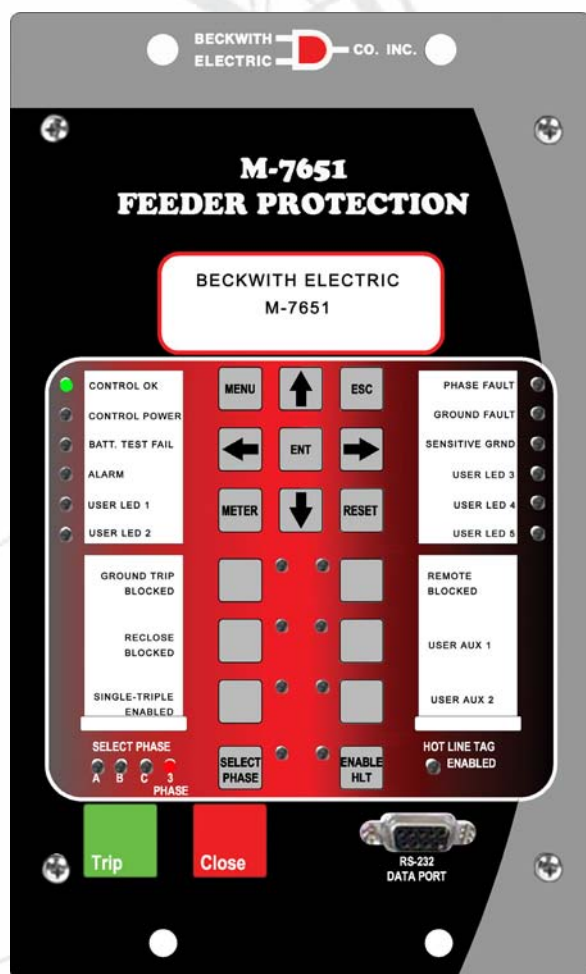


Feeder Protection M-7651



- **SmartGrid ready Advanced Feeder Protection**
- **18 Protective Relaying Functions, including Sync-Check with four Step Recloser (User selectable Single and Three-Phase breaker)**
- **Sampling Rate of 128 sample/cycle provides Advanced Metering and Power Quality; THD (Total Harmonic Distortion), CBEMA Events, Sags and Swells, and Load Profile trending**
- **Reports Reliability Indices; SAIFI, SADI, MAIFI, CAIFI, CAIDI, and ASAL**
- **Advanced Recording Capability; 32 Fault Event Reports, 3500 Event Records with Fault Location, Oscillograph Records user configurable for 16, 32, 64 or 128 samples per cycle**

- **Expandable I/O up to 20 programmable inputs, 15 programmable outputs, plus programmable front LED and Function Pushbuttons**
- **Local and remote serial communication, protocols include BECO 7000, MODBUS, DNP3.0, Harris 5000, Smart P2P (16 bit Peer to Peer), and optional Ethernet**

Standard Protective Functions

- Sync-check (25)
- Phase Undervoltage protection (27)
- Directional Power protection (32)
- Open Phase protection (46OP)
- Negative Sequence Overcurrent protection (46DT / 46IT)
- Voltage Unbalance protection (47)
- Phase Instantaneous Overcurrent Elements (50)
- Ground Instantaneous Overcurrent (50G)
- Neutral Instantaneous Overcurrent (50N)
- Sensitive Ground Instantaneous Overcurrent (50GS)
- Breaker Failure (50BF)
- Phase Time Overcurrent Elements (51)
- Ground Time Overcurrent Elements (51G)
- Neutral Time Overcurrent Elements (51N)
- Sensitive Ground Time Overcurrent Elements (51GS)
- Phase Overvoltage protection (59)
- Neutral Overvoltage protection (59N)
- VT fuse-loss (60FL)
- Directional Phase and Ground Overcurrent protection (67)
- Directional Ground Overcurrent protection (67G)
- Directional Sensitive Ground Overcurrent protection (67GS)
- Four step Recloser (79) three or single phase
- Underfrequency (81U), Overfrequency (81O) and RCOF (81R) Frequency protection
- High current lockout Phase and Ground

Standard Features

- Eleven digital outputs
- Eleven digital inputs
- Event Recording
- Fault Recording
- Six Settings Groups
- Load Profile (Trending)
- Cold Load Pickup
- Breaker Trip and Close Circuit Monitoring (74TC / 74CC)
- DC Station Battery Monitor
- Fault locator
- Oscillographic Recording
- Metering of measured and calculated parameters
- Self Diagnostics
- Three Phase Current Inputs
- One Ground or Sensitive Ground Current Input
- Three Phase Voltage Inputs
- One Sync Check Voltage Input
- 50 and 60 Hz models available
- 1 or 5 A rated CT inputs available
- 50 mA Sensitive Ground CT Input option
- S-7651 Communications Software
- Front RS-232, Rear RS-232 and RS-485 or optical fiber
- IRIG-B time synchronization
- Includes BECO7000, MODBUS, DNP 3.0, Smart P2P, (Peer to Peer) and Harris 5000 protocols

Optional Features

- RJ45 Ethernet port that includes BECO 7000, DNP3.0, TCP/IP, UDP/IP, and MODBUS TCP/IP including Expanded I/O (4 additional outputs and 9 additional inputs)
- Bluetooth and USB port (replaces front RS-232 port)

STANDARD PROTECTIVE FUNCTIONS

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
Synchrocheck				
25	Reference Phase	A, B, C	–	–
	Undervoltage Permission			
	Dead Line/Dead Bus	No/Yes	–	–
	Dead Line/Live Bus	No/Yes	–	–
	Live Line/Dead Bus	No/Yes	–	–
	Line Minimum Voltage	0 to 200 V	0.1 V	20 mV or $\pm 0.5\%$
	Bus Minimum Voltage	0 to 200 V	0.1 V	20 mV or $\pm 0.5\%$
	Synchrocheck Permission			
	Minimum Time	0 to 100 Sec	0.01 Sec	\pm Half Cycle
	Minimum Voltage	0 to 300 V	0.001 V	
	Angle Difference	0° to 90°	0.1°	$\pm 0.3^\circ$
	Magnitude Difference	0 to 300 V	0.01 V	20 mV or $\pm 0.5\%$
	Frequency Difference	0 to 5 Hz	0.001 Hz	± 0.03 Hz
	Undervoltage (#1 to #4 Steps)			
27	Pickup	0 to 300 V	0.001 V	20 mV or $\pm 0.5\%$
	Definite Time	0 to 60 Sec	0.01 Sec	\pm Half cycle
Directional Power				
32	Pickup	–30000 to 30000 W	0.1 W	± 1 W
	Definite Time	0 to 600 Sec	0.01 Sec	\pm Half cycle
Open Phase				
46 OP	Pickup	0.10 to 0.5 (PU of I_2/I_1)	0.01 (PU of I_2/I_1)	$\pm 0.5\%$
	Definite Time	0.05 to 300 Sec	0.01 Sec	\pm Half cycle

[†]Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
Negative Sequence Overcurrent				
	Negative Sequence Definite Time			
	Pickup I2	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
	Definite Time	0 to 60 Sec	0.01 Sec	± Half cycle
	Negative Sequence Inverse Time-Overcurrent			
46DT	Pickup I2	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
	Curve	IEC/ANSI/US CURVE/RECLOSER/OTHERS/ USER 1/USER 2/ USER 3/ USER 4/DEFINITE TIME		
46IT	IEC Curve Family	Standard Inverse Very Inverse Extremely Inverse Short Time Inverse Long Time Inverse Special Very Inverse		
	Time-Multiplier	0.05 to 1.09	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	ANSI Curve Family	Standard Inverse Very Inverse Extremely Inverse Moderately Inverse		
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	US Curve Family	U1. Moderately Inverse U2. Inverse U3. Very Inverse U4. Extremely Inverse U5. Short Time Inverse		
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	Other Curves Very Inverse, Moderately Inverse, Extremely Inverse			
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	Definite Time Curve			
	Constant Time	0 to 600 Sec	0.01 Sec	± Half cycle

†Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS (cont.)

