

# **POWER SYSTEM PROTECTION SOLUTIONS**



**Generator Protection**

**Transformer Protection**

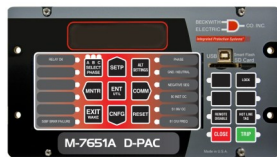
**Distributed Energy Resource  
(DER/DG) Protection**



**Distribution Protection**

**Motor Bus Transfer**

**Synchronizing**



**Products defined by you, refined by Beckwith**

## About Beckwith Electric

Founded in 1967, Beckwith Electric introduced the first solid state tapchanger control in 1968, and was the first to develop the microprocessor protective relay in 1981. Today, Beckwith Electric has thousands of protection and control units in service worldwide, with a reputation for cutting-edge technology, defined by its customers and refined by Beckwith. This success starts with Beckwith Electric Employees and their commitment to quality in the products, all 100% designed and manufactured in Largo, Florida, U.S.A.



Beckwith Electric is the leading provider of innovative solutions for Smart Grid Volt/VAr Optimization (VVO) and Conservation Voltage Reduction (CVR). The capacitor controls and regulator/LTC controls designed by Beckwith Electric incorporate advanced features to enable maximum benefits to be derived from an Integrated Volt/Var Management (IVVM) system. From Smart Voltage Reduction to Smart Reverse Power, these controls enable successful implementations and can be applied as stand-alone controls with no communications, or as a critical part of an overall centralized IVVM system with extensive communications, either serial or Ethernet.

At Beckwith Electric, we believe that the essential Smart Grid application with the quickest payback for our customers is voltage reduction. By coordinating capacitor bank controls with regulator and LTC controls, a flatter voltage profile can be obtained across the entire distribution circuit. This enables greater levels of voltage and load reduction, either continuously or on command. On command voltage reduction reduces system peaks and the amount of reserve capacity required. This can delay the necessity for additional generating units. During emergency conditions, the utility can reduce load temporarily while procuring additional generation. Another benefit is the ability to use voltage reduction in lieu of starting up additional generating units when short-term demand overtakes online generation capacity. Long-term voltage reductions, performed regionally, can help extend the life of transformers and other equipment that would otherwise be forced to operate at full load capacity. This postpones the need for capital expenditures to upgrade transformers, distribution and transmission circuits, and construction of new substations and generating facilities.

Beckwith Electric is ISO 9001:2008 certified and a recent recipient of the 2012 Governor's Sterling Award - Florida's top honor for performance excellence. Our core principal continues to be "Products defined by you, refined by Beckwith."

Visit us online at [www.beckwithelectric.com](http://www.beckwithelectric.com), follow us on Twitter at [www.Twitter.com/beckwithcompany](http://www.Twitter.com/beckwithcompany) or connect with us on Facebook at [www.Facebook.com/BeckwithElectric](http://www.Facebook.com/BeckwithElectric).



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Protection Quick Reference Guide

Function	Description	M-3311A	M-3410A	M-3425A	M-3520	M-7651A	M-7679
21	Phase Distance			S	○		
24	Overexcitation	○		S			
25	Sync Check		S	S	S	S	S
27	Undervoltage	○	S	S	S	S	S
27B	Bus Side Voltage Supervision					S	S
27G	Undervoltage (Neutral)		S		S		
27PP	Phase to Phase Undervoltage					S	S
27TN	Third Harmonic Undervoltage (Neutral)			S			
32	Directional Power		S	S	S	S	S
40	Loss of Field		S	S		S	
46	Negative Sequence Overcurrent	S	S	S	S	S	S
46DT	Definite Time					S	S
46IT	Inverse Time					S	S
47	Negative Sequence Overvoltage		S		S	S	S
49	Winding thermal protection	S		S			
50/27	Inadvertent Energizing			S			
50BF	Breaker Failure	S		S		S	S
50DT	Definite time overcurrent for split-phase differential			S			
50(G/N)	Instantaneous/Definite Time Overcurrent (Neutral)	S		S	S	S	S
50GS	Sensitive Ground Pickup					○	○
50P	Instantaneous/Definite Time Overcurrent	S		S	S	S	S
51(G/N)	Ground Inverse Time Overcurrent (Neutral)	S	S	S	S	S	S
51GS	Sensitive Ground Inverse Time Overcurrent					○	○
51P	Phase Inverse Time Overcurrent	S				S	S
51V	Inverse Time Overcurrent (3-Phase with Voltage Control or Restraint)		S	S	S	S	S
59	Overvoltage	○	S	S	S	S	S
59D	Third Harmonic Voltage Differential			S			
59(G/N)	Overvoltage, Neutral Circuit or Zero Sequence	○	S	S	S	S	S
59I	Peak Overvoltage		S		S	S	S
59PP	Phase to Phase Overvoltage					S	S

