± 5%

US – Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse

Time Multiplier	**K**	0.05 to 15.00		± 2 cycles or ± 5%

Traditional Recloser – 101 to 202

Time Multiplier	**K**	0.10 to 2.00		± 2 cycles or ± 5%

Definite Time

Time Multiplier	**K**	0.10 to 100.00		± 2 cycles or ± 5%

Time Adder	**A**	0.00 to 30.00 s	Seconds	± 0.01 s* or ± 1%

Minimum Response

Time Adder	**B**	0.00 to 1.00 s	Seconds	± 0.01 s* or ± 1%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

■**NOTE:** Only enable the 51G function (51G #1 through 51G #5) to be tested.

■**NOTE:** The ground current (I_g) input must be selected as the neutral operating current.

Test Setup:

1.   Determine the 51G Ground Inverse Time Overcurrent settings to be tested.

2.   Enter the 51G Ground Inverse Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3.   Disable all other functions prior to testing.

4.   Connect test current input as shown in <u>Figure 7-3</u>, Current Inputs: Configuration C1. Inject current into the ground current input (I_g).

5.   Test levels may be chosen at any ampere values which are a minimum of 50% higher than the pickup amps, **P** amps. It is suggested that the user select 4 or 5 test points to verify curve.

Pickup Test:

1.   Use IPScom Communications Software to monitor the 51G function status. Slowly increase the ground current input until the **51G GROUND INVERSE TIME OVERCURRENT** green virtual LED illuminates on the IPScom Function Status screen.

The current level of operation will equal **P** amps ± the accuracy range in the Test Settings above.

2.   Reduce the ground current input to 0 amps. The 51G green virtual LED(s) will extinguish.

3.   Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply current equal to the chosen test level calculated in Test Setup Step 5 to ground current input and start timing. Use IPScom Communications Software to display the appropriate curve graph.

3. Select Setup/Setpoints/51G and select "View Graph".

    Read the operating time from the appropriate Inverse Curve Family and **K** (Time Multiplier) setting graph. The accuracy specified is valid for currents above 1.5 times the pickup current.

4. Reduce ground current input to 0 amps.

5. Press the **TARGET RESET** pushbutton to reset targets.

6. Repeat Steps 2, 3 and 4 for each test level chosen.

51GS   SENSITIVE GROUND INVERSE TIME OVERCURRENT

VOLTAGE INPUTS: None

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Pickup

10 mA Gnd CT	**P**	0.001 to 0.160 A	Amps	(TBD)
50 mA Gnd CT	**P**	0.005 to 0.800 A	Amps	0.0015 A or ± 3%
200 mA Gnd CT	**P**	0.020 to 2.500 A	Amps	(TBD)

Curve:

   IEC – Inverse, Very Inverse, Extremely Inverse

Time Multiplier	**K**	0.05 to 1.00	± 2 cycles or ± 5%

   IEEE – Moderately Inverse, Very Inverse, Extremely Inverse

Time Multiplier	**K**	0.10 to 25.00	± 2 cycles or ± 5%

   US – Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse

Time Multiplier	**K**	0.05 to 15.00	± 2 cycles or ± 5%

   Traditional Recloser – 101 to 202

Time Multiplier	**K**	0.10 to 2.00	± 2 cycles or ± 5%

   Definite Time

Time Multiplier	**K**	0.10 to 100.00	± 2 cycles or ± 5%

Time Adder	**A**	0.00 to 30.00 s	Seconds	± 0.01 s* or ± 1%

Minimum Response

Time Adder	**B**	0.00 to 1.00 s	Seconds	± 0.01 s* or ± 1%

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

■**NOTE:** Only enable the 51GS function (51GS #1 through 51GS #5) to be tested.

■**NOTE:** The ground current (I_g) input must be selected as the neutral operating current.

Test Setup:

1. Determine the 51GS Sensitive Ground Inverse Time Overcurrent settings to be tested.

2. Enter the 51GS Sensitive Ground Inverse Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test current inputs as shown in , Current Inputs: Configuration C1. Inject current into the ground current input (I_g).

5. Test levels may be chosen at any ampere values which are a minimum of 50% higher than the pickup amps, **P Amps**. It is suggested that the user select 4 or 5 test points to verify curve.

Pickup Test:

1. Use IPScom Communications Software to monitor the 51GS function status. Slowly increase the ground current input until the **51GS SENSITIVE GROUND INVERSE TIME OVERCURRENT** green virtual LED illuminates on the IPScom Function Status screen.

    The current level of operation will equal **P** amps ± the accuracy range in the Test Settings above.

2. Reduce the ground current input to 0 amps. The 51GS green virtual LED(s) will extinguish.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply current equal to the chosen test level calculated in Test Setup Step 5 to ground current input and start timing. Use IPScom Communications Software to display the appropriate curve graph.

3. Select Setup/Setpoints/51GS and select "View Graph".

    Read the operating time from the appropriate Inverse Curve Family and **K** (Time Multiplier) setting graph. The accuracy specified is valid for currents above 1.5 times the pickup current.

4. Reduce ground current input to 0 amps.

5. Press the **TARGET RESET** pushbutton to reset targets.

6. Repeat Steps 2, 3 and 4 for each test level chosen.

59P   PHASE OVERVOLTAGE

VOLTAGE INPUTS:	Configuration V1			
CURRENT INPUTS:	None			

TEST SETTINGS:

Pickup	**P**	10.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Input Voltage Select			(Phase)	
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 59P function (59P #1 through 59P #4) to be tested.

Test Setup:

1. Determine the 59P Phase Overvoltage settings to be tested.

2. Enter the 59P Phase Overvoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

Pickup Test:

1. Use IPScom Communications Software to monitor the 59P function status. Apply balanced three-phase voltage and then slowly increase the voltage magnitude until the **59P PHASE OVERVOLTAGE** virtual LED illuminates.

   The voltage level of operation should be equal to **P** volts ± the accuracy range in the Test Settings above.

2. Decrease the voltage magnitude until the corresponding green 59P virtual LED extinguishes.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply balanced three-phase voltage with a magnitude equal to (**P**+1) volts and start timing. The contacts will close after **D** cycles ± the accuracy range in the Test Settings above.

3. Reduce the voltage input to nominal voltage.

59PP   PHASE-TO-PHASE OVERVOLTAGE

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Pickup (line-to-line)	**P**	10.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Input Voltage Select			(Phase)	
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 59PP function to be tested. 59PP can only be enabled
> when the VT configuration is Line-to-Ground.

Test Setup:

1.   Determine the 59PP Phase-to-Phase Overvoltage settings to be tested.

2.   Enter the 59PP Phase-to-Phase Overvoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3.   Disable all other functions prior to testing.

4.   Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

Pickup Test:

1.   Use IPScom Communications Software to monitor the 59PP Phase-to-Phase function status. Apply balanced three-phase voltage and then slowly increase the voltage magnitude until the **59PP PHASE-TO-PHASE OVERVOLTAGE** virtual green LED illuminates.

       The voltage level (line-to-line) of operation should be equal to **P** volts ± the accuracy range in the Test Settings above.

2.   Decrease the voltage magnitude until the corresponding green 59PP virtual green LED extinguishes.

3.   Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1.   Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2.   Apply balanced three-phase voltage with a magnitude equal to (**P**+1) volts and start timing. The contacts will close after **D** cycles ± the accuracy range in the Test Settings above.

3.   Reduce the voltage input to Nominal Voltage.

59I   PEAK OVERVOLTAGE

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Pickup	**P**	100 to 150 %	% of nominal voltage	± 3%
Time Delay	**D**	0.01 to 140.00 s	Seconds	± 0.05 s*
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 59I function.

Test Setup:

1. Determine the 59I Peak Overvoltage settings to be tested.

2. Enter the 59I Peak Overvoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

Pickup Test:

1. Use IPScom Communications Software to monitor the 59I function status. Apply balanced three-phase second harmonic voltage (i.e., 100 Hz at 50 Hz nominal or 120 Hz at 60 Hz nominal) and then slowly increase the voltage magnitude until the **59I PEAK OVERVOLTAGE** virtual green LED illuminates.

   The voltage magnitude should be equal to **P** % ± the accuracy range in the Test Settings above.

2. Decrease the voltage magnitude until the corresponding green 59I virtual green LED extinguishes.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply (**P**+5) % and start timing. The contacts will close after **D** cycles ± the accuracy range in the Test Settings above.

59N   RESIDUAL OVERVOLTAGE

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Pickup	**P**	10.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Input Voltage Select			(Phase)	
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 59N function.

> ■**NOTE:** 59N operates on the internally calculated value $3V_0$ (i.e., $V_A + V_B + V_C$).

Test Setup:

1. Determine the 59N Residual Overvoltage settings to be tested.

2. Enter the 59N Residual Overvoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

Pickup Test:

1. Use IPScom Communications Software to monitor the 59N residual function status. Apply single-phase voltage to V_A input and then slowly increase the voltage magnitude until the **59N RESIDUAL OVERVOLTAGE** virtual green LED illuminates.

    The voltage level of operation should be equal to **P** volts ± the accuracy range in the Test Settings above.

2. Decrease the voltage magnitude until the corresponding green 59N virtual green LED extinguishes.

3. Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply single-phase voltage to V_A input with a magnitude equal to (**P**+1) volts and start timing. The contacts will close after **D** cycles ± the accuracy range in the Test Settings above.

3. Reduce the voltage input to zero.

59Vz1   OVERVOLTAGE

VOLTAGE INPUTS:	Configuration V1			
CURRENT INPUTS:	None			

TEST SETTINGS:

Pickup	**P**	10.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Input Voltage Select			(Phase)	
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

■**NOTE:** Only enable the 59Vz1 function to be tested.

Test Setup:

1.   Determine the 59Vz1 Overvoltage settings to be tested.

2.   Enter the 59Vz1 Overvoltage settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3.   Disable all other functions prior to testing.

4.   Connect test voltage inputs as shown in <u>Figure 7-1</u>, Voltage Inputs: Configuration V1.

Pickup Test:

1.   Use IPScom Communications Software to monitor the 59Vz1 function status. Apply single phase voltage to the Vz_1 input and then slowly increase the voltage magnitude until the **59Vz1 OVERVOLTAGE** virtual green LED illuminates.

   The voltage level of operation should be equal to **P** volts ± the accuracy range in the Test Settings above.

2.   Decrease the voltage magnitude until the corresponding green 59Vz1 virtual green LED extinguishes.

3.   Press the **TARGET RESET** pushbutton to reset targets.

Time Test:

1.   Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2.   Apply single phase voltage to the Vz_1 input with a magnitude equal to (**P**+1) volts and start timing. The contacts will close after **D** cycles ± the accuracy range in the Test Settings above.

3.   Reduce the voltage input to nominal voltage.

60FL   VT FUSE LOSS DETECTION

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Time Delay	**D**	0.03 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** It is necessary for "FL" to be designated as an initiating input (see Section 4.5, System Setpoints) in order to test this function.

Test Setup:

1. Determine the 60FL VT Fuse Loss Detection settings to be tested.

2. Enter the 60FL VT Fuse Loss Detection settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software. (FL initiate must be selected for this test.)

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

5. Connect test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1.

6. Inject nominal balanced three-phase voltage.

LOSS OF ONE PHASE VOLTAGE

Pickup Test:

1. Remove voltage from the V_A input. The **60FL** green virtual LED will illuminate on the IPScom Communications Software function status screen.

2. Restore voltage to the V_A input then press the **TARGET RESET** button to reset the targets.

Time Test:

1. Connect a timer to output contact **(Z)** so that the timer stops timing when the output contact closes.

2. Repeat Step 1 from the Pickup Test.

    The operating time will be **D** seconds ± the accuracy range in the Test Settings above.

3. Repeat Step 2 from the Pickup Test.

LOSS OF ALL THREE-PHASE VOLTAGES

Pickup Test:

1. Inject fifteen percent nominal balanced current.

2. Simultaneously remove voltage from all three voltage inputs V_A, V_B and V_C. The **60FL** green virtual LED will illuminate on the IPScom Communications Software function status screen.

3. Restore voltage to the V_A, V_B and V_C inputs.

4. Press the **TARGET RESET** button to reset the targets.

Time Test:

1. Connect a timer to output contact **(Z)** so that the timer stops timing when the output contact closes.

2. Repeat Step 1 from the Pickup Test.

    The operating time will be **D** seconds ± the accuracy range in the Test Settings above.

3. Repeat Step 2 from the Pickup Test.

67P   DIRECTIONAL PHASE OVERCURRENT

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Direction		(No-Direction, Directional)		
Polarization Voltage		V_1		
Max. Sensitivity Angle	**MSA #1**	0° to 359°	Degrees	
Max. Sensitivity Angle	**MSA #2**	5° to 90°	Degrees	
Pickup				
1 A CT	**P**	0.05 to 20.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.25 to 100.00 A	Amps	± 0.1 A or ± 3%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Min. Polarization Voltage	**VMIN**	2.0 to 10.0 %	% V_{nom}	± 3%
Action if $V_{pol} < V_{min}$		(Block Trip, Trip)		
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

■**NOTE:** Only enable the 67P function (67P #1 through 67P #5) to be tested.

Test Setup:

1.   Determine the 67P Directional Instantaneous/Definite Time Overcurrent settings to be tested.

2.   Enter the 67P Directional Instantaneous/Definite Time Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3.   Disable all other functions prior to testing.

4.   Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

5.   Connect the test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1.

Directional Pickup Test:

1.   Refer to Figure 7-6 (forward looking) or Figure 7-7 (reverse looking) to perform this test.

2.   Use IPScom Communications Software to monitor the 67P function.

3.   Apply balanced nominal three-phase voltage.

4.   Apply single phase current for the selected operating current (e.g., I_a) equal to 150 percent of the pickup **P** at an angle with respect to the polarizing voltage outside of the operate zone.

5.   Slowly rotate the current in the positive phase direction until the **67P Directional Phase Overcurrent** virtual green LED illuminates.

   The angle of operation will be equal to **MSA** ± 90° (See Figure 7-6 and Figure 7-7).

6.   Slowly decrease the current magnitude until the 67P virtual green LED extinguishes. The current level of dropout will be just less than **P** ± the accuracy range in the Test Settings above.

Time Test:

1.   Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2.   Increase the current magnitude to 150 percent of pickup **P** and start timing. The contacts will close after **D** seconds ± the accuracy range in the Test Settings above. The test current must be in the trip region of the directional characteristic.

3.   If Inverse Time Overcurrent is selected, refer to the test section 51P for test instructions.
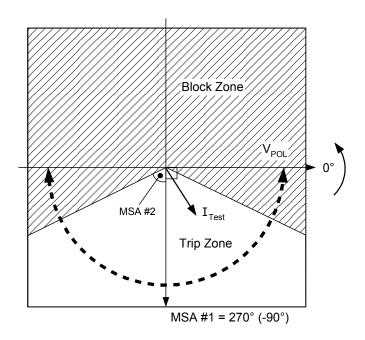
Figure 7-6   Function 67 Directional Trip Characteristic (Forward Looking)
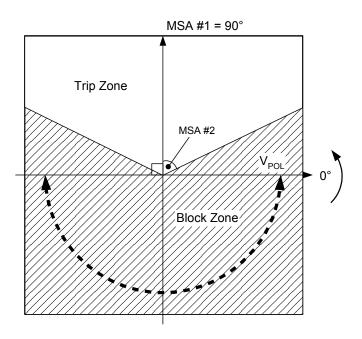
Figure 7-7   Function 67 Directional Trip Characteristic (Reverse Looking)

67N   RESIDUAL DIRECTIONAL OVERCURRENT

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Direction		(No-Direction, Directional)		
Operate Current		I_N		
Polarization Voltage		(Vz_1, V_1, V_2, V_0)		
Max. Sensitivity Angle	**MSA #1**	0° to 359°	Degrees	
Max. Sensitivity Angle	**MSA #2**	5° to 90°	Degrees	
Pickup				
1 A CT	**P**	0.05 to 20.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.25 to 100.00 A	Amps	± 0.1 A or ± 3%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Min. Polarization Voltage	**VMIN**	2.0 to 10.0 %	% V_{nom}	± 3%
Action if $V_{pol} < V_{min}$		(Block Trip, Trip)		
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ∎**NOTE:** Only enable the 67N function (67N #1 through 67N #5) to be tested.

Test Setup:

1. Determine the 67N Residual Directional Overcurrent settings to be tested.

2. Enter the 67N Residual Directional Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

5. Connect the test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1.

Directional Pickup Test:

1. Refer to Figure 7-6 (forward looking) or Figure 7-7 (reverse looking) to perform this test.

2. Use IPScom Communications Software to monitor the 67N function.

3. Apply a single phase voltage to polarize the relay. For example if voltage is applied to V_a only, then: $V_0 = V_2 = V_a/3$

4. Apply single phase current for the operating current I_N equal to 150 percent of the pickup **P** at an angle with respect to the polarizing voltage outside of the operate zone.

5. Slowly rotate the current in the positive phase direction until the **67N Residual Directional Overcurrent** virtual green LED illuminates.

   The angle of operation will be equal to **MSA** ± 90°.

6. Slowly decrease the current magnitude until the 67N virtual green LED extinguishes. The current level of dropout will be just less than **P** ± the accuracy range in the Test Settings above.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Increase the current magnitude to 150 percent of pickup **P** and start timing. The contacts will close after **D** seconds ± the accuracy range in the Test Settings above. The test current must be in the trip region of the directional characteristic.

3. If Inverse Time Overcurrent is selected, refer to the test section 51N for test instructions.

67G   GROUND DIRECTIONAL OVERCURRENT

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Direction		(No-Direction, Directional)		
Operate Current		I_g		
Polarization Voltage		(Vz_1, V_1, V_2, V_0)		
Max. Sensitivity Angle	**MSA #1**	0° to 359°	Degrees	
Max. Sensitivity Angle	**MSA #2**	5° to 90°	Degrees	
Pickup				
1 A CT	**P**	0.05 to 20.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.25 to 100.00 A	Amps	± 0.1 A or ± 3%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Min. Polarization Voltage	**VMIN**	2.0 to 10.0 %	% V_{nom}	± 3%
Action if $V_{pol} < V_{min}$		(Block Trip, Trip)		
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 67G function (67G #1 through 67G #5) to be tested.

Test Setup:

1. Determine the 67G Ground Directional Overcurrent settings to be tested.

2. Enter the 67G Ground Directional Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

5. Connect the test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1.

Directional Pickup Test:

1. Refer to Figure 7-6 (forward looking) or Figure 7-7 (reverse looking) to perform this test.

2. Use IPScom Communications Software to monitor the 67G function.

3. Apply a single phase voltage to polarize the relay. For example if voltage is applied to V_a only, then: $V_0 = V_2 = V_a/3$

4. Apply current to the current input I_g equal to 150 percent of the pickup **P** at an angle with respect to the polarizing voltage outside of the operate zone.

5. Slowly rotate the current in the positive phase direction until the **67G Ground Directional Overcurrent** virtual green LED illuminates.

   The angle of operation will be equal to **MSA** ± 90°.

6. Slowly decrease the current magnitude until the 67G virtual green LED extinguishes. The current level of dropout will be just less than **P** ± the accuracy range in the Test Settings above.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Increase the current magnitude to 150 percent of pickup **P** and start timing. The contacts will close after **D** seconds ± the accuracy range in the Test Settings above. The test current must be in the trip region of the directional characteristic.

3. If Inverse Time Overcurrent is selected, refer to the test section 51G for test instructions.

67Q   NEGATIVE-SEQUENCE DIRECTIONAL OVERCURRENT

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Direction		(No-Direction, Directional)		
Operate Current		I_2		
Polarization Voltage		V_2		
Max. Sensitivity Angle	**MSA #1**	0° to 359°	Degrees	
Max. Sensitivity Angle	**MSA #2**	5° to 90°	Degrees	
Pickup				
1 A CT	**P**	0.05 to 20.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**P**	0.25 to 100.00 A	Amps	± 0.1 A or ± 3%
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Min. Polarization Voltage	**VMIN**	2.0 to 10.0 %	% V_{nom}	± 3%
Action if $V_{pol} < V_{min}$		(Block Trip, Trip)		
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 67Q function (67Q #1 through 67Q #5) to be tested.