Device Number	Function	Setpoint Ranges	Increment	Accuracy [†]
Voltage Unbalance				
47	Pickup	0.1 to 0.5 (% of V_2/V_1)	0.01 (% of V_2/V_1)	± 0.5%
	Definite Time	0 to 60 Sec	0.01 Sec	± Half cycle
	Inverse Sequence Definite Time	0 to 60 Sec	0.01 Sec	± Half cycle
Phase, Ground and Neutral Instantaneous Overcurrent				
50	Phase/Ground Pickup	0.1 to 100 A	0.001 A	10 mA or ± 0.5 %
	Definite Time	0 to 60 Sec	0.01 Sec	± Half cycle
50G	Curve	IEC/ANSI/US CURVE/OTHERS/ USER 1/USER 2/ USER 3/ USER 4/DEFINITE TIME		
50N	IEC Curve Family	Standard Inverse Very Inverse Extremely Inverse Short Time Inverse Long Time Inverse Special Very Inverse		
	Time-Multiplier	0.05 to 1.09	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	ANSI Curve Family	Standard Inverse Very Inverse Extremely Inverse Moderately Inverse		
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	US Curve Family	U1. Moderately Inverse U2. Inverse U3. Very Inverse U4. Extremely Inverse U5. Short Time Inverse		
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	Other Curves	Very Inverse Moderately Inverse Extremely Inverse		
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	Definite Time Curve	0 to 600 Sec	0.01 Sec	± Half cycle

[†]Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS (cont.)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†	
Sensitive Ground Instantaneous Overcurrent (Replaces Standard Ground)					
50GS	Sensitive Ground Pickup	0.025 to 50 A	0.001 A	10 mA or ± 0.5 %	
	Definite Time	0 to 60 Sec	0.01 Sec	±Half cycle	
	Curve	IEC/ANSI/US CURVE/OTHERS/ USER 1/USER 2/ USER 3/ USER 4/DEFINITE TIME			
	IEC Curve Family	Standard Inverse Very Inverse Extremely Inverse Short Time Inverse Long Time Inverse Special Very Inverse			
	Time-Multiplier	0.05 to 1.09	0.01	–	
	Electromechanical Reset Delay	NO/YES	–	–	
	ANSI Curve Family	Standard Inverse Very Inverse Extremely Inverse Moderately Inverse			
	Time-Multiplier	0.5 to 30	0.01	–	
	Electromechanical Reset Delay	NO/YES	–	–	
	US Curve Family	U1. Moderately Inverse U2. Inverse U3. Very Inverse U4. Extremely Inverse U5. Short Time Inverse			
	Time-Multiplier	0.5 to 30	0.01	–	
	Electromechanical Reset Delay	NO/YES	–	–	
	Other Curves	Very Inverse Moderately Inverse Extremely Inverse			
	Time-Multiplier	0.5 to 30	0.01	–	
	Electromechanical Reset Delay	NO/YES	–	–	
	Definite Time Curve	0 to 600 Sec	0.01 Sec	± Half cycle	
	Breaker Failure				
	50BF	Phase Reinstatement	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
		Ground Reinstatement	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
		Open Definite Time	0 to 60 Sec	0.01 Sec	± Half cycle

†Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS (cont.)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
Phase, Ground and Neutral Time Overcurrent				
51	Phase/Ground Pickup Curve	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
51G	IEC Curve Family	IEC/ANSI/US CURVE/OTHERS/ USER 1/USER 2/ USER 3/ USER 4/DEFINITE TIME		
51N		Standard Inverse Very Inverse Extremely Inverse Short Time Inverse Long Time Inverse Special Very Inverse		
	Time-Multiplier	0.05 to 1.09	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	ANSI Curve Family	Standard Inverse Very Inverse Extremely Inverse Moderately Inverse		
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	US Curve Family	U1. Moderately Inverse U2. Inverse U3. Very Inverse U4. Extremely Inverse U5. Short Time Inverse		
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	Other Curves	Very Inverse Moderately Inverse Extremely Inverse		
	Time-Multiplier	0.5 to 30	0.01	–
	Electromechanical Reset Delay	NO/YES	–	–
	Definite Time Curve	0 to 600 Sec	0.01 Sec	± Half cycle

†Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS (cont.)

Device Number	Function	Setpoint Ranges	Increment	Accuracy [†]	
Sensitive Ground Time Overcurrent (Replaces Standard Ground)					
51GS	Sensitive Ground Pickup	0.025 to 50 A	0.001 A	10 mA or $\pm 0.5\%$	
	Curve	IEC/ANSI/US CURVE/OTHERS/ USER 1/USER 2/ USER 3/ USER 4/DEFINITE TIME			
	IEC Curve Family	Standard Inverse Very Inverse Extremely Inverse Short Time Inverse Long Time Inverse Special Very Inverse			
	Time-Multiplier	0.05 to 1.09	0.01	–	
	Electromechanical Reset Delay	NO/YES	–	–	
	ANSI Curve Family	Standard Inverse Very Inverse Extremely Inverse Moderately Inverse			
	Time-Multiplier	0.5 to 30	0.01	–	
	Electromechanical Reset Delay	NO/YES	–	–	
	US Curve Family	U1. Moderately Inverse U2. Inverse U3. Very Inverse U4. Extremely Inverse U5. Short Time Inverse			
	Time-Multiplier	0.5 to 30	0.01	–	
	Electromechanical Reset Delay	NO/YES	–	–	
	Other Curves	Very Inverse Moderately Inverse Extremely Inverse			
	Time-Multiplier	0.5 to 30	0.01	–	
	Electromechanical Reset Delay	NO/YES	–	–	
	Definite Time Curve	0 to 600 Sec	0.01 Sec	\pm Half cycle	
	Overvoltage (#1 to #4 Steps)				
	59	Pickup	0 to 300 V	0.001 V	20 mV or $\pm 0.5\%$
		Definite Time	0 to 60 Sec	0.01 Sec	\pm Half cycle
Neutral Overvoltage					
59N	Pickup	10 to 300 V	0.001 V	20 mV or $\pm 0.5\%$	
	Definite Time	0 to 600 Sec	0.1 Sec	\pm Half cycle	

[†]Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS (cont.)

Device Number	Function	Setpoint Ranges	Increment	Accuracy [†]
VT Fuse Loss Detection				
60FL	Negative sequence voltage	10 to 300 V	0.01 V	20 mV or $\pm 0.5\%$
	Negative sequence current	0.1 to 100 A	0.001 A	10 mA or $\pm 0.5\%$
Directional Phase and Ground Overcurrent				
67	Enabled Direction	Forward/Backward/Bi-directional	–	–
	Neutral Polarization Voltage	Zero Sequence Voltage/ Negative Sequence Voltage	–	–
67G	Maximum Torque Angle (Ph-N Faults)	0° to 90°	0.01°	$\pm 0.3^\circ$
	Ph-Ph Polarization Voltage	Fault Voltage/Positive Sequence Voltage/ Negative Sequence Voltage/ Quadrature Voltage	–	–
	Maximum Torque Angle (Ph-Ph Faults)	0° to 90°	0.01°	$\pm 0.3^\circ$
	Single Phase Polarization Voltage	Zero Sequence Voltage/ Negative Sequence Voltage/ Quadrature Voltage	–	–
	Maximum Torque Angle (Single Phase Faults)	0° to 90°	0.01°	$\pm 0.3^\circ$
Sensitive Ground Directional Overcurrent (Replaces Standard 67G Function)				
67GS	Enabled Direction	Forward/Backward/Bi-directional	–	–
	Neutral Polarization Voltage	Zero Sequence Voltage/ Negative Sequence Voltage	–	–
	Maximum Torque Angle (Ph-N Faults)	0° to 90°	0.01°	$\pm 0.3^\circ$
	Ph-Ph Polarization Voltage	Fault Voltage/Positive Sequence Voltage/ Negative Sequence Voltage/ Quadrature Voltage	–	–
	Maximum Torque Angle (Ph-Ph Faults)	0° to 90°	0.01°	$\pm 0.3^\circ$
	Single Phase Polarization Voltage	Zero Sequence Voltage/ Negative Sequence Voltage/ Quadrature Voltage	–	–
	Maximum Torque Angle (Single Phase Faults)	0° to 90°	0.01°	$\pm 0.3^\circ$

[†]Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS (cont.)