Function	Description	M-3311A	M-3410A	M-3425A	M-3520	M-7651A	M-7679
60FL	VT Fuse-Loss Detection		S	S	S	S	S
64(F/B)	Field Ground/Brush Lift-Off Detection			○			
64S	100% Stator Ground Fault by 20Hz Injection			○			
67	Phase Directional Overcurrent				S	S	S
67G	Ground Directional Overcurrent					S	S
67GS	Sensitive Ground Directional Overcurrent					○	○
67N	Residual Directional Overcurrent			S	S	S	S
67Q	Negative Sequence Directional Overcurrent					S	S
78	Out of Step Protection (Mho Characteristic)			S	○		
79	Recloser Relay					○	S
81(O/U)	Overfrequency/Underfrequency	○	S	S	S	S	S
81A	Underfrequency Accumulation			S			
81R	Rate of Change of Frequency			S	○	S	S
87	Phase Current Differential	S		S			
87GD	Ground (zero sequence) Differential	S		S			
87H	Phase Differential High Set Overcurrent	S					
87T	Phase Differential (Harmonic Restrained)	S					
AR	Auto Restoration		S		S	S	S
BM	Breaker Monitoring	S		S		S	S
CCM	Close Circuit Monitoring					S	S
HLT/MM	Hot-Line Tag/Maintenance Mode					S	S
TCM	Trip (Aux Input) Circuit Monitor	S		S		S	S
TF	Through Fault	S					
THD/TDD	Total Harmonic Distortion / Total Demand Distortion					S	S

S = Standard Feature      ○ = Optional Feature





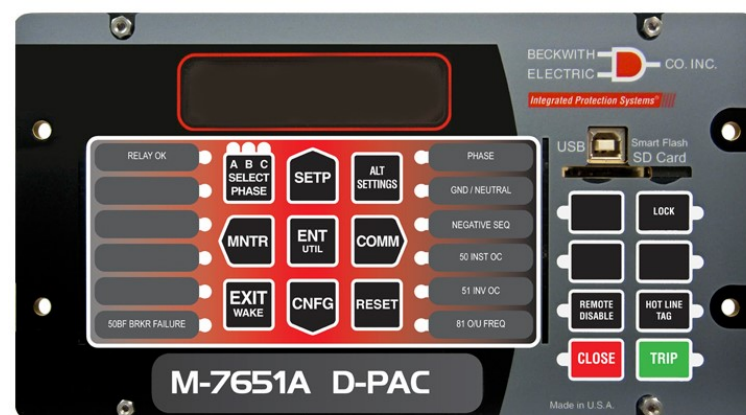
## M-7651A D-PAC

Protection, Automation and Control System for Power Distribution Applications

### Benefits

#### Protection

- Over 30 Protection Elements for optimal protection of Power Distribution Systems
- Ready to use advanced Protection Schemes for applications including Feeder Protection, Bay Control and DG Interconnection Protection
- 8 Setting Profiles
- Comprehensive I/O Matrix provides visual confirmation of enabled functions and selected outputs improving security