Test Setup:

1. Determine the 67Q Negative-Sequence Directional Overcurrent settings to be tested.

2. Enter the 67Q Negative-Sequence Directional Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

5. Connect the test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1.

Directional Pickup Test:

1. Refer to Figure 7-6 (forward looking) or Figure 7-7 (reverse looking) to perform this test.

2. Use IPScom Communications Software to monitor the 67Q function.

3. Apply a single phase voltage to polarize the relay. For example if the test voltage is applied to V_a only, then: $V_2 = V_a/3$

4. Apply single phase current for the operating current I_2 equal to 150 percent of the pickup **P** at an angle with respect to the polarizing voltage outside of the operate zone. For example if the test current is applied to I_a only, then: $I_2 = I_a/3$

5. Slowly rotate the current in the positive phase direction until the **67Q NEGATIVE-SEQUENCE DIRECTIONAL OVERCURRENT** virtual green LED illuminates.
   The angle of operation will be equal to **MSA** ± 90°.

6. Slowly decrease the current magnitude until the 67Q virtual green LED extinguishes. The current level of dropout will be just less than **P** ± the accuracy range in the Test Settings above.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Increase the current magnitude to 150 percent of pickup **P** and start timing. The contacts will close after **D** seconds ± the accuracy range in the Test Settings above. The test current must be in the trip region of the directional characteristic.

3. If Inverse Time Overcurrent is selected, refer to the test section 51Q for test instructions.

67GS   SENSITIVE GROUND DIRECTIONAL OVERCURRENT

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Direction		(No-Direction, Directional)		
Operate Current		I_g		
Polarization Voltage		(Vz_1, V_1, V_2, V_0)		
Max. Sensitivity Angle	**MSA #1**	0° to 359°	Degrees	± 4°
Max. Sensitivity Angle	**MSA #2**	5° to 90°	Degrees	± 4°
Pickup				
10 mA Gnd CT	**P**	0.005 to 0.200 A	Amps	(TBD)
50 mA Gnd CT	**P**	0.025 to 1.000 A	Amps	0.0015 A or ± 3%
200 mA Gnd CT	**P**	0.020 to 2.500 A	Amps	(TBD)
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Min. Polarization Voltage	**VMIN**	2.0 to 10.0 %	% V_{nom}	± 3%
Action if $V_{pol} < V_{min}$		(Block Trip, Trip)		
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 67GS function (67GS #1 through 67GS #5) to be tested.

Test Setup:

1. Determine the 67GS Sensitive Ground Directional Overcurrent settings to be tested.

2. Enter the 67GS Sensitive Ground Directional Overcurrent settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

5. Connect the test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1.

Directional Pickup Test:

1. Refer to Figure 7-6 (forward looking) or Figure 7-7 (reverse looking) to perform this test.

2. Use IPScom Communications Software to monitor the 67GS function.

3. Apply a single phase voltage to polarize the relay. For example if voltage is applied to V_a only, then: $V_0 = V_2 = V_a/3$

4. Apply single phase current for the operating current I_g equal to 150 percent of the pickup **P** at an angle with respect to the polarizing voltage outside of the operate zone.

5. Slowly rotate the current in the positive phase direction until the **67GS Sensitive Ground Directional Overcurrent** virtual green LED illuminates.

   The angle of operation will be equal to **MSA** ± 90°.

6. Slowly decrease the current magnitude until the 67GS virtual green LED extinguishes. The current level of dropout will be just less than **P** ± the accuracy range in the Test Settings above.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Increase the current magnitude to 150 percent of pickup **P** and start timing. The contacts will close after **D** seconds ± the accuracy range in the Test Settings above. The test current must be in the trip region of the directional characteristic.

3. If Inverse Time Overcurrent is selected, refer to the test section 51GS for test instructions.

79   RECLOSER (TRIP RECLOSER SEQUENCE, 50HCL AND 27BSVS)

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Trip Recloser Sequence (per trip)

Function	1	2	3	4	5
50P	☐	☐	☐	☐	☐
50N	☐	☐	☐	☐	☐
50G(GS)	☐	☐	☐	☐	☐
51P	☐	☐	☐	☐	☐
51N	☐	☐	☐	☐	☐
51G(GS)	☐	☐	☐	☐	☐
51Q	☐	☐	☐	☐	☐
67P	☐	☐	☐	☐	☐
67N	☐	☐	☐	☐	☐
67G(GS)	☐	☐	☐	☐	☐
67Q	☐	☐	☐	☐	☐

79 **Recloser**
Sequence Coordination

Ground Precedence	**GP**	(Enable/Disable)		
Sequence Coordination	**SC**	(None/1/2/3) Active # of trips		
Phase Reclose Count	**PRC**	(0/1/2/3/4)		
Ground Reclose Count	**GRC**	(0/1/2/3/4)		

Reset Timers

After Auto Reclose	**T79RST**	1 to 1800 s	Seconds	± 0.01 s* or ± 1%
After Manual Close	**TMCRST**	1 to 1800 s	Seconds	± 0.01 s* or ± 1%

Time Delay for Reclose # (up to four total)

Phase Fault	**DP#**	0.01 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Ground Fault	**DG#**	0.01 to 600.00 s	Seconds	± 0.01 s* or ± 1%

High Current Lockout (per trip)
Phase Pickup

1 A CT	**50PLO**	0.10 to 100.00 A	Amps	± 0.02 A or ± 3%
5 A CT	**50PLO**	0.50 to 500.00 A	Amps	± 0.1 A or ± 3%
Time Delay	**DPLO**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%

Ground Pickup

1 A Gnd CT	**50RLO**	0.03 to 100.00 A	Amps	± 0.02 A or ± 3%
5 A Gnd CT	**50RLO**	0.15 to 500.00 A	Amps	± 0.1 A or ± 3%
Time Delay	**DRLO**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%

Bus Side Voltage Supervision

Min. Closing Voltage	**VMINCL**	0.00 to 300.00 V	Volts	± 0.2 V or ± 0.5%
Supervision Time	**TVMINCL**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%

Programmed Outputs

Phase Fault Trip:	**TRIP_PH**	(1 to 12)	OUT
Ground Fault Trip:	**TRIP_G**	(1 to 12) OUT	OUT
Reclose:	**79**	(1 to 12) OUT	OUT

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ∎**NOTE:** It is not necessary to test the pickup for the time overcurrent tripping elements. These tests are performed separately for each overcurrent function.

> ∎**NOTE:** Only enable the functions you are using to reclose.

Test Setup:

1. Determine the 79 Recloser settings to be tested.

2. Enter the 79 Recloser settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all **non-related** functions prior to testing.

4. Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

5. Connect the test current inputs as shown in Figure 7-3, Current Inputs: Configuration C1.

Real Time Recloser Status Monitoring:

1. Use S-7600 IPScom Communications Software to monitor the Recloser Status.

2. Select Monitor/Recloser Monitoring from the IPScom Main screen menu bar. IPScom will display the Recloser Monitoring screen (Figure 7-8) which displays the status of the following:

   - Fault Type (phase or ground)
   - Sequence Coordination
   - Trip Time
   - Breaker Status (per phase)
   - Reclose Time
   - Reclose Status (per phase)
     – reset
     – auto-reclose in-progress
     – locked out
   - Reclose Count (i.e., total number of recloses for both phase and ground)
   - High Current Lockout
   - Cold Load Pickup
   - Bus Voltage Supervision
   - Reset Time

Figure 7-8   Recloser Status Monitoring Screen

Real Time Function Status Monitoring:

1.   Use S-7600 IPScom Communications Software to monitor the Function Status.

2.   Select Monitor/Function Status from the IPScom Main screen menu bar. IPScom will display the Function Status screen (Figure 7-9) which displays the status of the following:

   •   Overcurrent element status (50P, 50G(GS), 50N, 51P, 51G(GS), 51N)

   •   Input and Output status

Figure 7-9   Function Status Screen

Reclose Delay Time Tests:

Figure 7-10 illustrates a two shot auto-reclose cycle that goes to lockout following the third trip. Observe the reclose delay time following each trip by monitoring the close output.

> ■**NOTE:** Reclose delays for phase and ground each trip can be set independently.

> ■**NOTE:** 51R represents 51G and/or 51N.

The close output will close after **D#** seconds (± the accuracy range in the Test Settings above) following the corresponding trip. 51R1 and 51R2 correspond to the residual time overcurrent elements. The neutral operating current ($3I_0$ or I_g) is based on the relay configuration.
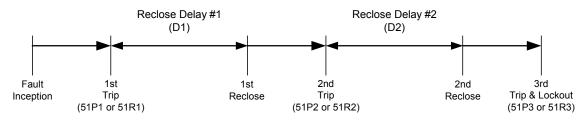
Figure 7-10   Two Shot Reclose Auto-Reclose Cycle

Ground Precedence Test:

Figure 7-11 illustrates how *ground precedence* works for a two shot auto-reclose cycle. Only the residual overcurrent elements (i.e., 51R1 and 51R2) can trip when ground precedence is enabled.

1.   Simulate a fault condition that picks up both the phase and residual overcurrent element for each trip (e.g., phase-to-phase-to-ground fault).

2.   Only the residual overcurrent elements will trip.
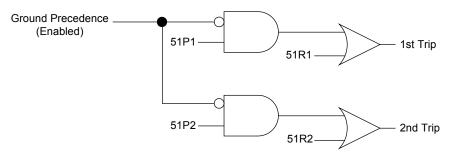
Figure 7-11   Ground Precedence

Sequence Coordination Test:

illustrates how *sequence coordination* works:
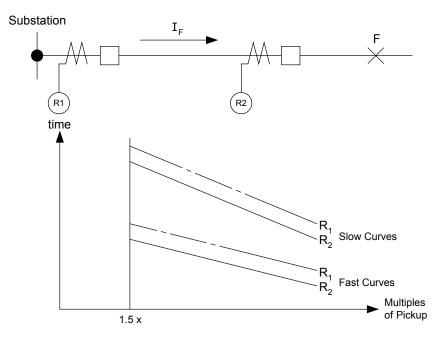
Figure 7-12   Sequence Coordination Example

Example: Recloser R_1 is located at the substation while recloser R_2 is a recloser located further downstream in the distribution system. Both reclosers are programmed to trip twice for an auto-reclose cycle then go to lockout. Both reclosers use a fast time overcurrent characteristic for the first trip and a slower time overcurrent characteristic for the second trip. The reclosers must maintain coordination so that for any faults beyond R_2 the recloser will trip first to minimize the outage. *Sequence coordination increments the trip count for recloser R_1 when it detects a fault but does not trip.* Therefore if the fault is still present following the first reclose at R_2 then R_1 will maintain coordination and not over trip dropping the entire feeder.

Sequence Coordination Trip:

1. Inject balanced three phase current high enough in magnitude to pick up 51P1.

2. Remove the current before 51P1 trips.

3. The recloser will increment.

4. Inject balanced three phase current high enough in magnitude to pick up 51P2.

5. 51P2 will trip.

6. Repeat steps 1 through 5 injecting single phase current to increment the trip counter and operate 51G2 or 51N2 based on the neutral operating current configuration ($3I_0$ or I_g).

50HCL High Current Lockout

High Current Phase Lockout Pickup Test:

1. Monitor the High Current Lockout function using either the Recloser Status Monitoring Screen **High Current Lockout** virtual LED or the trip output contact.

2. Inject balanced three phase current high enough in magnitude to pick up 51P1.

3. Quickly increase the current magnitude so that the high current phase lockout trips before 51P1. The current level of operation will be **50PLO** ± the accuracy range in the Test Settings above.

High Current Phase Lockout Time Test:

1. Connect a timer to the trip output contact so that the timer stops timing when the contacts close.

2. Repeat steps 1 and 2 from the High Current Phase Lockout Pickup Test.

3. Increase the current magnitude to 150 percent of pickup **50RLO** and start timing. The contacts will close after **DPLO** seconds ± the accuracy range in the Test Settings above.

High Current Ground Lockout Pickup Test:

1. Monitor the High Current Lockout function using either the Recloser Status Monitoring Screen **High Current Lockout** virtual LED or the trip output contact.

2. Inject single phase current high enough in magnitude to pick up 51R1.

3. Quickly increase the current magnitude so that the high current ground lockout trips before 51R1. The current level of operation will be **50RLO** ± the accuracy range in the Test Settings above.

High Current Ground Lockout Time Test:

1. Connect a timer to the trip output contact so that the timer stops timing when the contacts close.

2. Repeat steps 1 and 2 from the High Current Ground Lockout Pickup Test.

3. Increase the current magnitude to 150 percent of pickup **50RLO** and start timing. The contacts will close after **DRLO** seconds ± the accuracy range in the Test Settings above.

27 BSVS Bus Side Voltage Supervision

Bus Side Voltage Supervision Test:

Bus side voltage supervision is an undervoltage element. When the bus voltage on any phase is less than the pickup, then reclosing is blocked.

1. Monitor the **Bus Voltage Supervision** virtual LED in the Recloser Status Monitoring Screen.

2. Inject enough current to trip on minimum phase or ground.

3   Apply voltage and gradually decrease the magnitude. The Bus Voltage Supervision virtual LED will illuminate after the voltage magnitude drops below **VMINCL** (± the accuracy range in the Test Settings above) and **TVMINCL** time delay on pickup has expired.

81 FREQUENCY

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Pickup	**P**	40.00 to 65.00 Hz	Hz	± 0.02 Hz
Time Delay	**D**	0.00 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Hysteresis	**X**	0.0 to 1.0 Hz	Hz	
Programmed Outputs	**Z**	OUT	(1 to 12)	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Only enable the 81 function (81 #1 through 81 #4) to be tested.

Test Setup:

1. Determine the 81 frequency settings to be tested.

2. Enter the 81 frequency settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all other functions prior to testing.

4. Connect test voltage inputs as shown in <u>Figure 7-1</u>, Voltage Inputs: Configuration V1.

5. Apply nominal balanced three-phase voltage.

OVER FREQUENCY

Pickup Test:

1. Use IPScom Communications Software to monitor the 81 function status. Slowly increase the frequency until the **81 FREQUENCY** green virtual LED illuminates on the monitor function status screen to indicate that the function has picked up.

   The frequency level will be equal to **P** Hz ± the accuracy range in the Test Settings above, only if **P** is within 3 Hz of $f_{nom\ (60\ Hz)}$, otherwise it is ± 0.1 Hz.

2. Decrease the frequency to nominal frequency. The virtual LED(s) will extinguish.

3. Press **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply (**P** + 0.5) Hz and start timing. The contacts will close after **D** cycles ± the accuracy range in the Test Settings above, whichever is greater.

UNDER FREQUENCY

Pickup Test:

1. Use IPScom Communications Software to monitor the 81 function status. Slowly decrease the frequency until the **81 FREQUENCY** green virtual LED illuminates on the monitor function status screen to indicate that the function has picked up.

   The frequency level will be equal to **P** Hz ± the accuracy range in the Test Settings above, only if **P** is within 3 Hz of $f_{nom\ (60\ Hz)}$, otherwise it is ± 0.1 Hz.

2. Increase the frequency to nominal frequency. The virtual LED(s) will extinguish.

3. Press **TARGET RESET** pushbutton to reset targets.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Apply (**P** – 0.5) Hz and start timing. The contacts will close after **D** cycles ± the accuracy range in the Test Settings above, whichever is greater.

81R   RATE OF CHANGE OF FREQUENCY (#1, #2)

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: None

TEST SETTINGS:

Pickup	**P**	0.20 to 5.00 Hz/s	Hz/Sec	± 0.02 Hz/s
Time Delay	**D**	0.00 to 2.00 s	Seconds	± 0.01 s* or ± 1%
Negative-Sequence Voltage Inhibit	**N**	0 to 99	%	
Programmed Outputs	**Z**	(1 to 12)	OUT	
Function 81			See Below	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

> ■**NOTE:** Testing of the 81R function requires a three-phase voltage source capable of smoothly sweeping the frequency of all voltages at a variable rate, continuously.

Test Setup:

1.   Disable all other functions prior to testing.

2.   Confirm settings to be tested.

3.   Connect test voltage inputs as shown in Figure 7-1, Voltage Inputs: Configuration V1.

4.   It is recommended that the 81 function be used to establish a window of operation for the 81R function which is smaller than the actual sweep range of the frequency applied. This is accomplished by enabling 81#1 to pickup at a frequency 1 Hz higher than the minimum frequency of the ramp, and assign a unique output. Set 81#2 to pickup 1 Hz lower than the maximum frequency of the ramp, and assign a unique output (see Figure 7-13). The frequencies given are suggested for testing rates below 10 Hz/S. Higher rates will require consideration of the capabilities of the test equipment involved. Connect both of these outputs to an input with jumpers, and set the 81R function to block on this input (see Figure 7-14). Set the time delays and seal-in times of the 81 functions to minimum. This setup results in an operational window that is free of erroneous Hz/S measurements when the voltage source begins or ends a sweep.

Figure 7-13   Function 81R Blocking Regions

It is important to remember that the 81 elements being used will operate in the 81R blocking regions, and the 81R output contact operation must be distinguished from the 81 output contacts when using this setup.
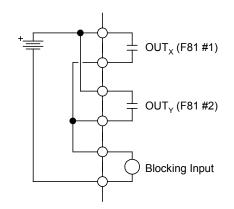
Figure 7-14   Function 81R Connection Diagram

Pickup Test:

1. Apply nominal voltage to all three phases. Calculate the time for the pickup setting and apply a sweep rate 25% less than the pickup (**P**).

2. Use IPScom Communications Software to monitor the 81R function status. Slowly increase the sweep rate until the **81R FREQUENCY** green virtual LED illuminates on the monitor function status screen to indicate that the function has picked up.

    The level will be equal to **P** ± the accuracy range in the Test Settings above.

3. Decrease the sweep rate until the **81R FREQUENCY** green virtual LED extinguishes.

Timer Test:

1. Reset targets and apply nominal voltage to all three phases at a sweep rate 25% below **P**.

2. Apply a sweep rate 25% above **P** with the associated output contact connected to a timer and start timing. The output contact will close after **D** cycles ± the accuracy range in the Test Settings above.

CLP   COLD LOAD PICKUP

VOLTAGE INPUTS: Configuration V1

CURRENT INPUTS: Configuration C1

TEST SETTINGS:

Time Locked Out to Activate Cold Load	**CLT**	Seconds	(1 to 60000)
Number of Recloses	**#79**		(0 to 4)

Restore to Normal:

Active Duration	**AD**	Seconds	(1 to 10000)
$I_{ph} < \%\ I_{nom}$	**%IPH**	Percent	(0 to 100)
$I_g < \%\ I_{nom}$	**%IG**	Percent	(0 to 100)
Time Delay	**TD**	Seconds	(0.01 to 600.00)

Reclose Timers (Same for phase and ground):

Reclose Timer 1	**D1**	Seconds	(0.01 to 600.00)
Reclose Timer 2	**D2**	Seconds	(0.01 to 600.00)
Reclose Timer 3	**D3**	Seconds	(0.01 to 600.00)
Reclose Timer 4	**D4**	Seconds	(0.01 to 600.00)

50P1:

Pickup	**P1**	Amps	(0.02 to 20.00)
Definite Time	**D01**	Seconds	(0.00 to 600.00)

50G1:

Pickup	**P2**	Amps	(0.02 to 20.00)
Definite Time	**D02**	Seconds	(0.00 to 600.00)

51P1 (Minimum Phase Trip):

Pickup	**P3**	Amps	(0.02 to 3.20)
Curve:	**C3**		

   IEC – Inverse, Very Inverse, Extremely Inverse
   US – Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse
   IEEE – Moderately Inverse, Very Inverse, Extremely Inverse
   Traditional Recloser – 101 to 202

Time Multiplier	**TM**		
IEC			(0.05 to 1.00)
US			(0.05 to 15.00)
IEEE			(0.10 to 25.00)
Traditional Recloser			(0.10 to 2.00)
Time Adder	**TA**	Seconds	(0.00 to 30.00)
Min. Response Time Adder	**MRTA**	Seconds	(0.00 to 1.00)
Electromechanical Reset	**ER**		(Enabled, Disabled)

51N1 or 51G1 (<u>Minimum Ground Trip</u>):

*P*ickup	**P4**	Amps	(0.02 to 3.20)

Curve:	**C4**	

    IEC – Inverse, Very Inverse, Extremely Inverse

    US – Moderately Inverse, Standard Inverse, Very Inverse, Extremely Inverse, Short Time Inverse

    IEEE – Moderately Inverse, Very Inverse, Extremely Inverse

    Traditional Recloser – 101 to 202

Time Multiplier	**TM**		
IEC			(0.05 to 1.00)
US			(0.05 to 15.00)
IEEE			(0.10 to 25.00)
Traditional Recloser			(0.10 to 2.00)
Time Adder	**TA**	Seconds	(0.00 to 30.00)
Min. Response Time Adder	**MRTA**	Seconds	(0.00 to 1.00)
Electromechanical Reset	**ER**		(Enabled, Disabled)

*P**hase High Current Lockout:***

Pickup	**P**	Amps	(0.10 to 100.00)
Definite Time	**D**	Seconds	(0.00 to 600.00)

*G**round High Current Lockout:***

Pickup	**P**	Amps	(0.03 to 100.00)
Definite Time	**D**	Seconds	(0.00 to 600.00)

> ■**NOTE:** Only enable the Cold Load Pickup Functions to be tested.