Device Number	Function	Setpoint Ranges	Increment	Accuracy†
Breaker Trip and Close Circuit Monitor				
74 TC	Excessive Trip Amount	1 to 254	1	–
	N Trips Time Windows	300 to 3600	1	± Half cycle
74 CC	Alarm threshold	0 to 65535	1	± 0.5%
	Calculation Type	KI, KI2 and KI2T	–	–
Recloser Relay				
79	Global			
	In Service	NO/YES	–	–
	Sequence Coordinator	NO/YES	–	–
	Number of recloses	1 to 4	1	–
	Reset time after auto reclose (Ph-Ph faults)	1 to 600 Sec	1 Sec	± Half cycle
	Reset time after auto reclose (Ph-G faults)	1 to 600 Sec	1 Sec	± Half cycle
	Reset time after manual reclose	1 to 600 Sec	1 Sec	± Half cycle
	High current lock-out (Phase)			
	Pickup	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
	Constant Time	0 to 60 Sec	0.01 Sec	± Half cycle
	Apply after first pickup	NO/YES	–	–
	Apply after Reclose 1	NO/YES	–	–
	Apply after Reclose 2	NO/YES	–	–
	Apply after Reclose 3	NO/YES	–	–
	High current lock-out (Ground)			
	Pickup	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
	Constant Time	0 to 60 Sec	0.01 Sec	± Half cycle
	Apply after first pickup	NO/YES	–	–
	Apply after Reclose 1	NO/YES	–	–
	Apply after Reclose 2	NO/YES	–	–
	Apply after Reclose 3	NO/YES	–	–
	Bus Side Voltage Supervision *(Only with Voltage option)			
	Reference Voltage	0 to 300 V	0.001 V	20 mV or ± 0.5%
Check Time	0.1 to 600 Sec	0.01 Sec	± Half cycle	

†Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS (cont.)

Device Number	Function	Setpoint Ranges	Increment	Accuracy[†]
Recloser Relay (cont.)				
	Recloses			
	Time Delay			
	Time delay (Ph-Ph fault)	0.1 to 600 Sec	0.01 Sec	± Half cycle
	Time delay (Ph-G fault)	0.1 to 600 Sec	0.01 Sec	± Half cycle
	Timing curve for Trip (Phases/Ground/Sensitive Ground)			
	Curve	IEC/ANSI/US CURVE/OTHERS/ USER 1/USER 2/ USER 3/ USER 4/DEFINITE TIME		
	IEC Curve Family	Standard Inverse Very Inverse Extremely Inverse Short Time Inverse Long Time Inverse Special Very Inverse		
	Time-Multiplier	0.05 to 1.09	0.01	-
	ANSI Curve Family	Standard Inverse Very Inverse Extremely Inverse Moderately Inverse		
	Time-Multiplier	0.5 to 30	0.01	-
	US Curve Family	U1. Moderately Inverse U2. Inverse U3. Very Inverse U4. Extremely Inverse U5. Short Time Inverse		
	Time-Multiplier	0.5 to 30	0.01	-
	Other Curves			
	Very Inverse, Moderately Inverse, Extremely Inverse			
	Time-Multiplier	0.5 to 30	0.01	-
	Definite Time Curve			
	Definite Time	0 to 600 Sec	0.01 Sec	± Half cycle

[†]Select the greater of these accuracy values.

STANDARD PROTECTIVE FUNCTIONS (cont.)

Device Number	Function	Setpoint Ranges	Increment	Accuracy [†]
Frequency (4 Steps)				
81 U/O	Underfrequency/Overfrequency			
	Pickup	46 to 65 Hz	0.01 Hz	± 0.03 Hz
	Definite Time	0.05 to 600 Sec	0.01 Sec	± 1 cycle
	Hysteresis	0 to 1 Hz	0.1 Hz	-
81 R	Frequency ROCOF			
	Supervisory Max. Frequency	40 to 70 Hz	0.01 Hz	± 0.03 Hz
	Supervisory Min. Frequency	0 to 100 A	0.1 A	10 mA or ± 0.5%
	Pickup	0.2 to 5 (Hz/Sec)	0.05 Hz/Sec	0.05 Hz/Sec ± 5%
	Definite Time	0 to 2 Sec	0.01 Sec	± 1 cycle
	Pickup Cycle Number	3 to 15 cycles	1 cycle	-
Cold Load Pickup				
	General Settings			
	Cold Load Time	0 to 10000 Sec	1 Sec	± Half cycle
	Pickup Time	0.1 to 3600 Sec	0.01 Sec	± Half cycle
Melting Fuses				
	Minimum operation current	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
	Time to trip	0 to 60 Sec	0.1 Sec	± Half cycle
	Time of fault memory	0 to 60 Sec	0.1 Sec	± Half cycle
Sectionalizer				
	Reclose counts	0 to 3	1	-
	Minimum operation current	0.1 to 100 A	0.001 A	10 mA or ± 0.5%
	Opening total time	0 to 30 Sec	0.1 Sec	± Half cycle

[†]Select the greater of these accuracy values.

The M-7651 is a microprocessor based distribution line relay which provides basic elements of protection, control and measurement of medium voltage electrical positions. Protection, measurement and waveform functions are included among other features. The settings for the different functions can be accomplished through the use of S-7651 Communications software or through the front panel pushbuttons.

Metering

Metering includes:

- Instantaneous values of the current for three phases, ground or sensitive ground
- Line and phase voltages
- DC battery voltage
- Active, reactive, apparent single and 3 phase power
- Active energy received and delivered
- Reactive energy in quadrants I and III
- Single phase and 3 phase power factor
- Frequency and phase sequence
- Thermal and Rolling Demand Metering of: Input Currents and voltages, power factor, active, reactive and apparent power, calculated per phase or 3 phase
- Sequence current and voltage magnitudes
- Power system harmonic components, THD, Cf (Crest factor), Df (Distortion factor) of current and voltage for each phase
- Power Quality (PQ) events: sags, swells, voltage and current imbalances; phase and supply voltage loss; short and long voltage variations, frequency variations and CBEMA curve event detection
- Reality indices:
 - System Average Interruption Frequency Index (SAIFI)
 - System Average Interruption Duration Index (SAIDI)
 - Momentary Average Interruption Frequency Index (MAIFI)
 - Customer Average Interruption Frequency Index (CAIFI)
 - Customer Average Interruption Duration Index (CAIDI)
 - Average Service Availability Index (ASAI)
- Equipment temperature
- Statistical data related to the operation and supervision of the equipment. Metering accuracy 0.5 %.

Oscillographic Recording

The M-7651 records voltage and current waveforms associated to faults and user selected events.

Samples per cycle (16, 32, 64, or 128), the number of saved cycles (1 to 3000; 1 to 2000; 1 to 1000; 1 to 500;) and the number of pre-fault cycles (1 to 20) are configurable. Table 1 illustrates examples of possible combinations.

Number of Samples by Cycle	Number of Cycles to Record	Maximum Number of Waveforms Records
16	3000	10
16	20	200
32	2000	7
32	20	180
64	1000	7
64	20	140
128	500	7
128	20	100

Table 1 Examples of Waveform Record Configuration

Load Profile (Trending)

The M-7651 can store in non volatile memory up to 25 user selected parameters (instantaneous, maximum and minimum). These parameters can be selected from the instantaneous values and energy accumulator groups in time intervals between 1 and 60 minutes, with 1 minute steps. 3000 registers can be stored.