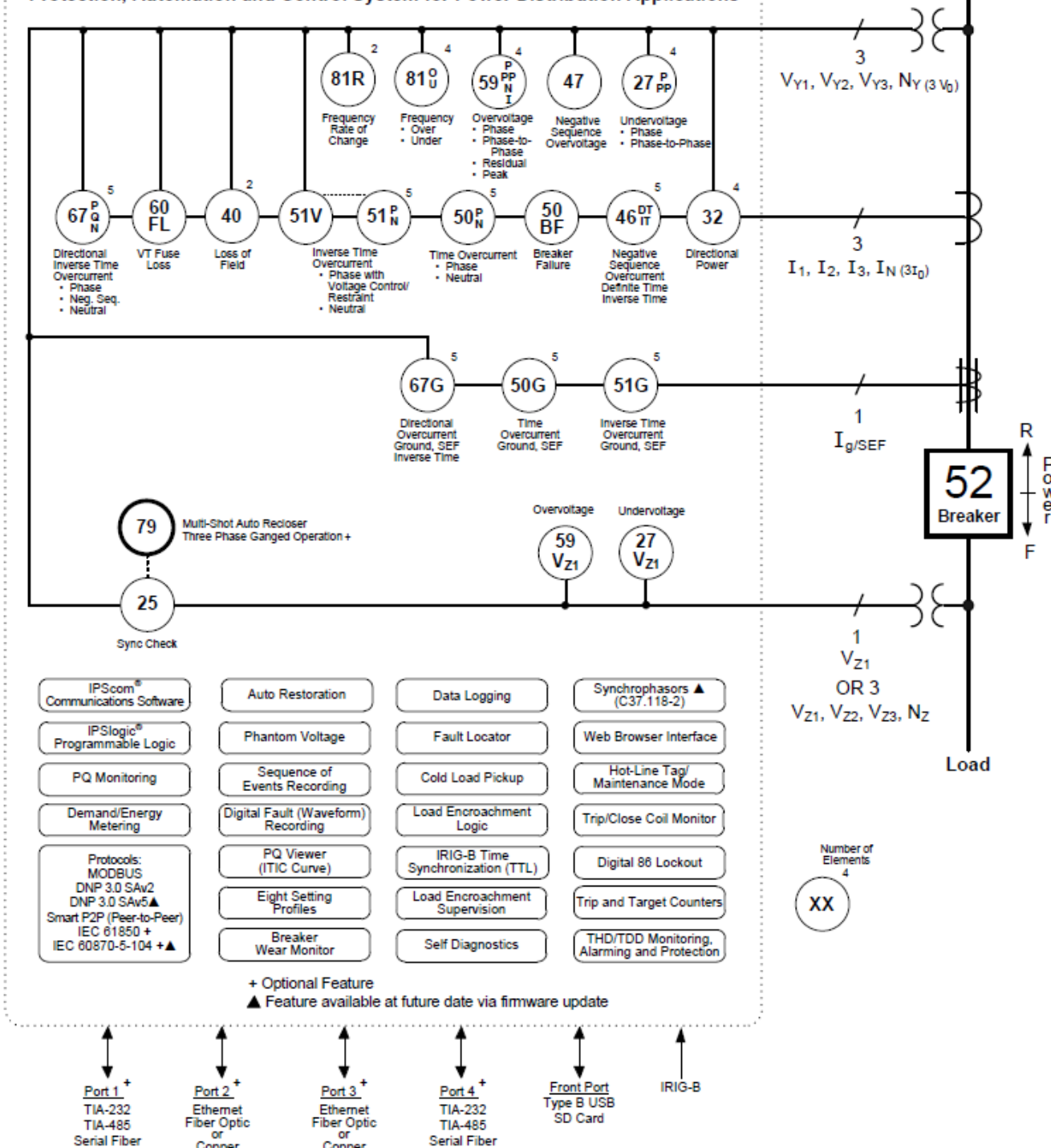


- Automation/Communications
  - Front panel USB and SD Card ports for local programming and data transfer
  - One or two optional serial ports (TIA-232, TIA-485 or Serial Fiber)
  - Optional single or dual Ethernet ports (copper or fiber) with simultaneous multi-user and multi-protocol support
  - Protocols supported include:
    - MODBUS, DNP3.0
    - Optional: IEC 61850
  - Comprehensive Cyber Security tools to implement NERC CIP requirements, including IPsec and Radius server security
  - IEEE 1686 Compliant
- Control
  - Four user programmable Inputs and Outputs, expandable to twelve Inputs and twelve Outputs
  - User programmable front-panel LEDs and pushbuttons
- 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

- IPScorn® – 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

### M-7651A D-PAC

Protection, Automation and Control System for Power Distribution Applications



M-7651A One-Line Diagram



Learn more at [www.beckwithelectric.com/products](http://www.beckwithelectric.com/products)

M-7651A D-PAC Mounting Solutions

The M-7651A D-PAC offers fast and easy retrofitting for most popular relays in existing cutouts using Beckwith's Adapter Panel Technology™. Adapter frames allow the M-7651A D-PAC to mount into an existing cutout or rack mount using the same mounting points with no panel modifications. For popular relay models, the adapter chassis offers mounting into an existing cutout plus it offers similar connection points for analog and digital signals, eliminating the need for a complete rewire of your panel.