Test Setup:

1. Determine the Cold Load Pickup settings to be tested.

2. Enter the Cold Load Pickup settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

3. Disable all **non-related** functions prior to testing.

4. Connect test voltage inputs as shown in <u>Figure 7-1</u>, Voltage Inputs: Configuration V1.

5. Connect test current inputs as shown in <u>Figure 7-3</u>, Current Inputs: Configuration C1.

Real Time Monitoring:

1. Use IPScom Communications Software to monitor the Cold Load Pickup function.

2. From the IPScom Main screen menu bar select Monitor/Recloser Monitoring. IPScom will display the Recloser Monitoring screen (<u>Figure 7-8</u>) which displays the Cold Load Pickup status.

Figure 7-15   Recloser Status Monitoring Screen

Time to Activate Cold Load Pickup Test:

1. Place the recloser in the lockout state.

2. Use the IPScom Recloser Status Monitoring screen to monitor the **Cold Load Pickup** virtual LED.

   ■**NOTE:** The breaker must be closed.

3. The Cold Load Pickup virtual LED will illuminate in **CLT** seconds (±0.5 cycles) after the recloser goes to lockout.

Overcurrent Pickup and Time Tests:

Repeat the pickup and time tests for the following overcurrent elements using the governing settings while the recloser is in the Cold Load Pickup state:

50P1, 50G(GS)1*, 50N1*, 51P1, 51N1*, 51G(GS)1*, High Current Phase Lockout, High Current Ground Lockout

* The neutral operating current configuration ($3I_0$ or I_g) determines which function is active.

Reclose Timer Tests:

The recloser loads new settings for the reclose timers and the total number of recloses while it is in the Cold Load Pickup state.

■**NOTE:** The recloser uses the same settings for both phase and ground faults during this condition.

Repeat the reclose timer tests using the governing settings while the recloser is in the Cold Load Pickup state:
D1, D2, D3, D4

Restore to Normal Tests:

Figure 7-16 illustrates how the recloser determines when to restore normal settings following Cold Load Pickup.

■**NOTE:** The breaker must be closed (that is, 52A contact is asserted).
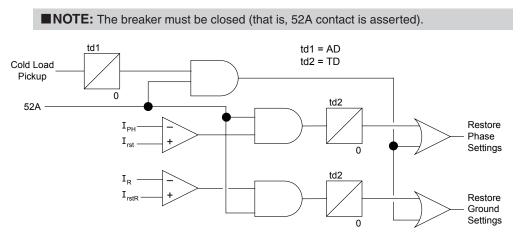
Figure 7-16   Restore to Normal Logic Diagram

I_{rst} and I_{rstR} respectively refer to the pickup settings **%IPH** and **%IG**. I_R is the neutral operating current ($3I_0$ or I_g).

Active Duration Time Test:

1.   Place the recloser in the lockout state with no current applied to the recloser.

2.   Use the IPScom Recloser Status Monitoring screen to monitor the **Cold Load Pickup** virtual LED. The recloser must be in the Cold Load Pickup state before proceeding to the next step.

■**NOTE:** The breaker must be closed.

3.   Apply phase current greater in magnitude than **%IPH** and ground current greater than **%IG**.

4.   The Cold Load Pickup virtual LED will extinguish in **AD** seconds (±0.5 cycles).

Time Delay Test:

1.   Place the recloser in the lockout state with no current applied to the recloser.

2.   Use the IPScom Recloser Status Monitoring screen to monitor the **Cold Load Pickup** virtual LED. The recloser must be in the Cold Load Pickup state before proceeding to the next step.

■**NOTE:** The breaker must be closed.

3.   Apply phase current less than **%IPH** and ground current less than **%IG**.

4.   The Cold Load Pickup virtual LED will extinguish in **TD** seconds (±0.5 cycles).

HLT   HOT LINE TAG

■**NOTE:** The M-7679 will trip for a fault then go to lockout when Hot Line Tag is enabled and the recloser control switches over to reserved settings for 50P, 51P, 50G/GS and 51G/GS. Enable Hot Line Tag to test these settings.

Follow the guidelines presented in this section as appropriate for 50P, 51P, 50G/GS and 51G/GS.

The M-7679 will drive to lockout immediately following a trip. You will not be able to issue a close command from the front panel, via SCADA until the auto-reclose function is reset.

■**NOTE:** Hot Line Tag settings take precedence when Cold Load Pickup is active.

TCM   TRIP CIRCUIT MONITORING

VOLTAGE INPUTS: As Described

CURRENT INPUTS: None

TEST SETTINGS:

Time Delay	**D**	0.01 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

Test Setup:

1.   Determine the Trip Circuit Monitoring function settings to be tested.

2.   Disable all other functions prior to testing.

3.   Connect a DC voltage supply capable of supplying 24/48/125/250 Vdc (marked on the rear of the recloser control) across the input selected for Trip Circuit monitoring.

4.   Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

> ■**NOTE:** This procedure assumes the input selected for the Trip Coil Monitor is in the active state when Open.

Pickup and Time Test:

1.   Enable the Trip Circuit Monitoring function and then enter the settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

2.   Apply the applicable DC voltage (24/48/125/250 Vdc, marked on the rear of the recloser control) across the selected TCM input.

3.   If the DC voltage is removed from the input then the virtual green **TCM** LED will illuminate on the Function Status Monitor. The virtual red **TCM** LED will then illuminate once the function has timed out after **D** seconds ± the accuracy range in the Test Settings above.

4.   Re-apply the applicable DC voltage and the virtual LEDs will extinguish.

CCM   CLOSE CIRCUIT MONITORING

VOLTAGE INPUTS: As Described

CURRENT INPUTS: None

TEST SETTINGS:

Time Delay	**D**	0.01 to 600.00 s	Seconds	± 0.01 s* or ± 1%
Programmed Outputs	**Z**	(1 to 12)	OUT	

*An additional measurement time of 1 cycle needs to be added to the measured time delay.

Test Setup:

1. Determine the Close Circuit Monitoring function settings to be tested.

2. Disable all other functions prior to testing.

3. Connect a DC voltage supply capable of supplying 24/48/125/250 Vdc (marked on the rear of the recloser control) across the input selected for Close Circuit monitoring.

4. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

> ■**NOTE:** This procedure assumes the input selected for the Close Coil Monitor is in the active state when Open.

Pickup and Time Test:

1. Enable the Close Circuit Monitoring function and then enter the settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

2. Apply the applicable DC voltage (24/48/125/250 Vdc, marked on the rear of the recloser control) across the selected CCM input.

3. If the DC voltage is removed from the input then the virtual green **CCM** LED will illuminate on the Function Status Monitor. The virtual red **CCM** LED will then illuminate once the function has timed out after **D** seconds ± the accuracy range in the Test Settings above.

4. Re-apply the applicable DC voltage and the virtual LEDs will extinguish.

BM   BREAKER MONITOR AND ACCUMULATOR

VOLTAGE INPUTS: None

CURRENT INPUTS: As Described

TEST SETTINGS:

Pickup	**P**	(1 to 60,000)	Cycles*
Delay	**D**	(0.00 to 600.00)	Seconds
Timing Method		$(I^{1.5}T, IT$ or $I^2T)$	
Preset Accumulators: Phase A, B, or C		(0 to 60,000)	
Programmed Outputs	**Z**	(1 to 12)	OUT
Blocking Inputs		(1 to 12)	
Output Initiate		(1 to 12)	
Input Initiate		(1 to 12)	

*kA cycles, $kA^{1.5}$ cycles or kA^2 cycles is dependent on the Timing Method that is selected.

Test Setup:

1. Determine the Breaker Monitoring Function settings to be tested (Input Initiate or Output Initiate).

2. Enter the Breaker Monitoring Function settings to be tested utilizing IPScom Communications Software.

3. Connect a current input to I_1 terminals 1 and 2, I_2 terminals 3 and 4, and I_3 terminals 5 and 6.

Accumulator Test:

1. Apply a current value that considers Timing Method and Pickup Setting to current input I_1.

2. Energize the designated input and/or assert the output contact selected as initiate.

3. Utilizing IPScom Communications Software (Monitor/Breaker Accumulator Status), verify that the Accumulator Status value for Phase A increments in **D** cycles ±1 cycle or ±1%.

4. De-assert the output and/or de-energize the input in Step 2.

5. Decrease applied I_1 current to 0 amps.

6. If desired, repeat test for I_2 and I_3.

Pickup Test:

1. Apply a current value that considers Timing Method and Pickup Setting to current input I_1.

    ■**NOTE:** If the target pickup setting is a large value, the Preset Accumulator Settings feature can be used to pre-set the accumulator values to just below the target setting.

2. Utilizing IPScom Communications Software (Monitor/Breaker Accumulator Status) to monitor the accumulator value, energize the designated input or assert the output contact selected as initiate and then de-energize the input or de-assert the output.

    Following the time out of the delay the accumulator will increment. Repeat as necessary to increment the accumulator to a point where the pickup setting is exceeded.

3. When the accumulator value exceeds the pickup value the **OUTPUT** LED(s) will illuminate and the function status indicator on the **Monitor Function Status** screen indicates that the function has picked up.

    The output contacts **Z** will operate in **D** cycles ±1 cycle or ±1% from the last initiate.

4. If desired, repeat test for I_2 and I_3.

PSM   IED POWER SUPPLY MONITORING

VOLTAGE INPUTS: + and – Terminals on the Power Supply inputs

CURRENT INPUTS: None

TEST SETTINGS: Power Supply Type   Low Voltage   or   High Voltage
                                                             (24/48 Vdc)   (125/220 Vac/Vdc)

Time Delay	**D**	Seconds	(0 to 60000)
Reference High Voltage	**VHI**	Volts	(60.0 to 300.0)
Reference Low Voltage	**VLO**	Volts	(60.0 to 250.0)
Programmed Outputs	**Z**	OUT	(1 to 4)
Blocking Inputs			(4)

> ■**NOTE:** The range of the Low Voltage Power Supply is 18–60 Vdc. The range of the
>   High Voltage Power Supply is 90–280 Vac/90–315 Vdc.

Test Setup:

1. Apply a variable voltage source to the power supply. Set the output voltage from the source equal to the nominal rating of the power supply.

2. Determine the Power Supply Monitoring settings to be tested.

3. Enter the Power Supply Monitoring settings to be tested utilizing either the HMI or S-7600 IPScom Communications Software.

High Voltage Test:

1. Use IPScom Communications Software to monitor the **PSM** green virtual LED. Slowly increase the output voltage from the source. The **PSM** green virtual LED will illuminate when the output voltage from the source is **VHI** (±3 Vac or ±2 Vdc).

2. Lower the supply voltage to the nominal rating of the power supply. The **PSM** green virtual LED will extinguish.

Low Voltage Test:

1. Slowly decrease the output voltage from the source. The **PSM** green virtual LED will illuminate when the output voltage from the source is **VLO** (±3 Vac or ±2 Vdc).

2. Raise the supply voltage to the nominal rating of the power supply. The **PSM** green virtual LED will extinguish.

Time Test:

1. Connect a timer to output contacts **(Z)** so that the timer stops timing when the contacts **(Z)** close.

2. Raise the supply voltage to (**VHI** + 4) Volts. The contacts will close after **D** seconds ±0.5 cycles.

7.3   Auto Calibration

VT Calibration Procedure
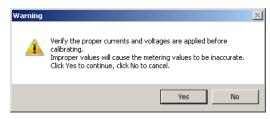
The M-7679 Recloser Control includes an Auto Calibration feature. To perform an automatic calibration proceed as follows:
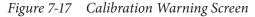
Required Equipment

- Voltage source capable of providing a 120 Vac source voltage
- Voltage source capable of providing a 0.1 to 12.5 Vac source voltage
- Current source capable of providing a 1 Amp current source
- Current source capable of providing a 50 mA current source

Calibration Procedure

1. Determine the recloser voltage input configuration, then connect the voltage source as shown in Figure 7-22.

2. Determine the recloser current input configuration, then connect the current source as shown in Figure 7-23.

3. Apply the appropriate voltage to the unit.
   - 120 Vac for VT and LEA High voltage
   - 5 Vac for LEA Low Voltage

4. Apply the appropriate current to the unit:
   - 1 Amp ∠0° current
   - 50 mA ∠0° current

5. Start S-7600 IPScom Communications Software, then connect to the control.

6. From the IPScom Main Screen select Utility/Calibrate. IPScom will display the "Calibration Warning" screen (Figure 7-17).

Figure 7-17   Calibration Warning Screen

7. Select "Yes". IPScom will display the "Confirm Calibration" screen (Figure 7-18).

Figure 7-18   Confirm Calibration Screen

8. Select "OK". IPScom will respond in one of the following manners:
   • If LEA input hardware is not present on the unit, the calibration process will initiate. Go to Step 11.
   • If LEA input hardware is present on the unit, then IPScom will display the LEA Calibration Voltage dialog screen Figure 7-19. Go to Step 9.

Figure 7-19   LEA Calibration Voltage Dialog Screen

9. Select "Low Voltage" or "High Voltage".

10. Enter the appropriate voltage for the inputs being calibrated, then select "Calibrate".

11. When the calibration is Successful without any errors, IPScom will display the "Calibration Successful" confirmation screen (Figure 7-20).
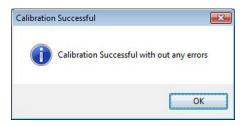
Figure 7-20   Calibration Successful Screen

When the calibration is complete but with errors, IPScom will display the "Calibration Done" screen (Figure 7-21) listing any errors.

Figure 7-21   Calibration Done with Errors Screen

12. Restore the Control and current and voltage inputs to the pre-calibration configuration.
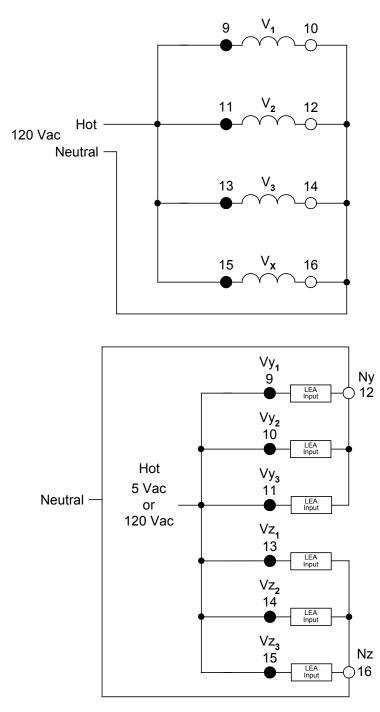
Figure 7-22   Calibration Voltage Input Configuration
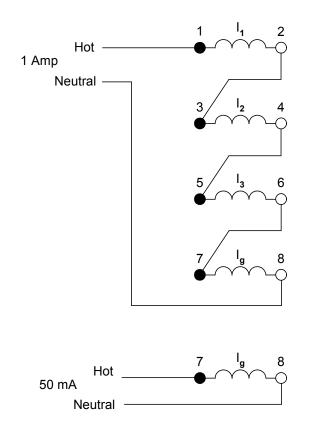
Figure 7-23   Calibration Current Input Configuration

A HMI Menus

■ **CYBER SECURITY NOTE:**

When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

HMI Menu Flow
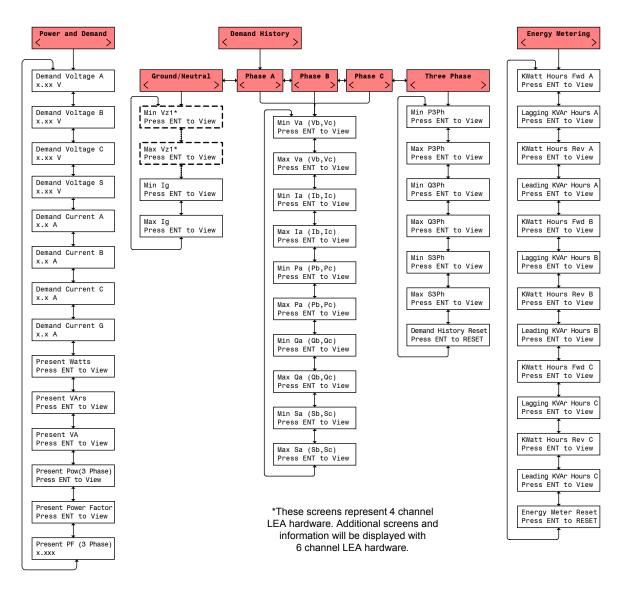
```
        MONITOR
    < UTIL      SETP >
```

```
    Primary Metering
    <              >
```

```
    Secondary Metering
    <              >
```

```
Current and Voltages          Seq Components              Power
<              >           <              >          <              >
```

```
Current and Voltages                                    Seq Components
<              >                                     <              >
```

```
 Va  *            V1  *            Watts A
 x V              x V              x.xx W
```

```
 Vb  *            V2  *            Watts B
 x V              x V              x.xx W
```

```
 Vc  *            Vo  *            Watts C
 x V              x V              x.xx W
```

```
 Vz1 *            I1               VArs A
 x V              x A              x.xx var
```

```
 Ia               I2               VArs B
 x A              x A              x.xx var
```

```
 Ib               Io               VArs C
 x A              x A              x.xx var
```

```
 Ic                                VA A
 x A                               x.xx VA
```

```
 In/Ig                             VA B
 x A                               x.xx VA
```

```
       Magnitude               Phase
    <          >           <          >
```

```
V1(V)V2(V)V3(V)*
  x.x  x.x  x.x
```

```
Va(V)Vb(V)Vc(V)*      Va(dg)Vb(dg)Vc(dg)*
  x.x  x.x  x.x         x.x  x.x   x.x
```

```
I1(A) I2(A) Io(A)
  x.x  x.x   x.x
```

```
Vz1(V)*              Vz1(dg)*
Press ENT to View      x.x
```

```
Ia(A) Ib(A) Ic(A)   Ia(dg) Ib(dg) Ic(dg)
  x.x  x.x   x.x      x.x    x.x    x.x
```

```
In/Ig(A)            In/Ig(dg)
  x.xxx               x.x
```

```
 VA C
 x.xx VA
```

*These screens represent 4 channel
LEA hardware. Additional screens and
information will be displayed with
6 channel LEA hardware.

```
 Watts(3 Phase)
 x.xx W
```

```
 VArs(3 Phase)
 x.xx var
```

```
 VA(3 Phase)
 x.xx VA
```

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ← → to move sideways to the adjacent Menu Header.

Figure A-1   Monitor Menu Flow (1 of 3)

Figure A-1   Monitor Menu Flow (2 of 3)

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ←   → to move sideways to the adjacent Menu Header.

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ← → to move sideways to the adjacent Menu Header.