External Connections

The possible external connections of the M-7651 are shown in Figures 2 and 3.

Fault Report

The M-7651 keeps records of the last 32 faults with the following information:

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

Event Records

The M-7651 can record and store up to 3500 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.

Each event contains its corresponding voltage and current signals RMS values. The user can limit the events stored by disabling those that are considered less important

Self Diagnostics

The relay includes several self diagnostic functions routines that, when enabled detect possible hardware failures. It also includes a test mode which checks if the LEDs, Inputs, Outputs, Display and Keyboard are working properly.

Settings Groups

Six Settings Groups

Auxiliary Power Supply

24/48 V dc or 24/48 V ac: Range: 18 to 60 V dc/ac

125/220 V dc or 125/220 V ac: Range: 86 to 280 V dc/ac

Current Analog Inputs

The M-7651 has three inputs for phase current and one input for ground or sensitive ground current.

Phase Current Rating:

- I Nominal = 5 A, option 1 A
- I Continuous = 15 A, option 3 A
- I Maximum = 100 A, option 20 A
- I Short duration = 250 A (1 cycle)
- Burden: < 0.1 VA @ 5 A

One of the following:

Ground Current Rating:

- I Nominal = 5 A, option 1 A
- I Continuous = 15 A, option 3 A
- I Maximum = 100 A, option 20 A
- I Short duration = 250 A (1 cycle)
- Burden: < 0.1 VA @ 5 A

Sensitive Ground Current Rating:

- I Nominal = 50 mA
- I Continuous = 10 A
- I Short duration = 150 A (1 cycle)
- Burden: < 0.2 VA @ 5 A

Voltage Analog Inputs

The M-7651 has four Voltage Inputs.

V_{L-N} Nominal = 120 V ac

Min = 60 V ac

Max = 300 V ac

Burden \leq 0.1 VA

Digital Inputs (Opto-Isolated)

The M-7651 has three programmable inputs (expandable up to 20)

Digital Inputs Voltage	Turn-on Voltage Range	Burden
24 V dc	15-17 V dc	54 kohms
48 V dc		51 kohms
110 V dc	84-97 V dc	345 kohms
125 V dc		343 kohms
220 V dc		342 kohms
250 V dc		342 kohms
300 V dc		341 kohms

Table 2 Digital Inputs Voltage Range and Burden

M-7651 Feeder Protection Relay

Digital Outputs

Four contact outputs (standard), three programmable (2 Form A and 1 Form C) and one dedicated Form C Self Test, (number of total output contacts is expandable up to 15)

Specifications:

- 240 V ac / 250 V dc
- Make: 30 A - 0.2 sec
- Carry: 10 A continuous
- Pickup time: < 8 ms
- Dropout time: < 5 ms

Operation Frequency

50 Hz or 60 Hz

Communications Ports

Front: RS 232 Port

Rear: COM1: RS 232

COM2: RS 485 (standard) or Serial Fiber (optional)

COM3: RJ45 Ethernet Port (optional)

Concurrent Ethernet and Serial connections are supported by flexibility in integrating the M-7651 with multiple networks.

Time Synchronization Port

- IRIG - B (B000)
- Input: Demodulated
- Input level: TTL
- Isolation: 500 V

RJ45 Ethernet Port (optional)

- 600 ohm impedance isolated transformer interface
- Isolation: 500 V
- Female RJ45 connector
- Communication speed: 10/100 Mb
- Cable type: UTP cat 5
- Maximum cable length: 100 m

Protocols

Front port: BECO 7000, DNP 3.0 Level 2 slave, MODBUS RTU and Harris 5000

Rear ports: BECO 7000, DNP3.0 level 2 slave, MODBUS RTU, Harris 5000 and Smart P2P (Peer to Peer)

Optional Ethernet port: BECO 7000, DNP 3.0 over TCP/IP and UDP/IP, and MODBUS over TCP/IP

Ethernet port supports multi-user rights for up to 6 concurrent users with the following protocols:

BECO7000 – 3 concurrent users

DNP3.0 – 1 user TCP + 1 user UDP

MODBUS – 1 user TCP

Front Panel

LCD 4 x 20 with configurable contrast

12 programmable front LEDs

20 programmable SMART function accessible from front panel.

- Fixed pushbuttons: **↑**, **↓**, **←**, **→**, **ENT**, **MENU**, **ESC**, **METER**, **RESET**
- Programmable pushbuttons: F1 to F6

S-7651 IPScm Communications Software

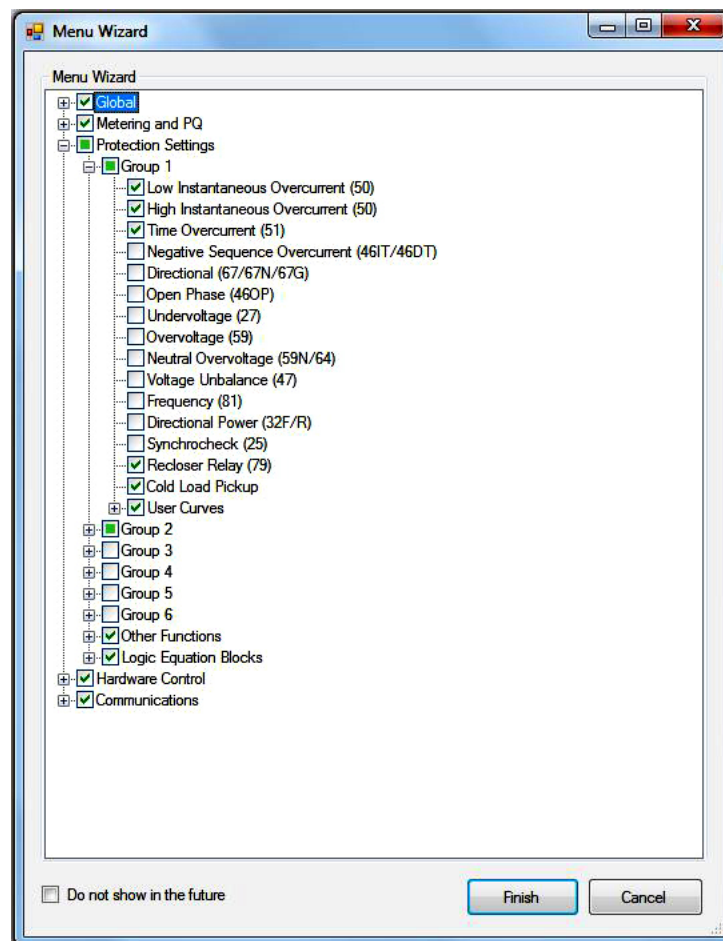
The S-7651 IPScm® Communications Software enables communication between a PC and M-7651 Multifunction Protection System. It is a Windows application, which allows the user to interact with software modules in different languages. The S-7651 IPScm Communications Software makes efficient use of object-oriented programming, achieving a smooth and scalable design, and has an open data structure that allows its maintenance and the incorporation of new functions.