Locate your existing relay brand and model number to find the Beckwith Electric adapter chassis or adapter frame you will need for replacement.

- ♦ V = The adapter is designed for a Vertical mounting M-7651A D-PAC
- ♦ H = The adapter is designed for a Horizontal mounting M-7651A D-PAC



M-7651A Mounting Solution for 19" Rack

M-7651A Beckwith Electric Mounting Solutions

Manufacturer/Model	Adapter Frame
<b>Beckwith Electric</b>	
19" 3U Rack (H)	B-1612
w/one test block cutout	B-1612-01
w/adapter for two (H) M-76XX relays	B-1685
M-3410A (V)	B-1662
M-3410A (H)	B-1665

M-7651A Mounting Solutions for Other Manufacturers

Manufacturer/Model	Adapter Chassis	Adapter Frame
<b>ABB</b>		
DPU2000 19" 3U Rack (H)		B-1612
w/one test block cutout		B-1612-01
w/adapter for two (H) M-76XX relays		B-1685
FT-21, FT-22 (V)		B-1654
FT-31, FT-32 (V)		B-1655
w/one test block cutout		B-1655-01
w/two test block cutouts		B-1655-02
FT-41, FT-42 (V)		B-1656
w/one test block cutout		B-1656-01
w/two test block cutouts		B-1656-02
<b>Basler</b>		
M1 (V)		B-1653
w/one test block cutout		B-1653-01
w/two test block cutouts		B-1653-02
S1 (V)		B-1652
<b>General Electric</b>		
L2, L2B, L2D, L2T, L1, L1E (V)		B-1661
w/one test block cutout		B-1661-01
w/two test block cutouts		B-1661-02
M1, M1E (V)		B-1659
w/one test block cutout		B-1659-01
w/two test block cutouts		B-1659-02
M2, M2D (V)		B-1660
w/one test block cutout		B-1660-01
w/two test block cutouts		B-1660-02
S1, S1E (H)		B-1657
S2 (V)		B-1658
<b>SEL</b>		
SEL-351S Legacy (H)	M-2416-L	B-1612
SEL-351S Enhanced (H)	M-2416-E	B-1612