Figure A-1   Monitor Menu Flow (3 of 3)

Figure A-2   Setpoints Menu Flow (1 of 2)

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ←   → to move sideways to the adjacent Menu Header.

```
    SETPOINTS
 ⟨MNTR      CNFG⟩
```

Continued

Setpoint Profile
Selected for Editing

```
Overcurrent  (P1)
⟨              ⟩
```

Three Phase Ganged

```
   Phase ABC
⟨            ⟩
```

```
   Element #1
⟨            ⟩
```            ```
  Elements #2-#5
⟨   ⟩
```

```
   50PABC #1
⟨   ⟩
```   ```
   51PABC #1
⟨   ⟩
```   ```
  HCL PABC #1
⟨   ⟩
```

```
Enable 50PABC #1
DISABLE
```   ```
Enable 51PABC #1
DISABLE
```   ```
Enable HCLPABC #1
DISABLE
```

```
Pickup 50PABC #1
xx.xx A
```   ```
Pickup 51PABC #1
x.xx A
```   ```
Pickup HCLPABC #1
xxx.xx A
```

```
Time Delay 50PABC #1
xxx.xx s
```   ```
Curve 51PABC #1
IEC Inv
```   ```
Tm Delay HCLPABC #1
xxx.xx s
```

**Independent Phase**

```
    Phase A
⟨   ⟩
```   ```
    Phase B
⟨   ⟩
```   ```
    Phase C
⟨   ⟩
```

```
   Element #1
⟨   ⟩
```   ```
  Elements #2-#5
⟨   ⟩
```

```
   50PA #1
⟨            ⟩
```      ```
   51PA #1
⟨   ⟩
```   ```
  HCL PA #1
⟨   ⟩
```

```
Enable 50PA #1
DISABLE
```      ```
Enable 51PA #1
DISABLE
```   ```
Enable HCLPA #1
DISABLE
```

```
Pickup 50PA #1
xx.xx A
```      ```
Pickup 51PA #1
x.xx A
```   ```
Pickup HCLPA #1
xxx.xx A
```

```
Time Delay 50PA #1
xxx.xx s
```      ```
Curve 51PA #1
IEC Inv
```   ```
Tm Delay HCLPA #1
xxx.xx s
```

⚠ **CAUTION: When Operation Mode is 3T3LO, all settings must be identical for Phases A, B and C for proper control operation.**

```
     Gnd
⟨            ⟩
```

```
   Element #1
⟨            ⟩
```            ```
  Elements #2-#5
⟨   ⟩
```

```
   50G(GS) #1
⟨   ⟩
```   ```
   51G(GS) #1
⟨   ⟩
```

When HCL Operating
Current Reference is "G"

```
  HCL G(GS) #1
⟨            ⟩
```

```
Enable 50G #1
DISABLE
```      ```
Enable 51G #1
DISABLE
```   ```
Enable HCLG #1
DISABLE
```

```
Pickup 50G #1
xx.xx A
```      ```
Pickup 51G #1
x.xx A
```   ```
Pickup HCLG #1
xxx.xx A
```

```
Time Delay 50G #1
xxx.xx s
```      ```
Curve 51G #1
IEC Inv
```   ```
Tm Delay HCLG #1
xxx.xx s
```

```
    Residual
⟨              ⟩
```

```
   Element #1
⟨            ⟩
```            ```
  Elements #2-#5
⟨   ⟩
```

When HCL Operating Current
Reference is "3IO"

```
   50N #1
⟨   ⟩
```   ```
   51N #1
⟨   ⟩
```   ```
  HCL N #1
⟨   ⟩
```

```
Enable 50N #1
DISABLE
```   ```
Enable 51N #1
DISABLE
```   ```
Enable HCLN #1
DISABLE
```

```
Pickup 50N #1
xx.xx A
```   ```
Pickup 51N #1
x.xx A
```   ```
Pickup HCLN #1
xxx.xx A
```

```
Time Delay 50N #1
xxx.xx s
```   ```
Curve 51N #1
IEC Inv
```   ```
Tm Delay HCLN #1
xxx.xx s
```

**NOTE: Items in GRAY will be displayed ONLY with the optional Independent Phase Capable Recloser**

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ←  → to move sideways to the adjacent Menu Header.

*Figure A-2    Setpoints Menu Flow (2 of 2)*

*Figure A-3    Configuration Menu Flow*

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ←  → to move sideways to the adjacent Menu Header.

```
           ┌─────────────────┐
           │    UTILITIES    │
           │⟨COMM      MNTR⟩ │
           └────────┬────────┘
                    │
   ┌────────────┬───┴────────┬──────────────┬──────────────────┬──────────────────┬──────────────────┐
```

About	Battery Charger	Comm Status
⟨ ⟩	⟨ ⟩	⟨ ⟩

		DSP COMM STATUS	COM1 ERR STATUS	COM4 ERR STATUS	Ethernet Status
		⟨ ⟩	⟨ ⟩	⟨ ⟩	⟨ ⟩

Serial Number	Aux Power	SEQUENCE ERR CNT	Overrun Error Cnt	Overrun Error Cnt	RX OK Frame Count
xxxxx	DISABLE	x	x	x	x

Program Version	Battery Load Test	CRC ERR CNT	Parity Error Cnt	Parity Error Cnt	RX ERR Frame Count
D-O347Vxx.xx.xx	Press ENT to begin	x	x	x	x

Bootloader Version	Battery charger cal.	NO RESPONSE CNT	Framing Error Cnt	Framing Error Cnt	RX Multicast Count
D-0349Vxx:xx:xx	Press ENT to begin	x	x	x	x

Setpoints Checksum	Battery threshold	COMMAND REPEAT CNT	Break interrupt	Break interrupt	RX Unicast Count
EE=xxxx CALC=xxxx	xx.xx V	x	x	x	x

Calib. Checksum		SEQUENCE NUMBER	RX bytes counter	RX bytes counter	RX Broadcast Count
EE=xxxx CALC=xxxx		xxxxxxx	x	x	x

		RX PKT CNT	TX bytes counter	TX bytes counter	TX OK Frame Count
		xxxxxxxx	x	x	x

		TX PKT CNT			TX ERR Frame Count
		xxxxxxxx			x

					TX Collision Count
					x

```
           ┌─────────────────┐
           │    UTILITIES    │
           │⟨COMM      MNTR⟩ │
           └─────────────────┘
```

Continued

Disk Info	Calibration/Test
⟨ ⟩	⟨ ⟩

	Calibration Magn	Calibration Phase	Calibration Offset	LED Scroll Test	Button Input Test	Reset Counters
	⟨ ⟩	⟨ ⟩	⟨ ⟩	⟨ ⟩	⟨ ⟩	⟨ ⟩

Free Space	Magnitude Ch0	Phase Ch0	Offset Ch0	LED Scroll Test	Button Input Test	Powerdown Count
xxxx.xx MB	xxxx	R=xxxx I=xxxx	xxxx	Test in progress...	Key:NONE	X

Life Remained	Repeats for	Repeats for	Repeats for			Watchdog Count
xx %	Magnitude Ch1 thru Ch7	Phase Ch1 thru Ch7	Offset Ch1 thru Ch7			X

Bad Blocks						
x						

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ← → to move sideways to the adjacent Menu Header.

Figure A-4   Utilities Menu Flow

```
┌──────────────────────┐
│   COMMUNICATIONS      │
│ ⟨CNFG        UTIL⟩    │
└──────────────────────┘
```

PORT1 Settings	PORT4 Settings	Comm ports security		Comm Settings
⟨ ⟩	⟨ ⟩	⟨ ⟩		⟨ ⟩

PORT1 Settings	PORT4 Settings	Physical Ports	Protocol access	Comm Settings
Protocol MODBUS	Protocol MODBUS	USB Port ENABLE	Modbus Protocol ENABLE	Modbus Address 1
Baud Rate 115200 bps	Baud Rate 115200 bps	COM1 Port ENABLE	DNP TCP DISABLE	DNP Address 1
Parity NONE	Parity NONE	COM4 Port ENABLE	DNP UDP DISABLE	
Stop Bit 1	Stop Bit 1	SD CARD ENABLE	IEC61850 DISABLE	
TX Delay 10 ms	TX Delay 10 ms	ETHERNET Port ENABLE	ICMP ENABLE	
Sync Time 100 ms	Sync Time 100 ms		HTTP DISABLE	
Port Type RS-232/RS-485	Port Type RS-232/RS-485		IPSEC DISABLE	
			Radius DISABLE	
			Radius accounting DISABLE	
			Remote FW Update DISABLE	

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ←   → to move sideways to the adjacent Menu Header.

Figure A-5   Communications Menu Flow (1 of 2)