Using the S-7651 IPScm Communications Software, the user can configure the following settings:

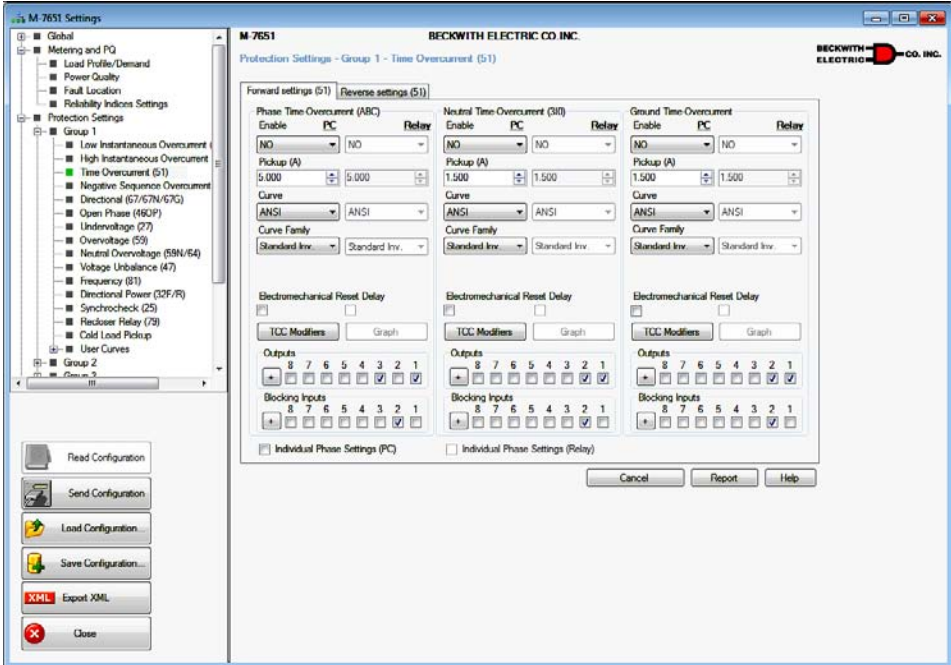
- Protection, control and measurement functions
- Digital signals inputs and outputs
- LEDs and front panel programmable keys
- Communication parameters for serial ports and Ethernet
- Profile of the communication protocols on different ports
- Programmable logic functions
- Waveform records
- IRIG-B Synchronization
- Enable events
- DC Battery voltage supervision
- Daylight Saving Time

IPScm Menu Wizard

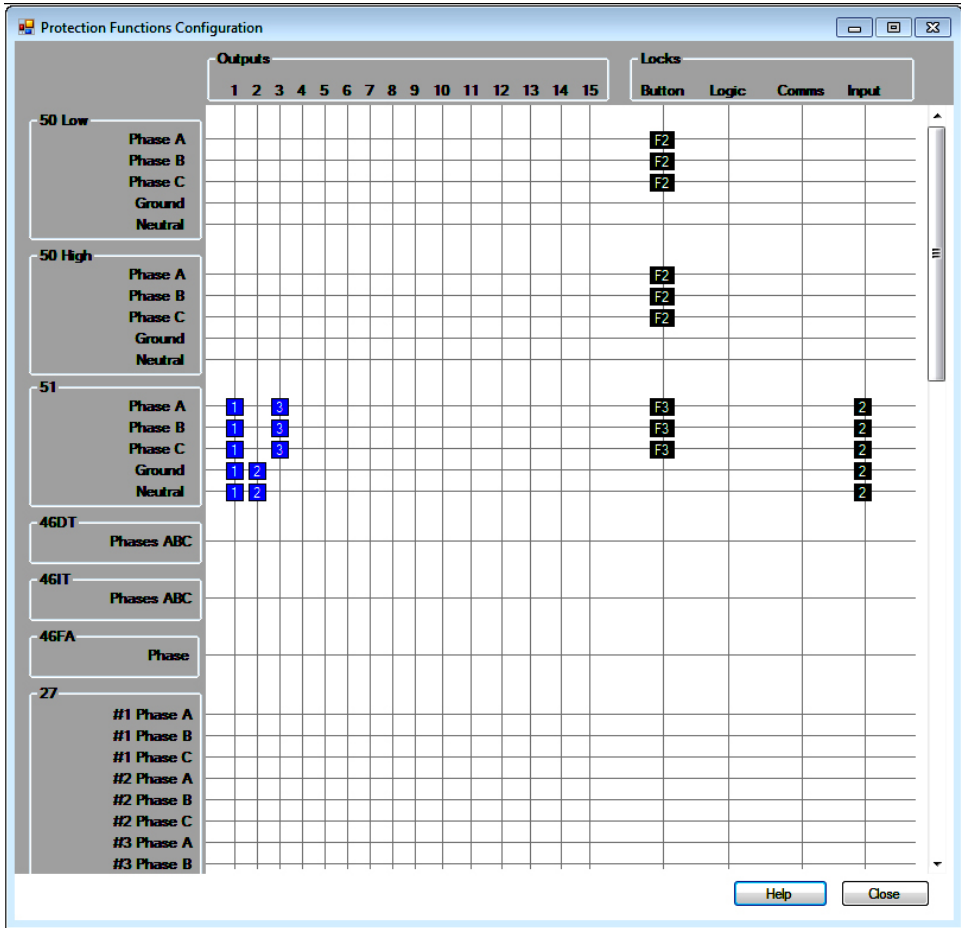
The Menu Wizard allows the user to select which relay features and functions are to be displayed in the IPScm application software. Features and functions not being used in an application will be masked out from the screen. This feature provides easy and simplified setting and setup of the relay using the IPScm.



The S-7651 Software provides simple easy function programming.

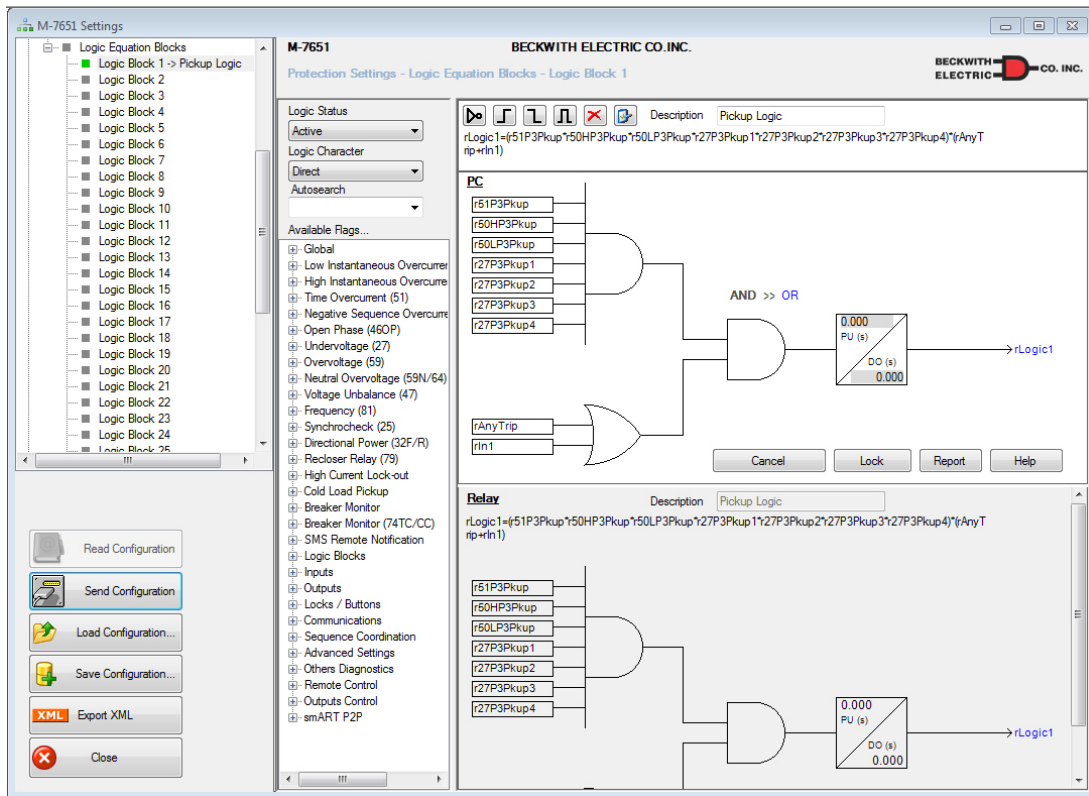


The S-7651 Configuration Matrix permits easy verification of relay function I/O programming.