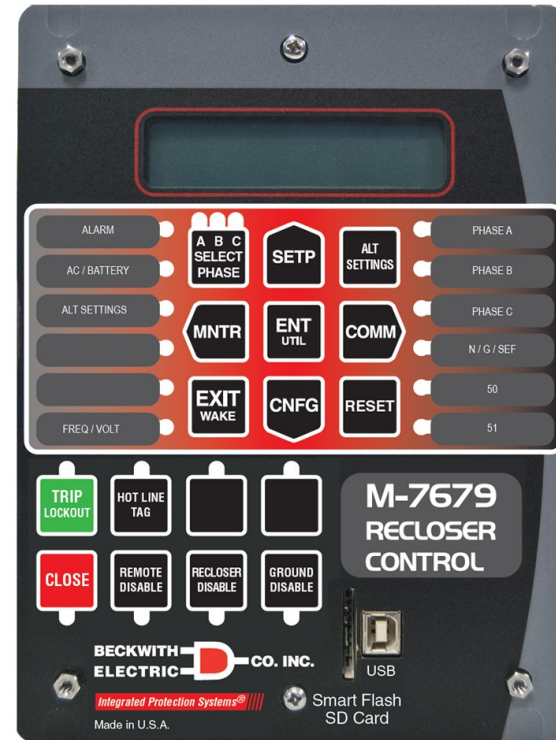


## M-7679 Recloser Control

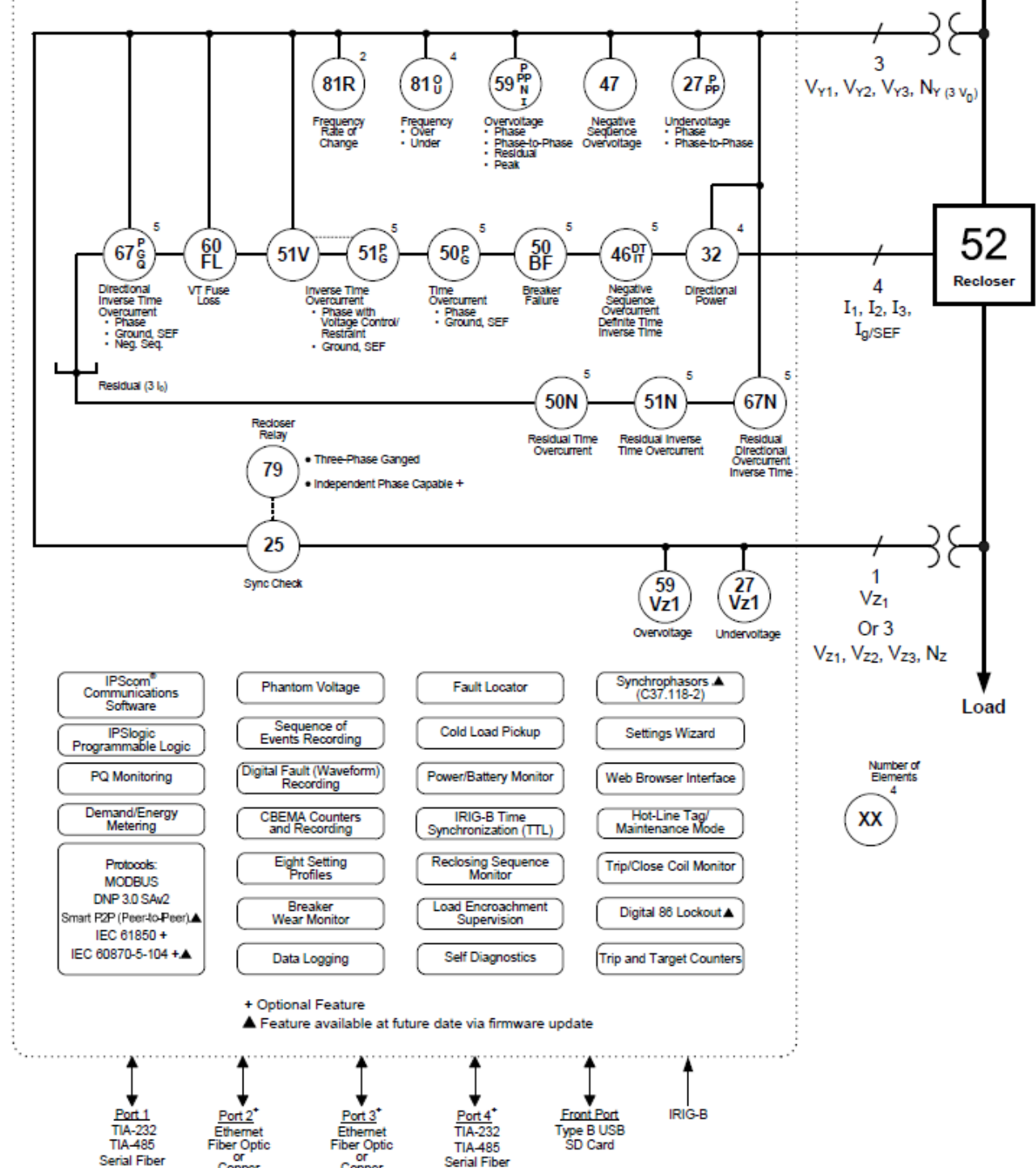
Next generation Recloser Control and Protection System for Advanced Distribution Grids

### Benefits

- Protection and Control
  - Over 30 Protection Elements for optimal protection of Power Distribution Systems
  - Compatible with Three Phase (Standard) and Independent Phase capable Reclosers (Optional)
  - Four (Standard) 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 SAV2, Smart P2P (Peer-To-Peer)
    - Optional: IEC 61850, IEC 60870-5-104/101, Combination
  - Comprehensive Cyber Security tools to implement NERC CIP requirements, including IPsec and Radius server security
  - IEEE 1686 Compliant
- IPScm® – 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
  - IPSclogic 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



M-7679 Recloser Control



M-7679 One-Line Diagram



M-7679 Recloser Control Mounting Solutions

Along with the M-7679 Recloser Control, the Beckwith Electric M-2979 Enclosure offers a complete solution for new installations or replacing existing Three-Phase or Independent-Phase controls.