```
    COMMUNICATIONS
  ‹ CNFG        UTIL ›
```

Continued

Memory Card ‹ ›	**Ethernet** ‹ ›	**HMI** ‹ ›
Load Setpoints Press ENT to begin	**Settings** ‹ › ↔ **Status** ‹ ›	Set LCD Contrast *************
Save Setpoints Press ENT to begin	Static IP Address x. x. x. x	IP Address x. x. x. x
Save Datalog range Press ENT to begin	Net Mask x. x. x. x	Net Mask x. x. x. x
Save Datalog Press ENT to begin	Gateway x. x. x. x	Gateway x. x. x. x
Save Seq. rec Press ENT to begin	DHCP Enable ENABLE	MAC Address xx:xx:xx:xx:xx:xx
Save Seq. rec range Press ENT to begin	Modbus Port 502	
Save Oscillograph Press ENT to begin	DNP Port 20000	Radius accnt. port 1 1813
Save Tse. rec Press ENT to begin	SNTP Enable DISABLE	Radius server IP 2 x. x. x. x
Clone Save Press ENT to begin	SNTP Server IP x. x. x. x	Radius server port 2 1814
Clone Load Press ENT to begin	Auto Negotiate ENABLE	Radius accnt. port 2 1815
Save Metering Data Press ENT to begin	IP Keepalive timer 120 sec	Radius secret dfltsec
Firmware Update Press ENT to begin	Radius server IP 1 x. x. x. x	IPSEC log DISABLE
Bootloader Update Press ENT to begin	Radius server port 1 1812	

At any menu screen:

Press EXIT to go to the Menu Header.

Press either ←   → to move sideways to the adjacent Menu Header.

Figure A-5   Communications Menu Flow (2 of 2)

B   Recloser Control I/O Configuration Worksheet

This Appendix contains a copy of the Recloser Control Input/Output Configuration Table and is herein provided to define and record the inputs and outputs configuration for the recloser control. For each function, check if **DISABLED** or **ENABLED**, then check the output contacts to be operated by the function. Also check the inputs designated to block the function operation.

Additional copies of the worksheet can be printed to record I/O configuration for up to 8 profiles. Examples of the suggested use of these forms are illustrated in **Chapter 5**, **Setpoints** and **Chapter 2**, **Operation**.

An interactive pdf Record Form is available for download from our website BeckwithElectric.com. This document may be used to record and save all configuration and setpoint settings. The pdf also contains an integrated Input/Output Map.

■**NOTE:** The M-7679 is shipped with all functions disabled.

■ **CYBER SECURITY NOTE:**
When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

Profile #

Function	Enable	Disable	OUTPUTS 1	2	3	4	5	6	7	8	9	10	11	12	BLOCKING INPUTS 1	2	3	4	5	6	7	8	9	10	11	12	FL	Virtual Input V1	V2	V3
25 – Sync Check																														
25																														
27 – Undervoltage																														
27 #1 (ABC)																														
27 #1 A																														
27 #1 B																														
27 #1 C																														
27 #2 (ABC)																														
27 #2 A																														
27 #2 B																														
27 #2 C																														
27 #3 (ABC)																														
27 #3 A																														
27 #3 B																														
27 #3 C																														
27 #4 (ABC)																														
27 #4 A																														
27 #4 B																														
27 #4 C																														
27PP – Phase to Phase Undervoltage																														
27PP (ABC)																														
27PP AB																														
27PP BC																														
27PP CA																														

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 1 of 11)

Profile #

Function	Enable	Disable	OUTPUTS												BLOCKING INPUTS													Virtual Input		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	FL	V1	V2	V3
27Vz1 – Vz1 Undervoltage																														
27Vz1																														
32 – Directional Power																														
32 #1 (ABC)																														
32 #2 (ABC)																														
32 #3 (ABC)																														
32 #4 (ABC)																														
46DT – Negative Sequence Definite Time Overcurrent																														
46DT #1																														
46DT #2																														
46DT #3																														
46DT #4																														
46DT #5																														
46IT – Negative Sequence Inverse Time Overcurrent																														
46IT #1																														
46IT #2																														
46IT #3																														
46IT #4																														
46IT #5																														

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 2 of 11)

Profile #

Function	Enable	Disable	OUTPUTS 1	2	3	4	5	6	7	8	9	10	11	12	BLOCKING INPUTS 1	2	3	4	5	6	7	8	9	10	11	12	FL	Virtual Input V1	V2	V3
47 – Negative Sequence Overvoltage																														
47																														
50BF – Breaker Failure																														
50BF							Retrip Output								Input Initiate															
							Outputs								Blocking Inputs												−			
50P – Phase Instantaneous/Definite Time Overcurrent																														
50P #1 (ABC)																														
50P #1 A																														
50P #1 B																														
50P #1 C																														
50P #2 (ABC)																														
50P #2 A																														
50P #2 B																														
50P #2 C																														
50P #3 (ABC)																														
50P #3 A																														
50P #3 B																														
50P #3 C																														
50P #4 (ABC)																														
50P #4 A																														
50P #4 B																														
50P #4 C																														

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 3 of 11)

Profile #

Function	Enable	Disable	OUTPUTS												BLOCKING INPUTS													Virtual Input		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	FL	V1	V2	V3
50P – Phase Instantaneous/Definite Time Overcurrent (Continued)																															
50P #5 (ABC)																															
50P #5 A																															
50P #5 B																															
50P #5 C																															
50N – Residual Instantaneous/Definite Time Overcurrent																															
50N #1																															
50N #2																															
50N #3																															
50N #4																															
50N #5																															
50G – Ground Instantaneous/Definite Time Overcurrent																															
50G #1																															
50G #2																															
50G #3																															
50G #4																															
50G #5																															
50GS – Sensitive Ground Instantaneous/Definite Time Overcurrent																															
50GS #1																															
50GS #2																															
50GS #3																															
50GS #4																															
50GS #5																															

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 4 of 11)

Profile #

Function	Enable	Disable	OUTPUTS 1	2	3	4	5	6	7	8	9	10	11	12	BLOCKING INPUTS 1	2	3	4	5	6	7	8	9	10	11	12	FL	Virtual Input V1	V2	V3
51P – Phase Inverse Time Overcurrent																														
51P #1 (ABC)																														
51P #1 A																														
51P #1 B																														
51P #1 C																														
51P #2 (ABC)																														
51P #2 A																														
51P #2 B																														
51P #2 C																														
51P #3 (ABC)																														
51P #3 A																														
51P #3 B																														
51P #3 C																														
51P #4 (ABC)																														
51P #4 A																														
51P #4 B																														
51P #4 C																														
51P #5 (ABC)																														
51P #5 A																														
51P #5 B																														
51P #5 C																														

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 5 of 11)

Profile #

Function	Enable	Disable	OUTPUTS													BLOCKING INPUTS													Virtual Input		
			1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12	FL	V1	V2	V3
51N – Residual Inverse Time Overcurrent																																
51N #1																																
51N #2																																
51N #3																																
51N #4																																
51N #5																																
51G – Ground Inverse Time Overcurrent																																
51G #1																																
51G #2																																
51G #3																																
51G #4																																
51G #5																																
51GS – Sensitive Ground Inverse Time Overcurrent																																
51GS #1																																
51GS #2																																
51GS #3																																
51GS #4																																
51GS #5																																

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 6 of 11)

Profile # _____

Function	Enable	Disable	OUTPUTS 1	2	3	4	5	6	7	8	9	10	11	12	BLOCKING INPUTS 1	2	3	4	5	6	7	8	9	10	11	12	FL	Virtual Input V1	V2	V3
59 – Overvoltage																														
59 #1 (ABC)																														
59 #1 A																														
59 #1 B																														
59 #1 C																														
59 #2 (ABC)																														
59 #2 A																														
59 #2 B																														
59 #2 C																														
59 #3 (ABC)																														
59 #3 A																														
59 #3 B																														
59 #3 C																														
59 #4 (ABC)																														
59 #4 A																														
59 #4 B																														
59 #4 C																														
59PP – Phase to Phase Overvoltage																														
59PP (ABC)																														
59PP AB																														
59PP BC																														
59PP CA																														

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 7 of 11)

Profile #

Function	Enable	Disable	OUTPUTS													BLOCKING INPUTS													Virtual Input		
			1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12	FL	V1	V2	V3
59I – Peak Overvoltage																																
59I (ABC)																																
59I A																																
59I B																																
59I C																																
59Vz1 – Vz1 Overvoltage																																
59Vz1																																
59N – Residual Overvoltage																																
59N																																
67P – Phase Directional Overcurrent																																
67P #1 (ABC)																																
67P #2 (ABC)																																
67P #3 (ABC)																																
67P #4 (ABC)																																
67P #5 (ABC)																																
67Q – Negative Sequence Directional Overcurrent																																
67Q #1																																
67Q #2																																
67Q #3																																
67Q #4																																
67Q #5																																

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 8 of 11)

Profile #

Function	Enable	Disable	OUTPUTS 1 2 3 4 5 6 7 8 9 10 11 12	BLOCKING INPUTS 1 2 3 4 5 6 7 8 9 10 11 12 FL	Virtual Input V1 V2 V3
67G – Ground Directional Overcurrent					
67G #1					
67G #2					
67G #3					
67G #4					
67G #5					
67GS – Sensitive Ground Directional Overcurrent					
67GS #1					
67GS #2					
67GS #3					
67GS #4					
67GS #5					
67N – Residual Directional Overcurrent					
67N #1					
67N #2					
67N #3					
67N #4					
67N #5					
81 – Frequency					
81 #1					
81 #2					
81 #3					
81 #4					

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 9 of 11)

Profile #

Function	Enable	Disable	OUTPUTS												BLOCKING INPUTS													Virtual Input		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	FL	V1	V2	V3
81R – Rate of Change of Frequency																															
81R #1																															
81R #2																															
CLP – Cold Load Pickup																															
CLP			N/A																												
IPS – IPSlogic™																															
IPSlogic #1																															
IPSlogic #2																															
IPSlogic #3																															
IPSlogic #4																															
IPSlogic #5																															
IPSlogic #6																															
IPSlogic #7																															
IPSlogic #8																															
BM – Breaker Monitor																															
BM																															

OUTPUTS labels: Output Initiate Phase A (1), Output Initiate Phase B (3), Output Initiate Phase C (5), Outputs

BLOCKING INPUTS labels: 52A (1), 52B (2), Breaker Input Status; Input Initiate Phase A (1), Input Initiate Phase B (3), Input Initiate Phase C (5), Blocking Inputs

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 10 of 11)

Profile #

Function	Enable	Disable	OUTPUTS												BLOCKING INPUTS													Virtual Input		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	FL	V1	V2	V3
79 – Recloser Relay (Three-Phase Ganged)																														
Function 79								N/A																						
79 – Recloser Relay (Independent Phase Operation 3T3LO – 3 Phase Trip & 3 Phase Lockout)																														
Enable 79								N/A																						
79 – Recloser Relay (Independent Phase Operation 1T3LO – 1 Phase Trip & 3 Phase Lockout)																														
Enable 79																														
	Reclose A							N/A																						
	Reclose B							N/A																						
	Reclose C							N/A																						
79 – Recloser Relay (Independent Phase Operation 1T1LO – 1 Phase Trip & 1 Phase Lockout)																														
Enable 79																														
	Reclose A							N/A																						
	Reclose B							N/A																						
	Reclose C							N/A																						

Table B-1   Recloser Control I/O Configuration Worksheet – Profile Setpoints (page 11 of 11)

Function	Enable	Disable	OUTPUTS 1–12	BLOCKING INPUTS 1–12, FL	Virtual Input V1, V2, V3
PSBC – Power Supply/Battery Charger Monitor					
Automatic Test					
TCM – Trip Circuit Monitor (Three-Phase Ganged)					
TCM				52A 52B 69 — — — — 52B — Trip Coil Input / Blocking Inputs / FL	V1 V2 V3
TCM – Trip Circuit Monitor (Independent Phase Capable)					
TCM				52A 52B — — — 52B — Trip Coil Input / Blocking Inputs / FL	V1 V2 V3
CCM – Close Circuit Monitor (Three-Phase Ganged)					
CCM				52A 52B 69 — — — 52A — Close Coil Input / Blocking Inputs / FL	V1 V2 V3
CCM – Close Circuit Monitor (Independent Phase Capable)					
CCM				52A 52B — — — 52A — Close Coil Input / Blocking Inputs / FL	V1 V2 V3

Table B-2   Recloser Control I/O Configuration Worksheet – Common Setpoints (page 1 of 2)

Function	Enable	Disable	OUTPUTS												BLOCKING INPUTS													Virtual Input		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	FL	V1	V2	V3
60FL – VT Fuse Loss Detection																						Input Initiate								
60FL																											I			
																				Blocking Inputs								I			
THD/TDD – Total Harmonic Distortion / Total Demand Distortion																														
THD/TDD #1 (ABC)																														
THD/TDD #1 (A)																														
THD/TDD #1 (B)																														
THD/TDD #1 (C)																														
THD/TDD #2 (ABC)																														
THD/TDD #2 (A)																														
THD/TDD #2 (B)																														
THD/TDD #2 (C)																														

Table B-2   Recloser Control I/O Configuration Worksheet – Common Setpoints (page 2 of 2)

C Utilizing the DNP Configuration Editor

■ **CYBER SECURITY NOTE:**
When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

The DNP Configuration Editor includes the following features and functions:

Variations – The variation of an object gives a different representation of the same data point, such as the size of the object or whether or not the object has flag information. Accordingly, the **Variations** section will configure listed objects with the desired and supported variations.

Master Address used for Unsolicited responses – This address will be used as the address to send unsolicited responses.

Modem Unsolicit Setting – Applies to TIA-232 interface connected to an Ethernet Modem. TCP/IP and UDP/IP unsolicit settings are used when DNP is being deployed over an Ethernet network. The setting elements are described below:

- Allow Unsolicit: Determines whether unsolicited null responses will be sent when session comes online. If enabled, subsequent unsolicited responses will be enabled through function code 0x14 (Enable unsolicited responses) and disabled through function code 0x15 (Disable unsolicited responses). If "Allow Unsolicit" is disabled, then function codes 0x14 and 0x15 will be responded to with an error.
- Class 1 Max Delay (Sec): If unsolicited responses are enabled, this parameter specifies the maximum amount of time after an event in the corresponding class is received before an unsolicited response will be generated.
- Class 1 Max Events: If unsolicited responses are enabled, the parameter specifies the maximum number of events in the corresponding class to be allowed before an unsolicited response will be generated.
- Class 2 Max Delay (Sec): If unsolicited responses are enabled, this parameter specifies the maximum amount of time after an event in the corresponding class is received before an unsolicited response will be generated.
- Class 2 Max Events: If unsolicited responses are enabled, the parameter specifies the maximum number of events in the corresponding class to be allowed before an unsolicited response will be generated.

Choosing Points – The Available Points window is populated when a DNP source file is opened. The selection of points from the Binary Inputs, Analog Inputs, Binary/Control Outputs and Analog Outputs tabs can be accomplished by either individually selecting, dragging and dropping points in the Selected Points window or utilizing the "Copy All" feature. The Copy All feature only copies the points in the open tab to the Selected Points window. The "Remove All" feature removes all the points displayed in the Selected Points window for the tab that is open.

Ordering Selected Points – Selected points can be reordered to match the users SCADA, RTU or Master setup by selecting, dragging and dropping the desired point within the Selected Points window.

Adding Dummy Points – The purpose of the Dummy Point is to allow the user to match other device DNP maps that contain points that are not supported in the control. This feature allows the user to communicate with the M-7679 control when it is connected to an RTU that contains other brands of controls and eliminates the need to re-configure the RTU or the other controls.

To insert a Dummy point, select "Insert Dummy". The Dummy Point will be inserted at the end of the Selected Points list. To move the Dummy Point, select, drag and drop the point at the desired location in the Selected Points list. The Dummy point will assume the Index Position and the remaining Selected Points will be modified to accommodate the Dummy Point.

Insert Offset – This allows an offset to be created in the DNP map without the point number being transmitted, thus providing the ability to construct a DNP profile that has non-consecutive point numbers within a group.

Editing Binary Input Points – The Binary Input "Value" and "Mask" values can be edited by double left clicking on the desired point Value or Mask elements. The default value for Value is TRUE, which means that the point will return a High or True when the item being monitored is active in the control. It can be changed to "FALSE" to match a SCADA Master if necessary. The "Mask" value defaults to "CLASS ONE" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS TWO or THREE by double left clicking on the desired point Mask element.

Editing Analog Input Points – The Analog Input "Deadband" and "Mask" values can be edited by double left clicking on the desired point Deadband or Mask elements. The Deadband can be set to define when the point will report by exception under the class type in the Mask setting. When the point value exceeds the deadband value, it will initiate a report by exception to the master. The "Mask" value defaults to "CLASS TWO" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS ONE or THREE by double left clicking on the desired point Mask element.

Editing Binary/Control Output Points – The Binary/Control Output Point "Crob", "Mask" and "Inverse" values can be edited by double left clicking on the desired point Crob, Mask or Inverse elements. The Crob (Control Relay Output Block) setting is used to define what control method will be used to operate the point. The possible settings for "Crob" are listed below:

• Latch On	• Pulse On	• Paired Close
• Latch Off	• Pulse Off	• Paired Trip
• Latch OnOff	• Pulse OnOff	• Paired TripClose
• Latch OnOff_TC	• Pulse OnOff_TC	

The "Mask" value defaults to "CLASS THREE" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS ONE or TWO by double left clicking on the desired point Mask element.

Inverse defines whether the command to be sent would be inverted, meaning that when TRUE is selected, sending a Trip, Close, etc will have the opposite effect. This was implemented due to variations seen in RTU manufacturer's implementation of direct control with DNP to allow full compatibility the widest possible number of RTU's.

Editing Analog Output Points – The Analog Output "Mask" value can be edited by double left clicking on the desired point Mask element. The "Mask" value defaults to "CLASS THREE" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS ONE or TWO by double left clicking on the desired point Mask element.

Editing Counters – The Counters "Mask" value can be edited by double left clicking on the desired point Mask element. The "Mask" value defaults to "CLASS THREE" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS ONE, CLASS TWO, CLASS NONE, CLASS ONE NOT CLASS 0, CLASS TWO NOT CLASS 0 or CLASS THREE NOT CLASS 0 by double left clicking on the desired point Mask element.

DNP Security – DNP authentication is now available and can be independently enabled in the DNP security tab for either serial or Ethernet (both TCP or UDP) interfaces.

The concepts of the Hashed Message Authentication Code (HMAC) and challenge-response as defined in the DNP3 specification for Secure Authenticate Version 2.0 document is employed.

When authentication is enabled, the following settings should be selected:

- HMAC Algorithm and Update key
- Challenge Response timeout
- Duration of session key
- Aggressive Mode
- Critical Request Function Codes

■**NOTE:** Before IPScom allows a user to change the Update key, the user has to enter the old update key.

HMAC Algorithm and Update Key – The HMAC algorithm is either SHA1 (4 OCT) or SHA1(10OCT). An Update key is necessary to provide secure SESSION key negotiation. Once a SESSION key is obtained any subsequent challenge/response session will employ that session key. The Update key can be up to 32 hex characters (0123456789ABCDF) (128 bits).

Challenge Response Timeout – The range is from 0-100 seconds. This is the response time within which the control is expecting a response to a challenge.

Duration of Session Key – This duration must be configured in minutes (0-100) and in count 0-65535. This duration represents the maximum time or the maximum number of challenges a particular session key is used before key negotiation is again performed.

Aggressive Mode – Full challenge/response exchanges increase the number messages in the protocol, which affects throughput performance. Therefore, DNP Secure Authentication provides an aggressive mode in which the data from a single challenge can be used to authenticate many subsequent messages. The sender of the critical message includes the HMAC at the end of the critical message without having to be challenged. At least one challenge must occur, however, before aggressive mode can be used.

Critical Request Function Codes – This represents the function codes that will require authentication if selected. If none is selected, authentication will not be performed on any function code although authentication has been enabled.

Figure C-1   DNP Configuration Editor Dialog Screen

Figure C-2   DNP Configuration Editor Binary Inputs Dialog Screen

Figure C-3   DNP Configuration Editor Analog Inputs Dialog Screen

Figure C-4   DNP Configuration Editor Binary Control Outputs Dialog Screen
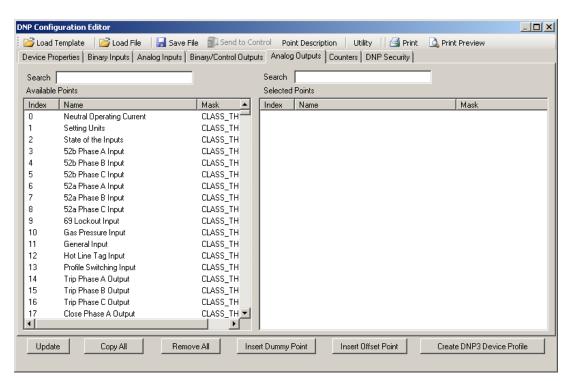
Figure C-5   DNP Configuration Editor Analog Outputs Dialog Screen

Figure C-6   DNP Configuration Editor Counters Dialog Screen

Figure C-7   DNP Configuration Editor Security Dialog Screen

Figure C-8   DNP Configure Update Keys and Critical Request Function Codes Dialog Screen

Example of DNP Configuration Editor Use – The following sequence of steps provides an example of utilizing the DNP Configuration Editor.

1. From the IPScom® S-7600 Communications Software Main Screen select **Communication/Protocol/DNP/DNP Configuration Editor**. IPScom will display the DNP Configuration Editor dialog screen (Figure C-1).

2. Select **Load Template/M-7679 Default** from the DNP Configurator menu bar. Select Binary Inputs tab, Figure C-2 is displayed. The Available Points list for each DNP Points Group tab will also be populated.

3. Select the Binary Input points you wish to include in the DNP map by selecting Copy All or dragging the desired point(s) to the Selected Points window.

4. Edit the Selected Points for each tab as necessary to match your SCADA, RTU or Master setup.

5. Select "Save File" from the DNP Configurator menu bar. IPScom will display a "Save As" dialog screen with a *.xml file extension.

6. Name the file and then select "Save".

7. If IPScom is connected to the target control then the "Send to Control" menu feature can be used as follows:

   a. Select "Send to Control". IPScom will display the "Authentication Key generated successfully" (Figure C-9).

Figure C-9   Authentication Key Generated Successfully Confirmation Screen

   b. Select "OK". IPScom will display the "Open File" dialog screen with a *.xml file extension.

   c. Select the file to be opened, then select Open. IPScom will initiate the file transfer as indicated by the "Send" dialog screen (Figure C-10), followed by a "DNP Upload" confirmation screen (Figure C-11).

Figure C-10   Send Dialog Screen

Figure C-11   DNP Upload Confirmation Screen

D Cyber Security

■ **CYBER SECURITY NOTE:**
When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

CYBER SECURITY OVERVIEW

The purpose of this appendix is to describe the security elements incorporated in the M-7679 and the settings and configuration choices that are necessary to allow the M-7679 to communicate securely over Virtual Private Networks (VPN).

The M-7679 is compliant with the applicable requirements of:

- IEEE 1686™-2007 Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities
- IPsec/IKE
- Radius

IEEE 1686 Standard

The M-7679 meets or exceeds the requirements established in IEEE Std 1686, IEEE Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities. Table D-1 represents the M-7679 Table of Compliance (TOC).

Permissions

IEEE Standard 1686 for the most part defines the standards for User Name, Passwords and the Permissions associated with each user. The specific permission categories are listed in Table D-2 "Permissions Implemented for IEEE 1686 Standard".

Clause/ subclause	Clause/subclause Title	Status	Comment
5	IED cyber security features	Acknowledge	
5.1	Electronic access control	Comply	
5.1.1	Password defeat mechanisms	Comply	
5.1.2	Number of individual ID/ passwords supported	Exceed	Product provides for 32 individual ID/password combinations
5.1.3	Password construction exception uppercase and lowercase letters are Interchangeable.	Comply	
5.1.4	Authorization levels by Password	Comply	
5.1.4.1	View data	Comply	
5.1.4.2	View configuration settings	Comply	
5.1.4.3	Force values	Comply	
5.1.4.4	Configuration change	Comply	
5.1.4.5	Firmware change	Comply	
5.1.4.6	ID/password management	Comply	
5.1.4.7	Audit log	Comply	
5.1.5	Password display	Comply/Exception	Except on local LCD
5.1.6	Access time-out	Comply	
5.2	Audit trail	Comply/Exception	Can only view audit trail events on computer
5.2.1	Storage capability	Comply	
5.2.2	Storage record	Comply	
5.2.2.1	Event record number	Comply	
5.2.2.2	Time and date	Comply	
5.2.2.3	User ID	Comply	
5.2.2.4	Event type	Comply	
5.2.3	Audit trail event types	Comply	
5.2.3.1	Login	Comply	
5.2.3.2	Manual logout	Comply	
5.2.3.3	Timed logout	Comply	
5.2.3.4	Value forcing	Comply	
5.2.3.5	Configuration Access	Comply	
5.2.3.6	Configuration change	Comply	
5.2.3.7	Firmware change	Comply	

Table D-1   IEEE Std 1686 Table of Compliance (1 of 2)

Clause/ subclause	Clause/subclause Title	Status	Comment
5.2.3.8	Firmware change	Comply	
5.2.3.9	ID/password deletion	Comply	
5.2.3.10	Audit-log access	Comply	
5.2.3.11	Time/date change	Comply/Exception	Indicated as a forced value change
5.2.3.12	Alarm incident		
5.3	Supervisory monitoring and control		
5.3.1	Events	Exception	Done through use of DNP unsolicited events
5.3.2	Alarms	Exception	
5.3.2.1	Unsuccessful login attempt		
5.3.2.2	Reboot	Exception	However, users can deduce that a reboot has taken place by examining the DNP3.0 initialization bit being set followed by a DNP3.0 request for time.
5.3.2.3	Attempted use of unauthorized configuration software	Comply	A public encryption key shall be sent by the control to the client software upon request. This is used to authenticate whether the software is valid by encrypting the user id and password with the correct algorithm and key. This feature can enabled/ disabled by not choosing "Encrypted password" for access level.
5.3.3	Alarm point change detect	Comply	DNP 3.0
5.3.4	Event and alarm grouping	Comply/Exception	DNP 3.0 Class poll
5.3.5	Supervisory permissive control	Exception	(TBD)
5.4	Configuration software	Acknowledge	
5.4.1	Authentication	Comply	See 5.3.2.3
5.4.2	ID/password control	Exceed	Initially password is created by administrator. Once changed by the user, password cannot be read by anyone.
5.4.3	ID/password-controlled features	Comply	
5.4.3.1	View configuration data	Comply	
5.4.3.2	Change configuration data	Comply	
5.4.3.3	Full access	Comply	
5.5	Communications port access	Comply	
5.6	Firmware quality assurance	Comply	

Table D-1   IEEE Std 1686 Table of Compliance (2 of 2)

Permission Categories (Access Permitted)	Default Permissons (X = Permission Category Included in Default Permission Set)										
	View Data	View Setpoints	Change Setpoints	Read Files	View Config	Change Config	Firmware Update	Manage Users	View Audit Log	Remote Control	Change Date/Time
Monitor Data	X										
View setpoints		X									
Change setpoints		X	X								
View configuration					X						
Change configuration					X	X					
Datalog setup					X	X					
Datalog download				X							
SOE setup					X	X					
SOE download				X							
OSC setup					X	X					
OSC download				X							
Security events log									X		
Manage users*								X			
Firmware update							X				
Remote control										X	
Change Date/Time											X
Get LED file				X							
Write LED file											
Get Button file				X							
Write Button file											
Write Wakeup Screens											

*User can change own password without manage users permissions set

Table D-2   Permissions Implemented for IEEE 1686 Standard

IPSEC/IKE OVERVIEW

IPsec/IKE is supported directly by the M-7679. This section describes the essential principles that reside within IPsec/IKE.

Internet Protocol security (IPsec) uses cryptographic security services to protect communications over Internet Protocol (IP) networks. IPsec is a suite of protocols specified by the Internet Engineering Task Force (IETF) that add security to the IP layer of internet traffic.