M-7651 Feeder Protection Relay

The configurable logic permits easy programming of complex logic, required for special applications.



With the S-7651 Communications Software, visual interaction between the user's PC and the M-7651 Multifunction Protection Relay is achieved in a friendly way, allowing the easy and intuitive configuration of the relay, and minimizing programming errors. Context sensitive help is available in all windows and integrates the Users Manual.

M-7651 Typical Connection Diagram

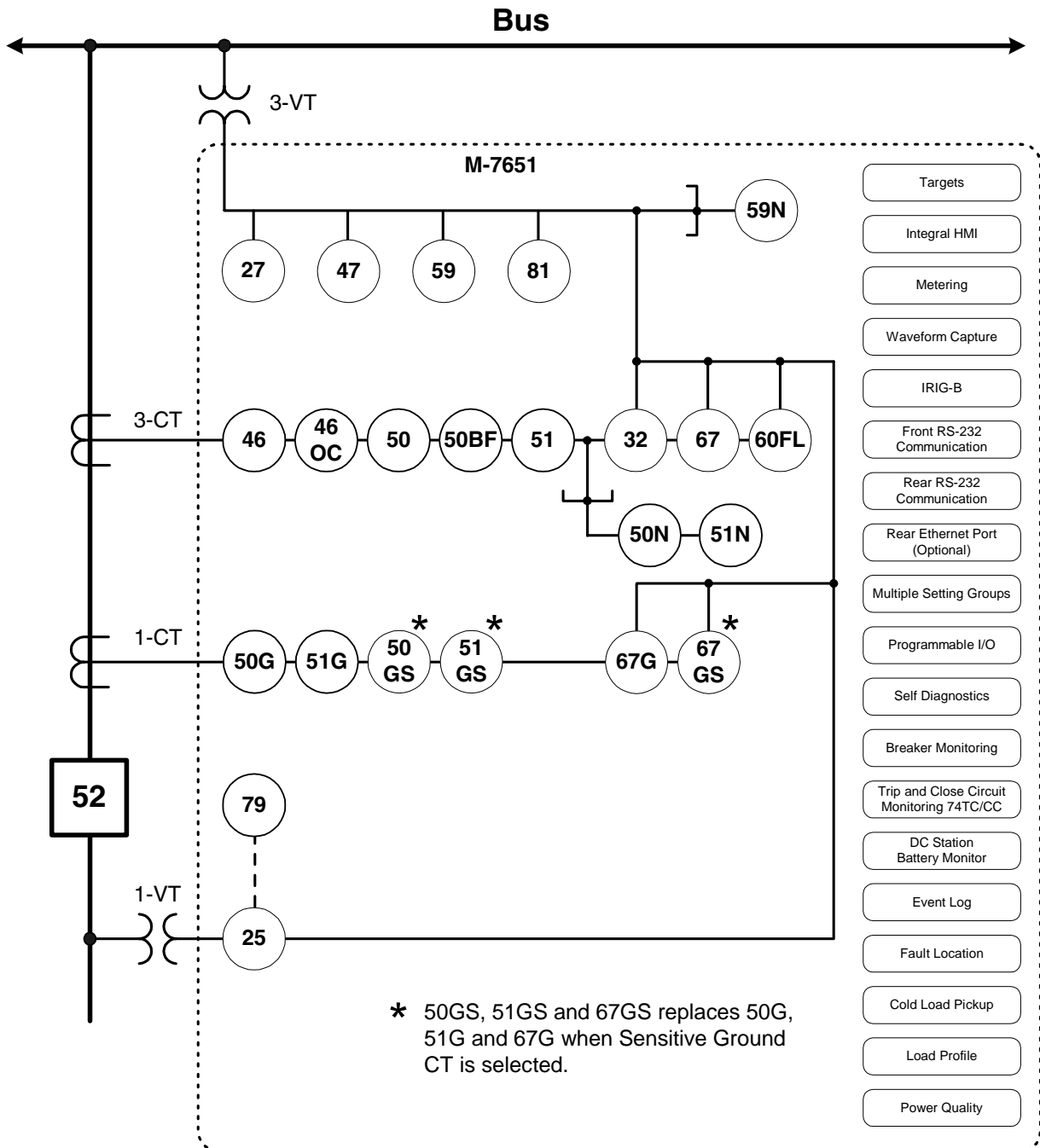


Figure 1 M-7651 One-Line Functional Diagram

M-7651 Feeder Protection Relay

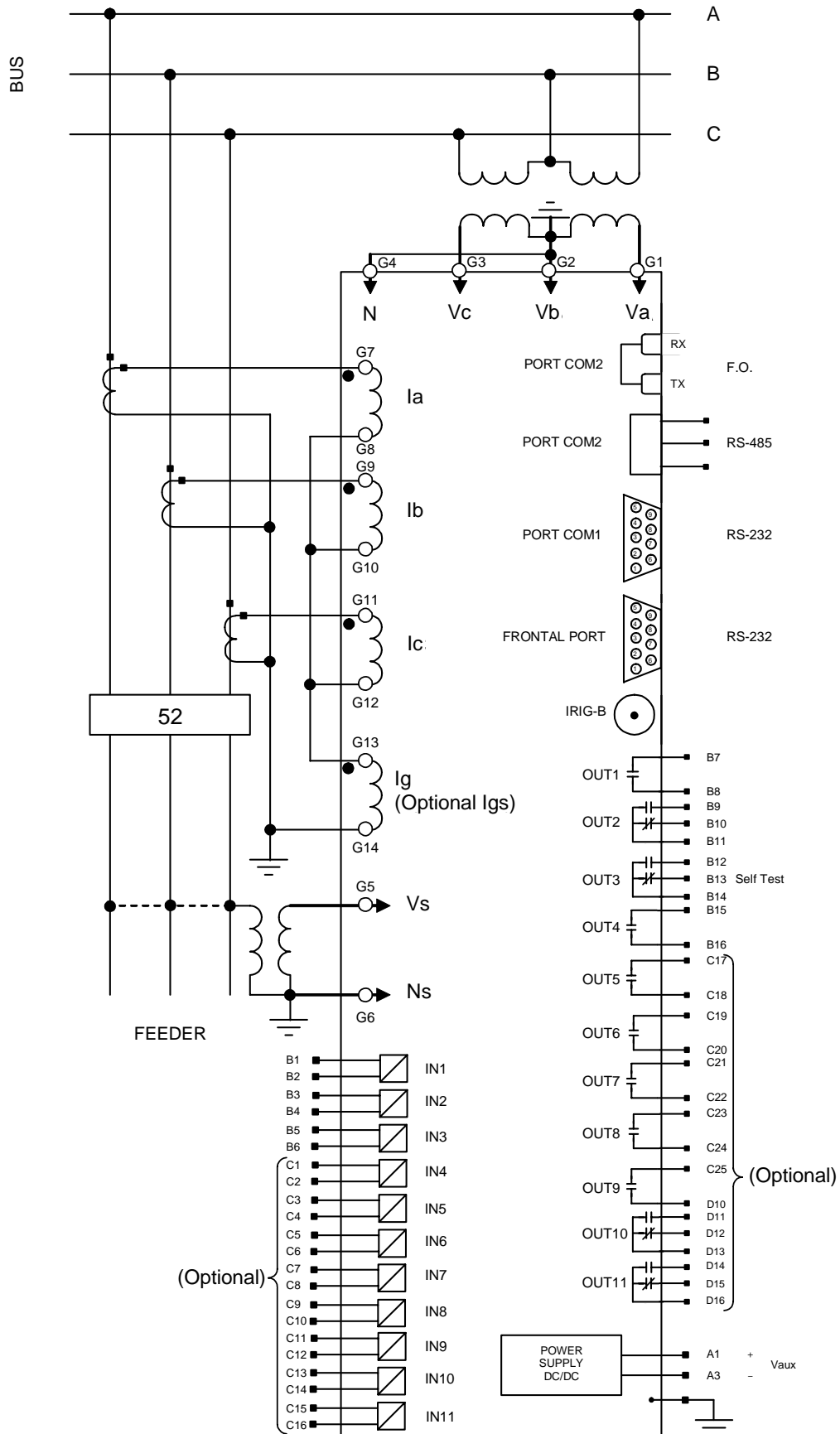


Figure 3 M-7651 Three Wire Open Delta Connection Diagram

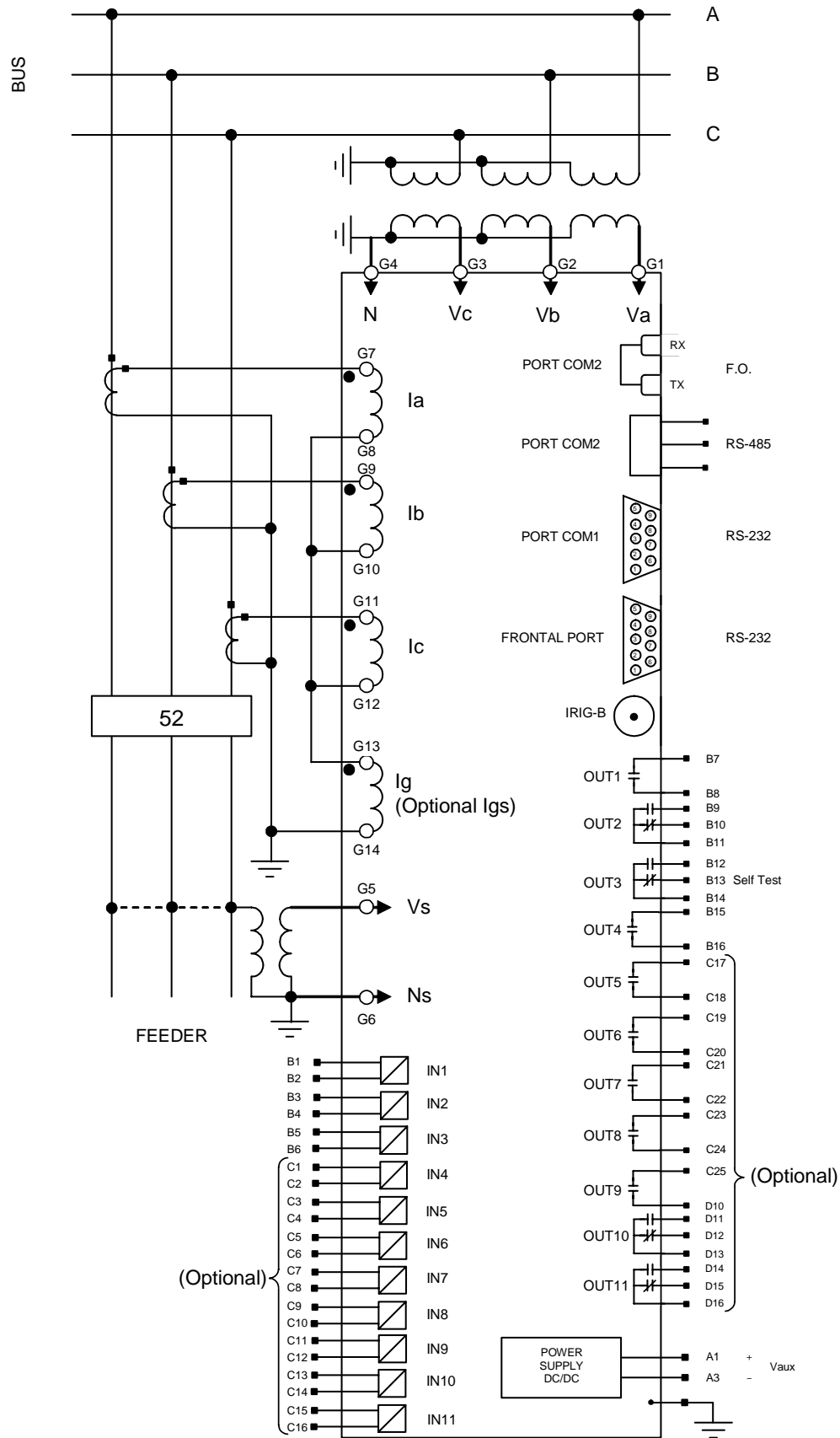


Figure 2 M-7651 Four Wire Wye Connection Diagram

Tests and Standards

The M-7651 complies with the following type tests and standards:

Voltage Withstand

Dielectric Withstand

IEC 60255-5 2,000 V ac

Impulse Voltage

IEC 60255-5 +/- 5,000 V-pk

Insulation Resistance

IEC 60255-5 > 100 Mega Ohms

Electrical Environment

Electromagnetic Emissions

IEC 60255-25 Class A Limits

Electrostatic Discharge Test

IEC 60255-22-2 Class 4 (+/- 8 kv) – point contact discharge

IEC 60255-22-2 Class 4 (+/- 15 kv) – air discharge

Radiated field Immunity

IEC 61000-4-3 10 V/m – 80 to 1000 MHz

IEC 61000-4-3 3 V/m – 1400 to 3000 MHz

Fast Transient Disturbance Test

IEC 61000-4-4 Class A (4 kv, 5 kHz)

Surge Immunity

IEC 61000-4-5 +/- 4 kv common mode

IEC 61000-4-5 +/- 2 kv differential mode