Implementing IPsec in the M-7679 secures internet traffic, including TCP and UDP packets. The important elements that are necessary to provide robust network data security include encryption and equally important authentication. Communication security cannot exist without a combination of both encryption, to prevent unauthorized monitoring of sensitive data, and authentication which validates the identity of all the parties involved in the communication scheme.

IPsec Establishment and Protocol

The original standard of IPsec/IKE uses IKE Version 1 (IKEv1). Although not supported in the M-7679 IPsec suite, it is important to understand how IKEv1 operates since IKEv2 utilizes many concepts that reside in IKEv1.

IKEv1

The IPsec tunnel is established through two separate phases. The first phase, called Phase 1, ISAKMP SA (Security Association) establishment, establishes the authenticity of both ends to each other. It uses the IKE (Internet Key Exchange) protocol to create a shared key between both ends, in a manner that the unauthorized monitoring entity will not know the newly created shared key (using Diffie-Hellman exchange).

The shared key is used to perform the second phase negotiation, which is referred to as Phase 2 or IPsec SA establishment. Phase 2 is also performed by IKE, but establishes the parameters and security association for the IPsec tunnel. Both Phase 1 and Phase 2 are periodically repeated (i.e. every several hours), establishing new shared keys to ensure the strong security of the IKE data. IKE data is typically communicated between both endpoints using UDP packets sent to port 500. If there is a firewall in between the tunnel, it is important that UDP port 500 is forwarded to the proper endpoint. Figure D-1 provides a simple illustration of an IKE packet.

Figure D-1   IKE Packet Configuration

When the IPsec tunnel has been established (after Phase 1 and Phase 2), traffic between both ends of the tunnel is communicated using a special IP protocol that encapsulated the original, unsecured packets. Figure D-2 provides an illustration of the IPsec packets.
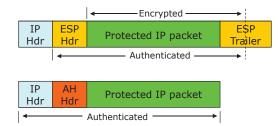
Figure D-2   ESP and AH Protocol IPsec Packet Examples

Normally, the ESP protocol is used, as it offers both encryption and authentication of the data from either endpoint. The AH protocol only offers authentication (i.e. the data is not fully protected), making it much less useful.

The creation and management of a security association is the most fundamental concept of the working of IKE and even IPsec. IKE can be considered the creator and manager of the SAs, while IPsec is the user of SAs.

IKEv2

In Phase 1, several messages are exchanged between the initiator and the receiver. The purpose of this phase is to generate the shared secret from which other keys will be computed and authenticate the communicating peers.

In IKEv2 there are only three sub-protocols in Phase 1 compared to eight sub-protocols in IKEv1. These are based on digital signatures (to be implemented later), MAC's (Message Authentication Code using pre-shared key), and EAP (Extensible Authentication Protocol) (not implemented).

Similar to IKEv1, Diffie-Hellman exponents and nonces are exchanged and used to compute several shared secret keys. The Phase 1 protocols establish an IKE SA (similar to IKEv1's ISAKMP SA) and a first child SA (similar to IKEv1's IPsec SA). Hence, contrary to IKEv1, an SA that can be used for IPsec (the child SA) is directly available after Phase 1.

In IKEv2 the Phase 2 SA is denoted as Child-SA which is created as a result of the Create-Child-SA request. This request may be launched by any of the parties once Phase 1 is completed. All messages in this phase are made secure due to the algorithms and keys negotiated in the first phase.

In addition, the Phase 2 in IKEv2 is known as Child Mode. The purpose of Child Mode is to re-key previous (IKE or child) SA's or to establish additional child SA's. IKEv2 is more efficient and requires less computing power.

RADIUS

Remote Authentication Dial In User Service (RADIUS) is a networking protocol that provides centralized Authentication, Authorization, and Accounting (AAA) management for computers to connect and use a network service. Authentication and Authorization RADIUS are described in RFC 2865 while Accounting is described by RFC 2866.

RADIUS is a client/server protocol that runs in the application layer, using UDP as transport. The following UDP ports are used:

- For Authentication and Authorization UDP port 1812 (previously 1645)
- For Accounting UDP port 1813 (previously 1646)

RADIUS serves three functions:

1. Authenticate users or devices before granting them access to a network
2. Authorize those users or devices for certain network services
3. Account for usage of those services

Password Authorization Mechanism

The M-7679 includes the capability to use Authentication based on IEEE 1686. When IEEE 1686 password security is disabled, the RADIUS protocol although settable is not functional.

When Authentication, based on IEEE 1686 is implemented, then the full functionality of the RADIUS protocol is available. The following features are available if RADIUS is enabled:

- The M-7679 provides local authentication capability if and ONLY if there is no other remote authentication server available to the device. Example of remote authentication server is the RADIUS server.
- The M-7679 has the capability of being configured to use two remote authentication servers. Examples are 2 RADIUS servers. In case the primary server is down and not responding, the secondary server shall be used, and finally if both servers are down, the device shall fall back to the local server which is the IEEE 1686 password authentication.

The device is shipped with a default password file configured with one Super user ID and password. It is up to the end user to change this default password to ensure the security of the network. Usually the local password should match security policy of the RADIUS server.
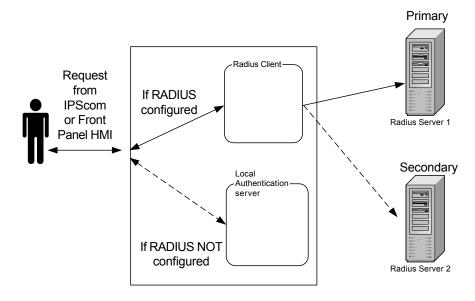
Figure D-3   RADIUS Server Configuration

Authentication and Authorization

The M-7679 firmware includes the client and the Remote Access Server (RAS) component of the RADIUS protocol implemented. The M-7679 sends a request to a RADIUS Server to gain access to a particular network resource using access credentials. The credentials are internally passed to the RAS.

In turn, the RAS sends a RADIUS Access Request message to the RADIUS server, requesting authorization to grant access via the RADIUS protocol. This request includes access credentials, typically in the form of user name and password provided by the user. The UDP port 1812 is used to communicate with the RADIUS server.

The RADIUS server checks that the information is correct using the defined authentication schemes. The User identification is verified along with the user's network address and user privileges.

The RADIUS server returns one of three responses to the client:
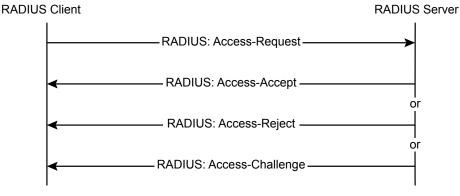
- Access Reject
- Access Challenge
- Access Accept

Access Reject – The user is unconditionally denied access to all requested network resources. Reasons may include failure to provide proof of identification or an unknown or inactive user account.

Access Challenge – Requests additional information from the user such as a secondary password. Access Challenge is also used in more complex authentication dialogs where a secure tunnel is established between the user device and the Radius Server in a way that the access credentials are hidden from the RAS.

Access Accept – The user is granted access. Once the user is authenticated, the RADIUS server will often check that the user is authorized to use the network service requested. A given user may be allowed to view data only, but not download files, for example. Again, this information may be stored locally on the RADIUS server, or may be looked up in an external source like LDAP or Active Directory.

Each of these three RADIUS responses may include a Reply-Message attribute which may give a reason for the rejection, the prompt for the challenge, or a welcome message for the accept.

RADIUS Authentication and Authorization Flow

Figure D-4   RADIUS Authentication and Authorization Flow

Accounting

RADIUS Accounting Flow Accounting is described in RFC 2866. The UDP port 1813 is used to communicate with the RADIUS server for accounting purpose.

When network access is granted to the user by the client, an Accounting Start (a RADIUS Accounting Request packet containing an Acct-Status-Type attribute with the value "start") is sent by the client to the RADIUS server to signal the start of the user's network access. "Start" records typically contain the user's identification, network address, point of attachment and a unique session identifier.

Periodically, Interim Update records (a RADIUS Accounting Request packet containing an Acct-Status-Type attribute with the value "interim-update") may be sent by the client to the RADIUS server, to update it on the status of an active session. "Interim" records typically convey the setpoint changes by user.

Typically, the client sends Accounting-Request packets until it receives an Accounting-Response acknowledgement, using some retry interval.

In general the primary purpose of this data is to log user activity (Login/logout, setpoint changes, file transfer).

Channel ID	Description
0	USB interface
1	Comm interface on UART 0
2	Serial interface on UART 1
3	HMI interface
4	MODBUS Ethernet (starts from Channel 4 and may run through Channel 11 since the M-7679 supports eight MODBUS Ethernet connections at a time)

CYBER SECURITY SETUP (IEEE STANDARD 1686) FROM IPSCOM

1. Start IPScom, then establish communications with the target control.

2. Select **Utility/Manage Accounts/Set Access Password Type** from the IPScom tool bar. IPScom will display the "Access Password Type" dialog screen (Figure D-5).

Figure D-5   Access Password Type Dialog Screen

■**NOTE:** The default User Name is "admin1"
          The default password is "admin1@M7679"

3. Select the desired Access Level:

   a. None – Cyber Security is not enabled. The user will not be prompted to enter a User Name and Password and will have access to ALL features and functions.

   b. Open Password – The password is not encrypted. This option should be chosen when IPScom is not the sole method of communication to the control.

   c. Encrypted Password – The password is encrypted and is authenticated by the control to allow the user to log on to the control. However, this selection only controls password encryption for a user login. Setpoints files and passwords contained in Account Permissions files are encrypted.

4. Select "Set". Based on the selection made, IPScom will display the applicable confirmation screen, either Figure D-6 or Figure D-7.

Figure D-6   Access Level "None" Confirmation Screen

Figure D-7   Access Level "Open Password" or "Encrypted Password" Confirmation Screen

5. Select "Yes". IPScom will display the following confirmation screen and will close communication with the control.

Figure D-8   Access Level Changed Confirmation Screen

6. Select "Yes". If Cyber Security is enabled. the user will now be prompted to enter a valid User Name and Password to log on to a control (Figure D-9).

Figure D-9   Log On User Name and Password Dialog Screen

USER ACCOUNTS

> ■**NOTE:** The default User Name is "admin1"
> The default password is "admin1@M7679"

The control contains default User Names, Passwords, and Roles. A user with the "Manage Users" permission can perform the following:

- Add/Delete a user
- Change the permissions associated with a user
- Assign a user to a specific Role
- Add/Delete a Role
- Open/Save/Save As, a ".bin" file
- Retrieve(Save As) and View an Audit Log ".bkp"

While the Manage Users permission allows the user to control all aspects of a User, the Manage Users permission does not allow changing or viewing a user's password beyond initially establishing the password when the User is created. However, the Manage Users permission can delete the user account, effectively canceling the password.

User Account information resides on the control in flash memory. When retrieving (IPScom only) the data is saved to a file with a ".bin" file extension. The file contains all user(s) information for display and editing.

When initially establishing a password or when changing a password, the password syntax must conform to the following criteria:

- Minimum length must be 8 characters
- Maximum length is 20 characters
- Must include at least one uppercase letter
- Must include at least one lowercase letter
- Must include at least one number
- Must include at least one non-alphanumeric character (e.g. @, %, *, etc.)

IPScom presents the password criteria in red type in the "Change Password" (Figure D-25) and "Add User" (Figure D-20) dialog screens. As the criteria is met for the entered password, the "type" that states the criteria that has been met changes to black.

During "Retrieve Account Permissions from Control" and "Send Account Permissions to Control" operations, all User Account information is included. However, when a Password is changed, only the password is written to the control.

■**NOTE:** The instructions presented in this section assume that the user has been granted the appropriate permissions (Manage Users) to access and make changes to the subject features and capabilities.

User Account Modification and Setup

The control contains default User Accounts. The following instructions describe:

- Modifying Account Permissions retrieved from the control
- Modifying an existing Account Permissions ".bin" file
- Setting up a new User Account in an Account Permissions file.

Modifying Account Permissions Retrieved from the Control

1. Start IPScom, then establish communications with the target control.

2. Select **Utility/Manage Accounts/Retrieve Account Permissions from Control** from the IPScom tool bar. IPScom will display a "Binary File" Save As dialog screen (Figure D-10).

Figure D-10   Retrieve Account Permissions from Control Binary File Save As Screen

3. Choose the "Save As" location and enter the desired file name that will contain the Account Permissions retrieved from the control.

4. Select "Save". IPScom will save the named binary file that contains the control Account Permissions to the selected location and display a confirmation screen.

5. Select **Utility/Manage Accounts/Manage Account Permissions** from the IPScom tool bar. IPScom will display a "Manage Account Permissions" dialog screen (Figure D-19).

6. From the Manage Account Permissions dialog screen menu bar select **File/Open**. IPScom will display the "Binary File" Open dialog screen (Figure D-11).
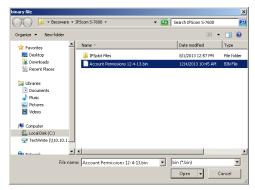
Figure D-11   Binary File Open Dialog Screen

7. Navigate to the file location and select the desired file name that contains the retrieved control Account Permissions to be modified.

8. Select "Open". IPScom will display a prompt for the User Name and Password associated with the selected file (Figure D-12).

Figure D-12   User Name and Password Prompt

9. Enter the User Name and Password associated with the file, then select "OK".

10. If the entered User Name and Password are rejected, then repeat Step 9.

11. If the entered User Name and Password are accepted for the target file, then IPScom will display a "Login Accepted" prompt (Figure D-13).

Figure D-13   Login Accepted Prompt Screen

12. Select "OK". IPScom will open the selected binary file that contains the Account Permissions in the Manage Account Permissions dialog screen (Figure D-14).

Figure D-14   Manage Account Permissions With Open Account Permissions File Dialog Screen

13. Select the "User" to be modified.

14. Select the desired Permissions for the User by either:

    • Checking or unchecking the desired Permissions

    • Selecting "Set Email Permissions" to automatically add the permissions required to access the E-mail Support feature:

        – View Data   – View Configuration

        – View Setpoints   – Manage Users

        – Read Files   – View Audit Log

    • Selecting a "Role" with pre-defined Permissions from the Role dropdown menu (Figure D-15)

Figure D-15   Pre-defined Roles

15. When all permissions have been selected/deselected, then select "Update Selected User". The original Binary File can be saved (File/Save) or saved to a different file name and/or location (File/Save As).

16. From the Manage Account Permissions dialog screen menu bar select **File/Save or Save As**. IPScom will display a "Send File" dialog screen to allow the user to save the file to the control or to the computer (Figure D-16).

Figure D-16   Send User File Dialog Screen

17. Select "Yes" to send the User File to the control. IPScom will display a confirmation screen (Figure D-17). Select "OK", IPScom will close communications.

Figure D-17   User Permission File Sent to Control Confirmation Screen

18. Select "No" to save the User File to the computer. If **File/Save As** was selected, IPScom will display the "User Access File" Save As dialog screen (Figure D-18).

Figure D-18   User Access File Save As Dialog Screen

19. Select the name and location of the User Access file to be Saved As.

20. Select "Save". IPScom will save the file to the selected location.

21. Record the User Name and Password associated with the saved file.

▲**CAUTION:** It is very important to record the User Name and Password associated with the saved file. The only way to access the file is to have the correct User Name and Password. In the case of writing the file to a control, the control will not be able to be accessed and will require the user to contact the factory to restore default User Name and Password.

Modifying Account Permissions in an Existing User Access ".bin" File

1. Start IPScom, then establish communications with the target control.

2. Select **Utility/Manage Accounts/Manage Account Permissions** from the IPScom tool bar. IPScom will display a "Manage Account Permissions" dialog screen (Figure D-19).

Figure D-19   Manage Account Permissions Dialog Screen

3. From the Manage Account Permissions dialog screen menu bar select File/Open. IPScom will display the "Binary File" Open dialog screen (Figure D-11).

4. Navigate to the file location and select the desired file name that contains the existing User Access ".bin" file to be modified.

5. Select "Open". IPScom will display a prompt for the User Name and Password associated with the selected file (Figure D-12).

6. Enter the User Name and Password associated with the file, then select "OK".

7. If the entered User Name and Password are rejected, then repeat Step 6.

8. If the entered User Name and Password are accepted for the target file, then IPScom will display a "Login Accepted" prompt (Figure D-13).

9. Select "OK". IPScom will open the selected binary file that contains the Account Permissions in the Manage Account Permissions dialog screen (Figure D-14).

10. Select the "User" to be modified.

11. Select the desired Permissions for the User by either:

    • Checking or unchecking the desired Permissions

    • Selecting a "Role" with pre-defined Permissions from the Role drop down menu (Figure D-15)

12. When all permissions have been selected/deselected, then select "Update Selected User". The original Binary File can be saved (File/Save) or saved to a different file name and/or location (File/Save As).

13. From the Manage Account Permissions dialog screen menu bar select **File/Save or Save As**. IPScom will display a "Send File" dialog screen to allow the user to save the file to the control or to the computer (Figure D-16).

14. Select "Yes" to send the User File to the control. IPScom will display a confirmation screen (Figure D-17). Select "OK", IPScom will close communications.

15. Select "No" to save the User File to the computer. If **File/Save As** was selected, IPScom will display the "User Access File" Save As dialog screen (Figure D-18).

16. Select the name and location of the User Access file to be Saved As.

17. Select "Save". IPScom will save the file to the selected location.

18. Record the User Name and Password associated with the saved file.

▲ **CAUTION:** It is very important to record the User Name and Password associated with the saved file. The only way to access the file is to have the correct User Name and Password. In the case of writing the file to a control, the control will not be able to be accessed and will require the user to contact the factory to restore default User Name and Password.

Setting Up a New User Account in a User Access File

1. Start IPScom, then establish communications with the target control.

2. Select **Utility/Manage Accounts/Manage Account Permissions** from the IPScom tool bar. IPScom will display a "Manage Account Permissions" dialog screen (Figure D-19).

3. From the Manage Account Permissions dialog screen menu bar select File/Open. IPScom will display the "Binary File" Open dialog screen (Figure D-11).

4. Navigate to the file location and select the desired file name for the User Access ".bin" file that the New User Account is to be added to.

5. Select "Open". IPScom will display a prompt for the User Name and Password associated with the selected file (Figure D-12).

6. Enter the User Name and Password associated with the file, then select "OK".

7. If the entered User Name and Password are rejected, then repeat Step 6.

8. If the entered User Name and Password are accepted for the target file, then IPScom will display a "Login Accepted" prompt (Figure D-13).

9. Select "OK". IPScom will open the selected binary file that contains the Account Permissions in the Manage Account Permissions dialog screen (Figure D-14).

10. Select "Add User". IPScom will display the "Add User" dialog screen (Figure D-20).

Figure D-20   Add User Dialog Screen

11. Enter a valid User Name and Password consistent with criteria presented in the User Accounts section earlier in this Appendix.

    IPScom presents the password criteria in red type. As the criteria is met for the entered password, the "type" that states the criteria that has been met changes to black.

12. When all Password criteria have been met, then select "Add". IPScom will return to the "Manage Account Permissions" dialog screen (Figure D-14) and display the new User.

13. Select the new User, then select the desired Permissions by either:
    • Checking or unchecking the desired Permissions
    • Selecting a "Role" with pre-defined Permissions from the Role drop down menu (Figure D-15)

14. When all permissions have been selected/deselected, then select "Update Selected User". The original Binary File can be saved (File/Save) or saved to a different file name and/or location (File/Save As).

15. From the Manage Account Permissions dialog screen menu bar select **File/Save or Save As**. IPScom will display a "Send File" dialog screen to allow the user to save the file to the control or to the computer (Figure D-16).

16. Select "Yes" to send the User File to the control. IPScom will display a confirmation screen (Figure D-17). Select "OK", IPScom will close communications.

17. Select "No" to save the User File to the computer. If **File/Save As** was selected, IPScom will display the "User Access File" Save As dialog screen (Figure D-18).

18. Select the name and location of the User Access file to be Saved/Save as.

19. Select "Save". IPScom will save the file to the selected location.

20. Record the User Name and Password associated with the saved file.

▲CAUTION: It is very important to record the User Name and Password associated with the saved file. The only way to access the file is to have the correct User Name and Password. In the case of writing the file to a control, the control will not be able to be accessed and will require the user to contact the factory to restore default User Name and Password.

ROLES

When the S-7600 IPScom is installed on the host PC, a Role file is created that contains the default Roles. Changes to existing Roles and creation of new Roles are captured in this file. However, Roles created on other IPScom PC installations may have different permissions for the same Role name. Adding and deleting "Roles" is accomplished from the "Manage Account Permissions" dialog screen (Figure D-19).

Retrieving Account Permissions from Control

To Retrieve Account Permissions from the M-7679 control perform the following:

1. Start IPScom, then establish communications with the target control.
2. Select **Utility/Manage Accounts/Retrieve Account Permissions from Control** from the IPScom tool bar. IPScom will display a "Binary File" Save As dialog screen (Figure D-10).
3. Choose the "Save As" location and enter the desired file name that will contain the Account Permissions retrieved from the control.
4. Select "Save". IPScom will save the named binary file that contains the control Account Permissions to the selected location.

Sending Account Permissions to the Control

To Send Account Permissions to the M-7679 control perform the following:

1. Start IPScom, then establish communications with the target control.
2. Select **Utility/Manage Accounts/Send Account Permissions to the Control** from the IPScom tool bar. IPScom will display a "Binary File" Open dialog screen (Figure D-11).
3. Navigate to the file location and select the desired file name that contains the Account Permissions to be sent to the control.
4. Select "Open". IPScom will attempt to send the selected binary file that contains the control Account Permissions to the target control.
5. If IPScom returns a "Failed to send Users.bin file to Control" confirmation (Figure D-21), then select "OK" and repeat Steps 2 through Step 4.
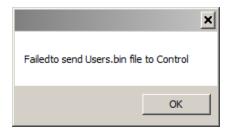
Figure D-21   Failed to Send Users.bin File to Control Confirmation Screen

6. If file transfer is successful, IPScom will display a "User Permission file sent to control" confirmation screen (Figure D-17). Select "OK", IPScom will close communications.

   If any changes were made to the permissions that were sent to the control, the changes will take effect the next time the user logs on to the control.

AUDIT LOG

The Audit Log captures security events in the order in which they occur. The Audit Log can be retrieved and viewed in IPScom. The Audit Log is saved to the PC with a "*.bkp" file extension. The Audit Log can also be saved as Comma Separated Values file "*.csv".

Each Audit Log entry includes:

- Date (Month, Day, Year)
- Time (Hour, Minute, Second)
- User Name
- Event Description regarding:
  - USB interface
  - Comm interface on UART 0
  - Serial interface on UART 1
  - HMI interface
  - MODBUS Ethernet – MODBUS Ethernet starts from Channel 4 and may run through Channel 11 since the M-7679 supports eight MODBUS Ethernet connections at a time.

Audit Log Retrieval, Viewing and Saving

The following sequence of steps describes retrieving, viewing and saving the Audit Log as a ".bkp" file.

1. Start IPScom, then establish communications with the target control.

2. Select **Utility/Manage Accounts/Audit Log/Retrieve** from the IPScom tool bar. IPScom will display the "Save As" dialog screen (Figure D-22) with the default "*.bkp" file extension.

Figure D-22   Audit Log Save As Dialog Screen

3. Choose the "Save As" location and enter the desired file name that will contain the Audit Log retrieved from the control.

4. Select "Save". IPScom will display a confirmation dialog screen that confirms that the file has been saved.

5. Select OK. IPScom will display the Audit Log dialog screen (Figure D-24).

6. To view a previously saved Audit Log, select **Utility/Manage Accounts/Audit Log/ View**. IPScom will display the "Audit Log file" Open dialog screen (Figure D-23) with the default "*.bkp" file extension.

Figure D-23   Audit Log File Open Dialog Screen

7. Navigate to the file location and select the desired file name for the Audit Log to be viewed.

8. Select "Open". IPScom will display the Audit Log Screen (Figure D-24).

Figure D-24   Audit Log Screen

9. To save the displayed Audit Log to a "*.csv" formatted file select "Export to CSV". IPScom will display a confirmation dialog screen that confirms that the file has been saved.

■**NOTE:** It may be necessary to select "View Hidden Folders" in Windows™ to locate the CSV file.

10. Select OK. IPScom will return to the Audit Log screen.

CHANGE PASSWORD

The Password associated with a specific User Name can only be changed by successfully connecting to the target control. When "Change Password" is selected in the "Change Password" dialog screen (Figure D-25), only the new Password is written to the control.

To change the Password for a specific User, proceed as follows:

1. Start IPScom, then establish communications with the target control.

2. Select **Utility/Manage Accounts/Change Password** from the IPScom tool bar. IPScom will display a "Change Password" dialog screen (Figure D-25).

Figure D-25   Change Password Dialog Screen

3. Enter a valid Password consistent with criteria presented in the User Accounts section earlier in this Appendix.

   IPScom presents the Password criteria in red type. As the criteria is met for the entered password, the "type" that states the criteria that has been met changes to black.

4. Re-enter the desired Password to confirm the entered Password.

5. When all Password criteria have been met, then select "Change Password". IPScom will display the "Changing Password" status screen (Figure D-26).

Figure D-26   Changing Password Status Screen

6. When the Password has been changed on the control IPScom will display the "Password Has Been Changed" confirmation screen (Figure D-27).

Figure D-27   Password Has Been Changed Confirmation Screen

7. Select OK. IPScom will display the "Password Changed Logout" confirmation screen (Figure D-28).

Figure D-28   Password Changed Logout Confirmation Screen

8. Select OK. IPScom will log the current user off the control. In order to re-login to the control the user must use the changed Password.

SECURITY MODE SETUP

■**NOTE:** The instructions presented in this section assume that IEEE Standard 1686 has been enabled and the user has been granted the appropriate permissions (Manage Users) to access and make changes to the subject features and capabilities.

Radius Configuration from IPScom

To set up the M-7679 Recloser Control to apply the Radius elements of the Cyber Security scheme perform the following:

1. Obtain the following information from the Network Administrator:
   • Primary Server IP Address
   • Primary Server Authentication Port
   • Primary Server Accounting Port
   • Secondary Server IP Address
   • Secondary Server Authentication Port
   • Secondary Server Accounting Port
   • Secret Key

2. Start IPScom, then establish communications with the target control.

3. Select **Communication/Setup/Communication Security/Security Mode/ Radius Configuration** from the IPScom tool bar. IPScom will display a "Radius Configuration" dialog screen (Figure D-29).

Figure D-29   Radius Configuration Dialog Screen

4. Enter the required settings in the Radius Configuration dialog screen.
5. Select "Save". IPScom will display a "Write to Device" confirmation screen (Figure D-30).

Figure D-30   Write to Device Confirmation Screen

6. Select "OK". IPScom will return to the Radius Configuration dialog screen.
7. From the Radius Configuration screen select "Secret Key". IPScom will display the "Radius Configuration Key" dialog screen (Figure D-31).
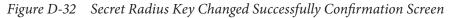
Figure D-31   Radius Configuration Key Dialog Screen

▲ **CAUTION**: It is very important that the Configuration Key is entered correctly. In the event that it is not entered correctly and Radius is "Enabled" the Radius server will deny access to the control because the Password will be encrypted in a way that the Radius server can not decrypt it properly.

8. Enter the Radius Configuration Key.
9. Select "Save". IPScom will display a "Write to Device" confirmation screen (Figure D-30).
10. Select "OK". IPScom will display a confirmation screen (Figure D-32).

Figure D-32   Secret Radius Key Changed Successfully Confirmation Screen

11. Select OK. IPScom will return to the Radius Configuration dialog screen.

Enable Radius Security from the HMI

1. Press [COMM] to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
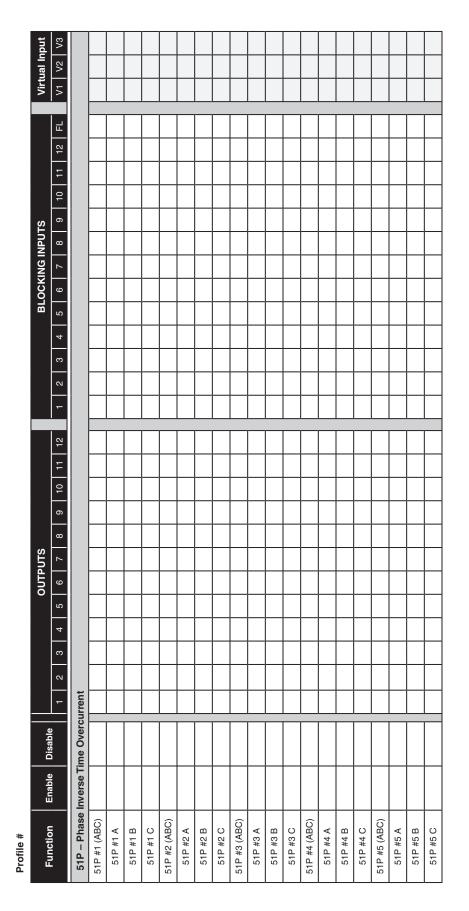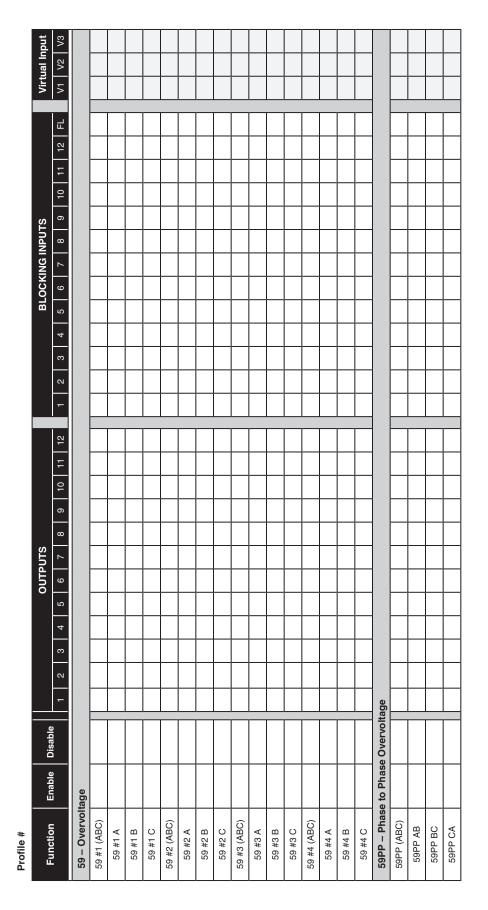    COMMUNICATIONS
 <CNFG          UTIL>
```