Conducted field Immunity

IEC 61000-4-6 10 Vemf

Power frequency magnetic field Immunity

IEC 61000-4-8 100 A/m continuous

1000 A/m 2 sec.

Damped oscillatory magnetic field Immunity

IEC 61000-4-10 100 A/m, 100 kHz, 1 MHz

Damped oscillatory wave Immunity

IEC 61000-4-12 +/- 2.5 kv common mode

IEC 61000-4-12 +/- 1 kv differential mode

Ripple on dc input power port Immunity

IEC 61000-4-17

Voltage interruptions Immunity

IEC 61000-4-29

1 MHz burst immunity

IEC 60255-22-1 +/- 2.5 kv common mode

IEC 60255-22-1 +/- 1 kv differential mode

M-7651 Feeder Protection Relay

Output Contacts

IEEE Make 30 A for 0.2 seconds, off for 15 seconds for 2,000 operations, per Section 6.7.1, Tripping
C37.90 Output Performance Requirements

Atmospheric Environment

Temperature

IEC 60068-2-1 Cold, -25°C (operating)
Cold, -40°C (storage)
IEC 60068-2-2 Dry Heat, +55°C (operating)
Dry Heat, +70°C (storage)
IEC 60068-2-30 Damp Heat condensing cycle, +25°C, +55°C @ 95% rh

IP Protection Degree

IEC 60529 IP 40

Mechanical Environment

IEC 60255-21-1 Vibration response Class 2 (1g)
Vibration endurance Class 2 (2g)
IEC 60255-21-2 Shock response Class 2 (10g)
Shock Withstand Class 2 (30g)
Bump Endurance Class 2 (20g)

IP Protection Degree

IP 40

Operating Environment

Operating Temperature: -25° C to +70° C
Storage Temperature: -40° C to +70° C
Humidity: Up to 95%, non-condensing

Physical

5 Unit Height and 1/3 rack of 19"
Size: 6.22" wide x 10.35" high x 5.06" deep (15.8 cm x 26.3 cm x 12.85 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

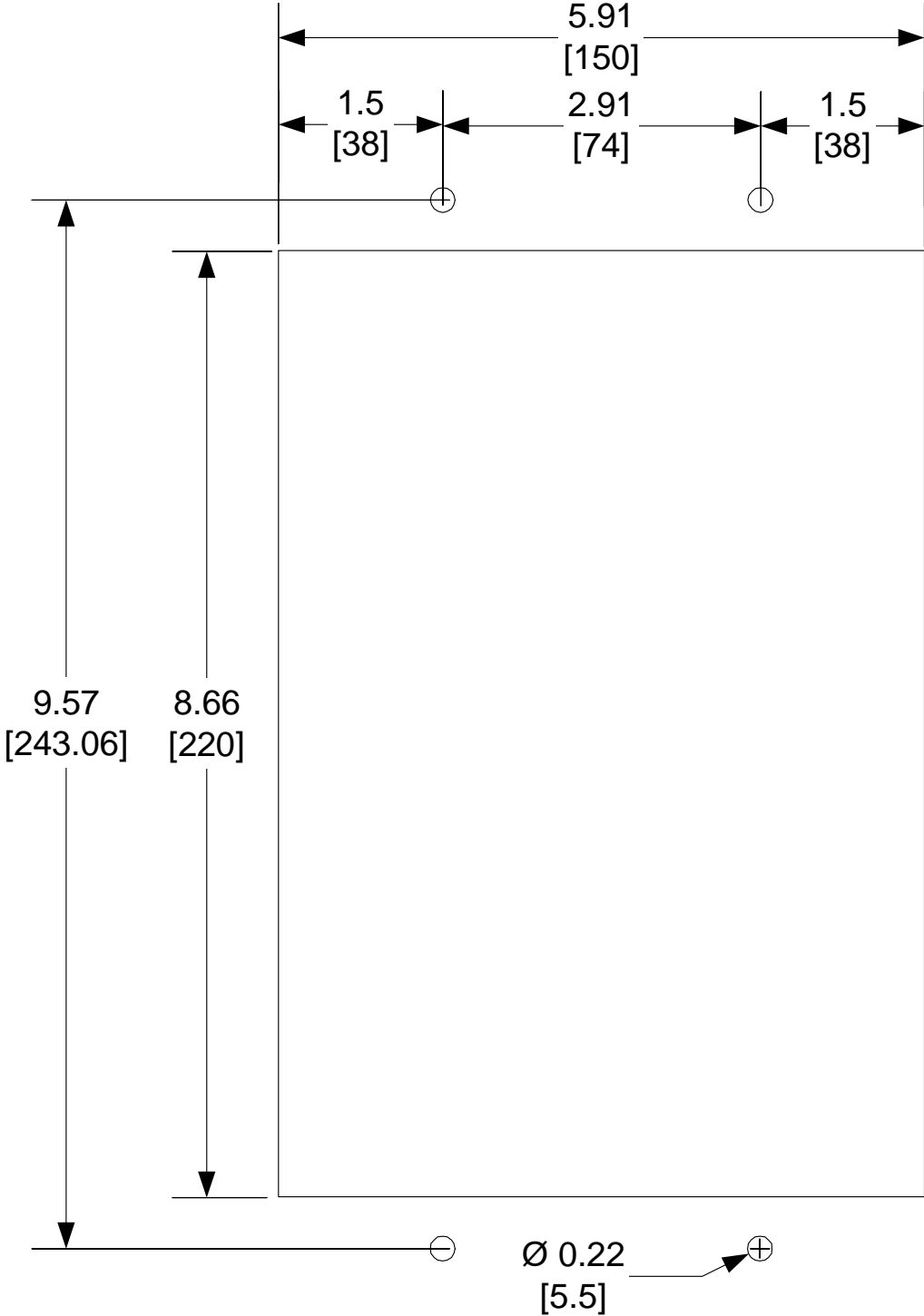
Humidity: Maximum relative humidity 80% for temperatures up to 31° C, decreasing to 31° C linearly to 50% relative humidity at 40° C.

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

Patent & Warranty

The M-7651 Feeder Protection Relay is covered by a five-year warranty from date of shipment.

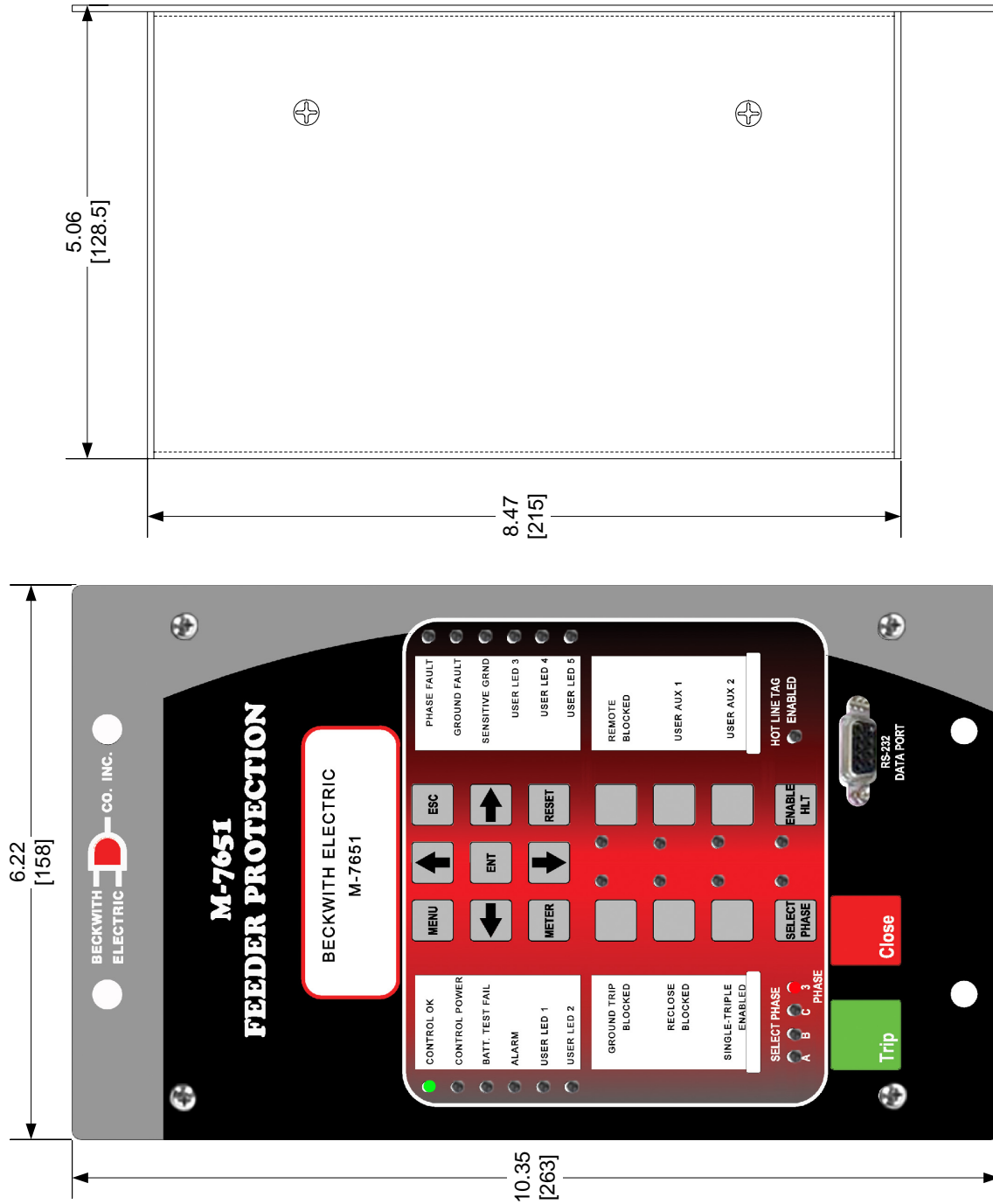
Specification subject to change without notice.



■ NOTE: Dimensions in brackets [] are in millimeters.

Figure 5 M-7651 Panel Drill Diagram

M-7651 Feeder Protection Relay



■ NOTE: Dimensions in brackets [] are in millimeters.

Figure 6 M-7651 External Dimensions

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