2. Press ENT/UTIL or CNFG once. The unit will display the following:

```
        PORT1 Settings
   <                        >
```

3. Press MNTR or COMM as necessary until "Comm Ports Security" is displayed.

```
      Comm Ports Security
   <                        >
```

4. Press ENT/UTIL or CNFG once. The unit will display the following:

```
        Physical Ports
   <                        >
```

5. Press MNTR or COMM as necessary until "Protocol Access" is displayed.

```
        Protocol Access
   <                        >
```

6. Press CNFG as necessary, until the "Radius" menu item is displayed.

```
   Radius
   DISABLE
```

7. Press ENT/UTIL. The following will be displayed.

```
   Radius
   DISABLE
```

8. Utilizing SETP or CNFG select **ENABLE**, then press ENT/UTIL. The following will be displayed.

```
   Radius
   ENABLE
```

9. Press SETP or CNFG as necessary until "Radius accounting" is displayed.

```
   Radius accounting
   DISABLE
```

10. Press ENT/UTIL. The following will be displayed.

```
   Radius accounting
   DISABLE
```

11. Utilizing SETP or CNFG select **ENABLE**, then press ENT/UTIL. The following will be displayed.

```
   Radius accounting
   ENABLE
```

Radius Configuration from the HMI

■**NOTE:** Radius Server 1 (Primary Server) is setup in this example. The steps to setup Radius Server 2 (Secondary Server) are similar.

1. Press [COMM] to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
        COMMUNICATIONS
   ❮CNFG            UTIL❯
```

2. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
        PORT1 Settings
   ❮                    ❯
```

3. Press [MNTR] or [COMM] as necessary until "Ethernet" is displayed.

```
          Ethernet
   ❮                    ❯
```

4. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
          Settings
   ❮                    ❯
```

5. Press [CNFG] as necessary, until the "Radius server IP 1" menu item is displayed.

```
   Radius server IP 1
    XX.  XX.  XX.  XX
```

6. Press [ENT/UTIL]. The following will be displayed.

```
   Radius server IP 1
    XX.  XX.  XX.  XX
```

7. Utilizing the arrow pushbuttons enter the desired Radius server IP address.

   Press [ENT/UTIL]. The desired Radius server IP address will be displayed.

8. Press [CNFG] as necessary, until the "Radius server port 1" menu item is displayed.

```
   Radius server port 1
      1812
```

9. Press [ENT/UTIL]. The following will be displayed.

```
   Radius server port 1
      1812
```

10. Utilizing the arrow pushbuttons enter the desired Radius server port.

   Press [ENT/UTIL]. The desired Radius server port will be displayed.

11. Press ![CNFG] as necessary, until the "Radius secret" menu item is displayed.

> Radius secret
> dfltsec

12. Press ![ENT UTIL]. The following will be displayed.

> Radius secret
> dfltsec

13. Utilizing the arrow pushbuttons enter the desired Radius secret key.

14. Press ![ENT UTIL]. The desired Radius secret key will be displayed.

IPsec Configuration from IPScom

To set up the M-7679 Recloser Control to apply the IPsec elements of the Cyber Security scheme perform the following:

1. Start IPScom, then establish communications with the target control.

2. Select "Enable" from the **Communication/Setup/Communication Security/ Security Mode/IPSEC Configuration** dropdown menu.

3. IPScom will display the "IPSec Enable" dialog screen (Figure D-33). Select "Enable IPSec".

Figure D-33   IPSec Enable Dialog Screen

4. Select **IPSEC Configuration/Configure Endpoint**. IPScom will display the "Configure Endpoint" (Figure D-34) dialog screen which allows the user to add, edit, delete or save IPsec Endpoints.

Figure D-34   IPsec Configure Endpoint Dialog Screen

5. Select an available Endpoint from the "Configure Endpoint" screen and then select "Edit". IPScom will display the "IPsec General Settings" screen (Figure D-35) which allows the user to configure IPsec security settings, including IKE (Internet Key Exchange) Policy, IPsec Policy, Policy Lifetimes and Identities.

6. Enter the required settings in the IPsec General Settings dialog screen tabs (Figure D-36 through Figure D-38).

Figure D-35   IPsec General Settings Dialog Screen

Figure D-36   IPsec General Settings "IPsec Policy" Tab

Figure D-37   IPsec General Settings "Policy Lifetimes" Tab

Figure D-38   IPsec General Settings "Identities" Tab

7. Select "Save All". IPScom will display an Error Message alerting the user to any required settings which have not been entered (Figure D-39).

Figure D-39   IPsec Configuration Error Screen

8. If applicable, enter all required settings and select "Save All".

9. Close the "General Settings" screen and return to the 'Configure Endpoint" dialog screen.

10. Add and/or edit any additional endpoints and select "Save". IPScom will display the "Save As" dialog screen (Figure D-40) which allows the user to name and save the IPsec configuration file (*.ifg).

Figure D-40   IPsec Save As Dialog Screen

11. Enter the desired IPsec Configuration filename and select "Save". IPScom will display a confirmation screen (Figure D-41).

Figure D-41   IPsec Configuration File Saved Confirmation Screen

12. Select "OK". IPScom will return to the "Configure Endpoint" screen.

■**NOTE:** IPsec configuration files may be sent to the control from the Configure Endpoint dialog screen.

Sending IPsec Configuration File to the Control From IPScom

1. Start IPScom, then establish communications with the target control.

2. Select **Communication/Setup/Communication Security/Security Mode/IPsec Configuration/Send Configuration File** from the IPScom tool bar. IPScom will display a "IPsec Configuration File" Open dialog screen (Figure D-42).

Figure D-42   IPsec Configuration File Open Dialog Screen

3. Select the desired file name that contains the IPsec Configuration to be sent to the control.

4. Select "Open". IPScom will send the selected file that contains the IPsec Configuration to the target control.

5. IPScom will display a "IPsec Configuration File Sent to Control" confirmation screen (Figure D-43). Select "OK" IPScom will return to the main screen.
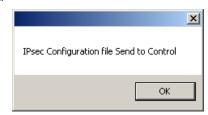
Figure D-43   IPsec Configuration File Sent to Control Confirmation Screen

Retrieving IPsec Configuration from the Control

To retrieve the IPsec Configuration from the M-7679 control perform the following:

1. Start IPScom, then establish communications with the target control.

2. Select **Communication/Setup/Communication Security/Security Mode/IPsec Configuration/Retrieve Configuration File** from the IPScom tool bar. IPScom will display a "IPsec File" Save As dialog screen (Figure D-40).

3. Choose the "Save As" location and enter the desired file name that will contain the IPsec Configuration retrieved from the control.

4. Select "Save". IPScom will save the (*.ifg) file that contains the control IPsec Configuration to the selected location and display a confirmation screen (Figure D-44).
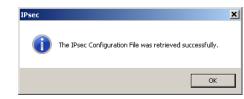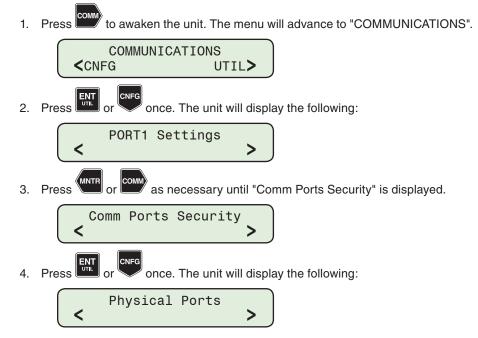
Figure D-44   IPsec Configuration File Retrieved Confirmation Screen

Enable IPsec Security from the HMI

1. Press [COMM] to awaken the unit. The menu will advance to "COMMUNICATIONS".

```
      COMMUNICATIONS
  <CNFG              UTIL>
```

2. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
      PORT1 Settings
  <                      >
```

3. Press [MNTR] or [COMM] as necessary until "Comm Ports Security" is displayed.

```
    Comm Ports Security
  <                      >
```

4. Press [ENT/UTIL] or [CNFG] once. The unit will display the following:

```
      Physical Ports
  <                      >
```

5. Press ⬡MNTR or ⬡COMM as necessary until "Protocol Access" is displayed.

```
        Protocol Access
   <                      >
```

6. Press ⬡CNFG as necessary, until the "IPSEC" menu item is displayed.

```
   IPSEC
   DISABLE
```

7. Press ⬚ENT/UTIL. The following will be displayed.

```
   IPSEC
   DISABLE
```

8. Utilizing ⬚SETP or ⬡CNFG select **ENABLE**, then press ⬚ENT/UTIL. The following will be displayed.

```
   IPSEC
   ENABLE
```

E Self-test Error Codes

26	FLASH configuration has invalid page size
27	FLASH access timeout
28	FLASH is missing configuration
29	FLASH configuration is invalid
30	FLASH configuration section is missing
31	FLASH configuration has invalid section range
32	FLASH configuration section is out of memory
33	FLASH configuration error
34	FLASH is out of memory
35	FLASH file system is out of memory
36	FLASH receive failed
37	FLASH PROGRAMMING ERROR
38	FLASH ACCESS ERROR
39	FLASH BUFFER ERROR
41	DNP CONFIGURATION OUT OF MEMORY
42	DNP MMS CONFIGURATION FAILED
43	FLASH FILE SYSTEM RESOURCES FAILED
44	LED MAP FILE NOT FOUND
45	LED MAP STATUS BIT MISSING
46	MISSING SETPOINT IN SPDB TABLE
47	SOE RECORDER INIT FAILED
48	MESSAGE LOG INIT FAILED
49	RAM DISK INIT FAILED
50	RAM DISK RESOURCES FAILED
51	INVALID MODBUS CHANNEL
52	ERROR IN SPDB DATABASE CONFIGURATION
53	SDCARD FAT MOUNT FAILED
54	OSCILLOGRAPH RECORDER HEADER MISMATCH

Table E-1   Self-Test Error Codes (1 of 2)

55	DATALOG RECORDER INIT FAILED
56	SPDB DATABASE HASH OUT OF MEMORY
57	ERROR DURING USER LOGOUT
58	PASSWORD FILE IS MISSING
59	ERROR IN PASSWORD FILE
60	BBRAM BATTERY FAILURE
61	BACKGROUND TASK FIFO ERROR
62	BACKGROUND TASK COMMAND POINTER IS NULL
63	OUT OF MEMORY DURING RSA INIT
64	IP SOCKET MUTEX ERROR
65	BBRAM RAMDISK INITIALIZATION FAILURE
66	MESSAGE LOG BUFFER OVERFLOW
67	DSP WATCHDOG ERROR
68	DSP CALIBRATION CHECKSUM ERROR
69	DSP SETPOINTS CHECKSUM ERROR
70	"MODBUS PORT" SETPOINT FAILURE
71	"GLOBAL PORTS ENABLE" SETPOINT FAILURE
72	EEPROM WRITE TIMEOUT
73	BOOTDATA IS CORRUPTED
74	BOOTDATA CHECKSUM ERROR
75	CONFIG FILE TYPE MISMATCH ERROR
76	DNP DTD FILE PARSE ERROR
77	"DNP PORT" SETPOINT FAILURE
100	ERROR LOCKING SPORT0 SEMAPHORE
101	NO RESPONSE FROM DSP VIA SPORT0
102	ERROR IN DSP RESPONSE
103	ERROR IN DSP METERING DATA
104	FAIL TO TRANSFER SETPOINTS TO DSP
200	IP SOCKETS ARE OUT OF MEMORY
201	IP SOCKET IS FULL
9000	UNAUTHORIZED PROGRAM FLASH ACCESS

Table E-1   Self-Test Error Codes (2 of 2)

F Battery Charger

■ **CYBER SECURITY NOTE:**

When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

1.0   M-2032A Battery Charger Overview

The purpose of this appendix is to describe the functionality of the M-2032A Battery Charger and it's interface with the M-7679 Recloser Control.

The M-2032A Battery Charger includes the following functions in support of the M-7679 Recloser Control:

- Receives commands from M-7679 to:
  - Turn-on/off battery load
  - Turn-on/off 13.8 Vdc accessory supply
  - Turn battery supply off

- Communicates the following to the M-7679:
  - Charger state
  - Main power supply status
  - Battery Voltage
  - Battery Current
  - Recloser Gas Pressure

- Includes a Wake-up system that can be initiated by either the Recloser Front Panel pushbutton or from the onboard serial port.

When the M-7679 main 120 Vac power supply source is energized, the M-2032A battery monitor/charger controls charging current to the battery system.

The M-2032A includes a 24 volt battery charging circuit powered from an external 120 Vac source. The battery charger includes circuitry to detect a loss of main power and automatically provides power from the 24 Vdc battery connections.

Turn-on/off Battery Load Command

The M-7679 issues the "Turn-on/off Battery Load" command to the M-2032A to test the battery capacity when the control is operating from the main power supply.

Turn-on/off 13.8 Vdc Accessory Supply Command

The accessory supply provides power for external devices such as radio, modems, etc. When the system is operating from battery power the user can opt to turn this supply off to conserve battery capacity. This can be done immediately upon loss of main power or after a delay determined by the user.

Turn Battery Supply Off Command

When the battery voltage decreases to less than a level set by the user, the battery supply to the M-7679 will be turned off (Sleep Mode) to protect the battery. Discharging batteries below certain levels will shorten the life of or damage the battery.

Wake-up System Command

The Wake-up system command is initiated by either a Serial Port or Front Panel Pushbutton. The wake-up system command allows the user to awaken the M-7679 from the Sleep Mode that was initiated by the Battery Supply Off command. The wake-up system command restores power to the M-7679 for a ten minute period. If the battery voltage is less than the user selected voltage after the ten minute period has expired, then the Turn Battery Supply Off command will be reinstated placing the M-7679 in Sleep Mode.

2.0 Battery System

The Battery System consists of two series connected 12 Vdc, 9 Ah sealed lead-acid batteries that create a 24 Vdc battery system that powers the M-7679 and provides Trip and Close power to the recloser when the main power supply source is de-energized. If the main 120 Vac power supply source is de-energized, a fully charged battery can sustain operation of the M-7679 for approximately 8 hours at temperature of 25 °C.

3.0 Battery Charger Monitoring System

The M-2032A provides various Battery, Charger, and Battery Load Test statuses to the M-7679 that can be viewed from the IPScom Battery Charger Monitoring status screen (Figure F-1).

The Battery Charger Monitoring System must be enabled in the Setpoints/Other Setpoints/ Power Supply/Battery Charger Monitor dialog screen (Figure F-2). Also included in the Battery Charger section are the settings for the "Turn-on/off Battery Load" command, the "Time to perform load test" and the "Battery Charger Model".

Main Power Detection

When the main 120 Vac power supply source is energized (green), the M-2032A battery charger/monitor controls the charging current to the battery system.

Figure F-1   Battery Charger Monitoring Status Screen

Figure F-2   Power Supply/Battery Charger Monitor Dialog Screen

Battery Charging Board Error

The Battery Charging Board Error is detected (red) when a combination of the Main Power Supply Source status, the direction of the charging/discharging current and battery voltage level indicate a malfunction condition.

Load Test ON

The M-7679 periodically tests the batteries by subjecting them to a 2 A load for 5 seconds. During the test, the "Load Test ON" status light is illuminated (red).

Discharge Test Fail

If the battery voltage falls below this threshold during the test, the "Discharge Test Fail" status light will be illuminated, and the BATTERY LED (if programmed) illuminates on the front panel. The "Discharge Test Fail" status light remains illuminated until the next successful battery load test.

The "Discharge Test Fail" status light also illuminates if the battery charger has been in the Charging Boost mode (29.4 Vdc) for greater than 24 hours. This is indicative of the battery not being able to take a charge or being nearly entirely depleted. Replace the battery if needed and perform a battery load test to extinguish the Discharge Test Fail status light.

Charging Mode

The M-7679 and M-2032A monitor the battery charge/discharge current and battery voltage. The M-7679 calculates the capacity of the batteries based on these measured values and determines the charging rate/mode that is required.

- Charging Boost – If the main power supply source is energized and a Boost charging mode is required, then the M-2032A will charge the batteries in Boost mode and the Charging Boost status light will be illuminated (red).
- Trickle Charge – If the main power supply source is energized and a Boost charging mode is not required, then the M-2032A will charge the batteries in the Trickle mode and the Trickle Charge status light will be illuminated (red). The Trickle mode current is approximately 12 mA.

Discharging

When the main 120 Vac power supply source is de-energized and the M-7679 is operating from battery power (measured current has reversed direction) the Discharging status light will be illuminated (red).

The changeover from main power to battery power is done by the M-2032A.

Also, when the M-7679 is operating from battery power, if the voltage decreases to less than a minimum user defined setting, the M-7679 will issue a "Turn-on/off Battery Load" command to disconnect the main 24 Vdc supply to the M-7679. Upon executing the command, the M-7679 will be powered down and the Battery Charger will enter a low power sleep mode and the M-7679 will instantly shut down.

Disconnected/Failed

If the charging current decreases to less than 40 mA, or the discharge current decreases to less than 100 mA, then the battery is considered failed or disconnected. In either case, the Disconnected/Failed status light will be illuminated (red).

If the batteries fail, or when the batteries are removed temporarily during replacement, the 120 Vac source and battery charging system provide sufficient power to Trip and Close most reclosers.

However, the 120 Vac may decrease significantly during a fault, reducing or eliminating the voltage needed to power the M-7679 and trip the recloser. A 22000 µF capacitor is included in the battery system to maintain power to the M-7679 and provide energy to trip the recloser. The capacitor is sized to provide at least 0.5 seconds of control power and trip energy after main power supply (120 Vac power) is lost and with the batteries failed or disconnected with enough time for a high-current instantaneous or fast curve operation.

Battery Charger Calibration from IPScom

The Battery Charger Calibration feature allows the user to calibrate the offset in charging current measurement. The Battery Charger must be disconnected from the battery before performing the calibration.

1. Disconnect the battery charger from the battery.
2. Select "Calibrate" from the Battery Charger Monitoring screen (Figure F-1). IPScom will display the "Calibration Confirmation" screen (Figure F-2). Ensure that the Battery Charger is disconnected.
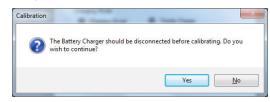
Figure F-3   Disconnect Battery Charger Confirmation Screen

3. Select "Yes". IPScom will perform the calibration and display the "Calibration Successful" confirmation screen (Figure F-4).
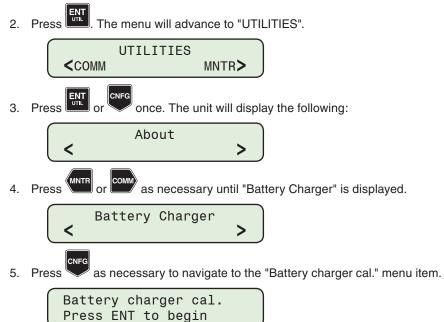
Figure F-4   Battery Charger Calibration Successful Confirmation Screen

4. Select "OK". IPScom will return to the Battery Charger Monitoring screen.

Battery Charger Calibration from the HMI

1. Disconnect the battery charger from the battery.
2. Press [ENT UTIL]. The menu will advance to "UTILITIES".

```
            UTILITIES
   <COMM                 MNTR>
```

3. Press [ENT UTIL] or [CNFG] once. The unit will display the following:

```
            About
   <                     >
```

4. Press [MNTR] or [COMM] as necessary until "Battery Charger" is displayed.

```
        Battery Charger
   <                     >
```

5. Press [CNFG] as necessary to navigate to the "Battery charger cal." menu item.

```
   Battery charger cal.
   Press ENT to begin
```

6. Press [ENT UTIL]. The unit will display the following:

> ```
> Disconnect battery!
> Press ENT to begin
> ```

7. Press [ENT UTIL]. The unit will perform the calibration and then display the following:

> ```
> Battery charger cal.
> Calibration finished
> ```

4.0   Battery Load Test

The M-7679 automatically load tests the 24 Vdc batteries once every 24 hours at a prescribed time of day (Figure F-2). An internal 24-hour timer cumulatively times whenever the M-2032A is in the charge mode (e.g., 120 Vac is powering the M-7679 thus providing 24 Vdc for main power supply for the M-7679 and charging the battery). Even if the battery is fully charged, the M-2032A maintains a low-rate charging current, so it is still in the charge mode.

After the 24-hour timer times out, and the M-2032A is still in the charge mode, a 2 A load (12 Ω 100 W resistor) is automatically paralleled with the battery for 5 seconds. If battery voltage decreases to less than 22.0 Vdc during this load test, the BATTERY LED illuminates (if programmed) and remains illuminated until the next battery test is successful. The "Discharge Test" status light will also illuminate (red).

The Battery Load Test can also be initiated from the M-7679 front panel HMI in the Utility/Battery Charger menu. The Battery Load test can also be initiated through a dedicated MODBUS point and DNP object. All Battery System settings have corresponding communication points.

The Battery System parameters can also be observed from the M-7679 front panel HMI in the Monitor/Battery Charger menu. The following parameters can be monitored:

- Battery Status (Battery Disconnected, Battery Failed or Battery Present)
- Battery Voltage (Volts)
- Charging Current (Amps)
- Battery Capacity (%)

G Appendix – S-1100
Remote Ethernet File Update Utility

■ **CYBER SECURITY NOTE:**
When Cyber Security is enabled, access to any feature described in this Chapter is subject to the Access Permissions Policy as designated by the Security Policy Administrator.

S-1100 REMOTE ETHERNET FILE UPDATE (REFU) UTILITY

The REFU Utility is a stand alone PC application. The REFU Utility utilizes a file transfer algorithm that Beckwith Electric has implemented in the M-7679 firmware for transferring such files as User Access, IPsec Policy and DNP device map files. The REFU Utility is capable of operation behind any secure firewall or within any IT security policy imposed by a local administrator.

Figure G-1   Remote Ethernet File Update Utility Program Icon

Remote Ethernet Firmware Update

The Remote Ethernet Firmware Update element of the Remote Ethernet File Update (REFU) Utility application allows the user to remotely update one or more control's firmware to a new version, utilizing an ethernet connection. The Remote Ethernet File Update (REFU) Utility dialog screen is presented in Figure G-2.

Figure G-2   Remote Ethernet File Update Utility (Firmware File) Dialog Screen

Remote Ethernet File Update and Cyber Security

To comply with Cyber security requirements, the REFU Utility will prompt for a password when launched. The default password is "BecoUpdate". This password is user settable (alphanumeric and special characters) upon launching the program for the first time and can also be changed from the **File/Password** menu.

Due to the sensitive nature of this utility, it is highly recommended not to distribute this application to unauthorized users. Therefore, this application will not be available for download from the Beckwith Electric website. Furthermore, it is only available upon written request from authorized personnel.

The Remote Ethernet Firmware Update application utilizes a special firmware update file created by Beckwith Electric that contains both the firmware version number in encrypted form and the regular firmware file with the ".bot" extension and a version filter (optional). The firmware update file format has an extension of ".upd". If the version filter is not included, the application will not perform a version check prior to sending the firmware to the control as described in Step 7 of the Firmware Update Sequence.

As an additional security measure, the REFU protocol must be enabled utilizing IPScom or the front panel HMI. To enable the REFU protocol in IPScom, navigate to the Protocol Access dialog screen *Communication>Setup>Comm Port Security>Protocol Access*. Select **Enable REFU** (Figure G-3).

Figure G-3   Comm Port Security/Protocol Access Dialog Screen

To enable the REFU protocol utilizing the HMI, navigate to the **Remote FW Update** menu screen *Communication>Comm Ports Security>Protocol Access*. Select **ENABLE**.

```
Remote FW Update
ENABLE
```

Additional Features

These features apply to both Firmware and Data File modes:

- The user can select for each control, which file(s) to be updated by selecting the appropriate check boxes.
- The utility can automatically generate consecutive IP Addresses, given a start IP Address and the number of controls in that IP Address range. It is important to note that the serial number verification by the utility is not performed when this feature is used.
- Users can also copy and paste IP address and serial number from a Microsoft® Excel® spreadsheet into the datagrid view of the REFU utility. Data may be pasted using "Ctrl+V" or by using a right mouse click and selecting "Paste".

■**NOTE:** The user cannot Copy/Paste only the serial number. The selection must be either (IP address + serial number) or (IP address only).

The information in the spreadsheet must be stored as illustrated below to use the Copy/Paste feature:

10.10.2.1	1
10.10.2.3	2
10.10.2.9	23
10.10.2.5	4

Remote Ethernet Firmware Update Procedure

■**NOTE:** These instructions describe the steps necessary to accomplish a remote firmware update utilizing the user interface provided by the Remote Ethernet File Update Utility. The actual dialog between the REFU Utility and the Control is described in detail in the Firmware Update Sequence section of this Appendix.

To remotely update the firmware of a control or a series of controls on an ethernet network proceed as follows:

1. Verify that the following conditions exist:
    - The Remote Ethernet File Update (REFU) Utility is installed and running on a PC with access to the target ethernet network.
    - A ".upd" file created by Beckwith Electric that contains the firmware to be updated is available.

2. Launch the Remote Ethernet File Update (REFU) Utility. The REFU dialog screen (Figure G-2) will be displayed.

3. Select "Firmware File".

4. Select "Choose File". The utility will display Figure G-4 allowing the user to select the applicable product.
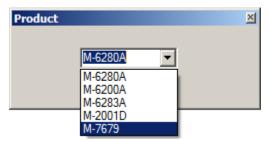
Figure G-4   REFU Select Product Dropdown List

5. Select the ".upd" file. The utility will:
    - Populate the "Firmware File" field with the path/file name
    - Open the selected file and retrieve and decrypt the version information and populate the "File Version" field with the firmware version

6. Enter the IP Address and the Serial Number of the control to be updated.

7. Select "Add". The information will be added to the list of controls to be updated. Repeat Step 6 for any other controls to be updated.

    The user can create a list of controls that will have their firmware updated. This list can be saved if desired and can be retrieved for use at a later date. The list of controls and their associated information (except for the "Update to Version") is stored in an encrypted format.

8. From the Settings dropdown menu select the number of "Retries" to be attempted if there is any failure to update the firmware on any control.

    The maximum number of retries is 10. The default number of retries is 3. The range is from 0 to 10.

9. Select the controls to be updated.

10. Select either "Update Selected" or "Update All" to start the update sequence.

    The REFU Utility will start the update sequence for each control. The sequence is described in detail in the Firmware Update Sequence described below.

Firmware Update Sequence Summary

1. The REFU Utility opens a TCP connection on port 62000.
2. The REFU Utility initiates the Authentication session by sending an encrypted hash signature.
3. The Control verifies the received encrypted hash string.
4. If the Control can not verify the received encrypted hash string, then the connection is automatically closed by the Control.
5. If the received hash string verification is successful, then the Control goes into the programming mode.
6. The REFU Utility will then query the Control for the firmware version installed on the Control and if selected, the serial number of the Control.
7. The REFU Utility will compare the installed firmware version received from the Control, and if selected, the serial number to the REFU Utility internal serial number and version filter, and continue as follows:
   - If the installed firmware version is found to be a firmware version that does not support remote ethernet firmware update, and/or if selected, the serial number does not match, then after the selected number of attempts have also failed then the REFU Utility will close the connection.
   - If the comparison is successful, then update procedure continues.
8. The REFU Utility starts the file upload to the control.
9. When the file is completely uploaded to the Control, the control will verify the digital signature of the firmware.
10. Based on the results of the verification, the control will proceed as follows:
    - If the digital signature verification is unsuccessful, then the Control will send the appropriate error message to the REFU Utility and terminate the update session.
    - If the digital signature verification is successful, then the programming sequence will continue.
11. Prior to programming the flash, the following steps are taken:
    a. A block of all automatic and remote operations is activated, leaving the Control state unchanged.
    b. All ongoing operations are terminated.
    c. All setpoints and calibration data is backed up into internal data flash memory.

▲**CAUTION:** The update process, from erasing the Program Flash to complete reprogramming takes approximately 15 seconds. Any error or loss of power after the flash has been erased will be fatal to the control.

12. The flash programming is initiated as follows:
    a. The entire Program Flash is erased.
    b. The new firmware is burned into the program flash.

If for any reason the erasing or programming of the Program Flash is unsuccessful, then the Control will terminate the update process and return to normal program execution without rebooting.

The Control will also notify the REFU Utility by sending the appropriate error message when queried. This type of error can result in the Program Flash not being completely programmed. Therefore, the user should retry to update the firmware again. A power loss in this condition will result in the Control not being able to reboot properly.

13. When the burning of the firmware into the program flash has been completed, the Control will Reboot.

14. When the Control has completed the reboot process, the Control will commence normal operation subject to the previously saved setpoints and calibration data.

15. After the Control has completed its rebooting process the REFU Utility will reopen a TCP connection on port 62000 and query for the firmware version number.

16. If the queried version number does not match the programmed version number, the REFU Utility application will notify the user of the status of the process and allow the user to repeat the update if desired.

17. If the queried version number matches the programmed version number, the programming process has been successful.

Remote Data File Update Procedure

To remotely update selected data files of a control or a series of controls on an ethernet network proceed as follows:

1. Verify that the following conditions exist:
   - The Remote Ethernet File Update (REFU) Utility is installed and running on a PC with access to the target ethernet network.
   - The desired "User Access", "IPsec Policy", or "DNP Configuration" file is available.

2. Launch the Remote Ethernet File Update (REFU) Utility. The REFU dialog screen (Figure G-2) will be displayed.

3. Select "Data File". The REFU Data File dialog screen will be displayed (Figure G-5).

4. Select "Choose File" for the file(s) to be updated. The utility will prompt for the desired file location and file name.

5. Select the desired file. The utility will populate the "DNP Configuration" field with the path/file name.

6. Enter the IP Address and the Serial Number of the control to be updated.

7. Select "Add". The information will be added to the list of controls to be updated. Repeat Step 6 for any other controls to be updated.

   The user can create a list of controls that will have their data files updated. This list can be saved if desired and can be retrieved for use at a later date. The list of controls and their associated information (except for the "Update to Version") is stored in an encrypted format.

8. From the Settings dropdown menu select the number of "Retries" to be attempted if there is any failure to update the data files on any control.

   The maximum number of retries is 10. The default number of retries is 3. The range is from 0 to 10.

9. Select the controls to be updated.

10. Select the desired file types to be updated on each individual control.

11. Select either "Update Selected" or "Update All" to start the update sequence.

    The REFU Utility will start the update sequence for each control. The sequence is described in detail in the File Update Sequence described below.

File Update Sequence Summary

1. The REFU Utility opens a TCP connection on port 62000.
2. The authentication sequence is started with the control. The authentication sequence is similar to the firmware update authentication.
   - If the authentication sequence fails, then the connection is automatically closed by the Control.
   - If the authentication sequence is successful, then the Control starts the update procedure.
3. The REFU Utility starts the file upload.
4. File transfer is complete.

Figure G-5   Remote Ethernet File Update Utility (Data File) Dialog Screen

This Page Left Intentionally Blank

H Index

Legal Information

Patent

The units described in this manual are covered by U.S. Patents, with other patents pending.

Buyer shall hold harmless and indemnify the Seller, its directors, officers, agents, and employees from any and all costs and expense, damage or loss, resulting from any alleged infringementof United States Letters Patent or rights accruing thereform or trademarks, whether federal, state, or common law, arising from the Seller's compliance with Buyer's designs, specifications, or instructions.

Warranty

Seller hereby warrants that the goods which are the subject matter of this contract will be manufactured in a good workmanlike manner and all materials used herein will be new and reasonably suitable for the equipment. Seller warrants that if, during a period of ten years from date of shipment of the equipment, the equipment rendered shall be found by the Buyer to be faulty or shall fail to peform in accordance with Seller's specifications of the product, Seller shall at his expense correct the same, provided, however, that Buyers shall ship the equipment prepaid to Seller's facility. The Seller's responsibility hereunder shall be limited to replacement value of the equipment furnished under this contract.

Seller makes no warranties expressed or implied other than those set out above. Seller specifically excludes the implied warranties of merchantibility and fitness for a particular purpose. There are no warranties which extend beyond the description contained herein. In no event shall Seller be liable for consequential, exemplary, or punitive damages of whatever nature.

Any equipment returned for repair must be sent with transportation charges prepaid. The equipment must remain the property of the Buyer. The aforementioned warranties are void if the value of the unit is invoiced to the Seller at the time of return.

Indemnification

The Seller shall not be liable for any property damages whatsoever or for any loss or damage arising out of, connected with, or resulting from this contract, or from the performance or breach thereof, or from all services covered by or furnished under this contract.

In no event shall the Seller be liable for special, incidental, exemplary, or consequential damages, including but not limited to, loss of profits or revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of purchased power, cost of substitute equipment, facilities or services, downtime costs, or claims or damages of customers or employees of the Buyer for such damages, regardless of whether said claim or damages is based on contract, warranty, tort including negligence, or otherwise.

Under no circumstances shall the Seller be liable for any personal injury whatsoever.

It is agreed that when the equipment furnished hereunder are to be used or performed in connection with any nuclear installation, facility, or activity, Seller shall have no liability for any nuclear damage, personal injury, property damage, or nuclear contamination to any property located at or near the site of the nuclear facility. Buyer agrees to indemnify and hold harmless the Seller against any and all liability associated therewith whatsoever whether based on contract, tort, or otherwise. Nuclear installation or facility means any nuclear reactor and includes the site on which any of the foregoing is located, all operations conducted on such site, and all premises used for such operations.

Notice:

Any illustrations and descriptions by Beckwith Electric Co., Inc. are for the sole purpose of identification.

The drawings and/or specifications enclosed herein are the proprietary property of Beckwith Electric Co., Inc., and are issued in strict confidence; therefore, shall not be used as a basis of reproduction of the apparatus described therein without written permission of Beckwith Electric Co., Inc.

No illustration or description contained herein shall be construed as an express warranty of affirmation, promise, description, or sample, and any and all such express warranties are specifically excluded nor shall such illustration or description imply a warranty that the product is merchantable or fit for a particular purpose. There shall be no warranties which extend beyond those contained in the Beckwith Electric Co., Inc. terms of sale.

This Page Left Intentionally Blank

BECKWITH ELECTRIC CO., INC.
6190 - 118th Avenue North • Largo, Florida 33773-3724 U.S.A.
PHONE (727) 544-2326 • FAX (727) 546-0121
marketing@beckwithelectric.com
www.beckwithelectric.com
ISO 9001:2008

800-7679-IB-09   08/16