Provides easy direct replacement of recloser controls for:

- ◆ **Cooper**
- ◆ **G&W**
- ◆ **Travrida**
- ◆ **Thomas & Betts**
- ◆ **Whipp & Bourne**

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.



Manufacturer	Model	Control Cable Interface
Cooper	NOVA Three Phase, TS or STS	14, 19, 26 Pin
G&W	Viper S	14, 19 Pin
	Viper ST/LT	32, 42 Pin
Tavrida	OSM-15/25	42 Pin
Thomas & Betts	Elastimold MVR	32 Pin
Whipp & Bourne	GVR	24 Pin

When combined with the M-7679 Recloser Control, an Adapter Frame, Kit, or Chassis provides convenient direct mechanical and electrical replacement of select older recloser controls in their existing cabinets:

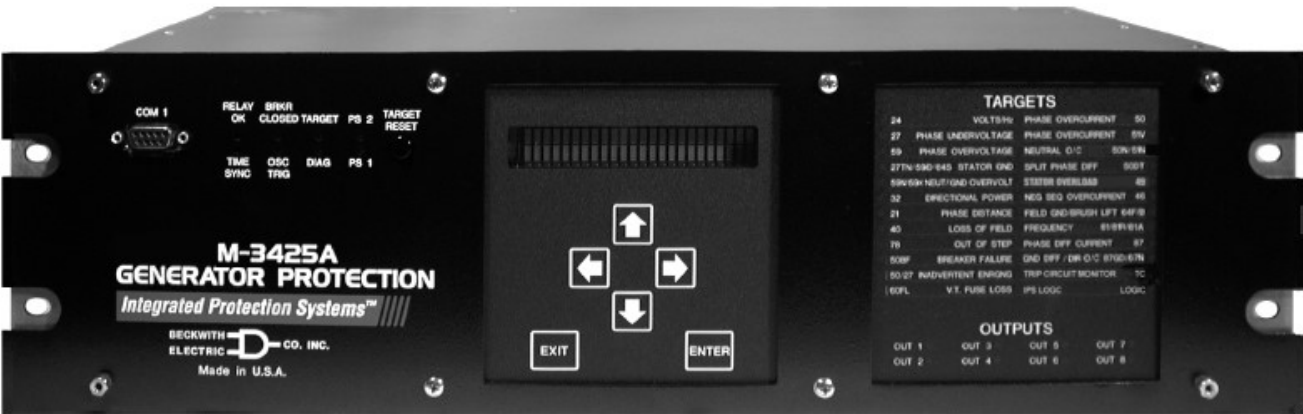
- ◆ Beckwith Electric Adapter Frame A Beckwith Electric Frame allows for mounting of the M-7679 Recloser Control in an existing cutout. The frame includes holes that duplicate the mounting studs used to mount the old control.
- ◆ Beckwith Electric Adapter Kit An adapter kit includes an adapter frame and a specially designed wire harness that facilitates the mounting of the M-7679 into an existing enclosure.
- ◆ Beckwith Electric Adapter Chassis The Adapter Chassis provides compatible connector sockets that match the pin out of the existing control. Simply unplug control power, input, output and communications connectors and plug into the same locations on the Adapter Chassis allowing for an upgrade to be done in minutes.



Manufacturer	Model	Adapter Chassis	Adapter Kit	Adapter Frame
Arteche	P500			B-1666
Cooper	Form 5		M-2418 (14 Pin)	
	Form 6		M-2413 (14 Pin)	
SEL	351P-3/Panacea	M-2411		B-1608
	351R-2	M-2410		B-1608



# M-3425A Comprehensive Generator Relay



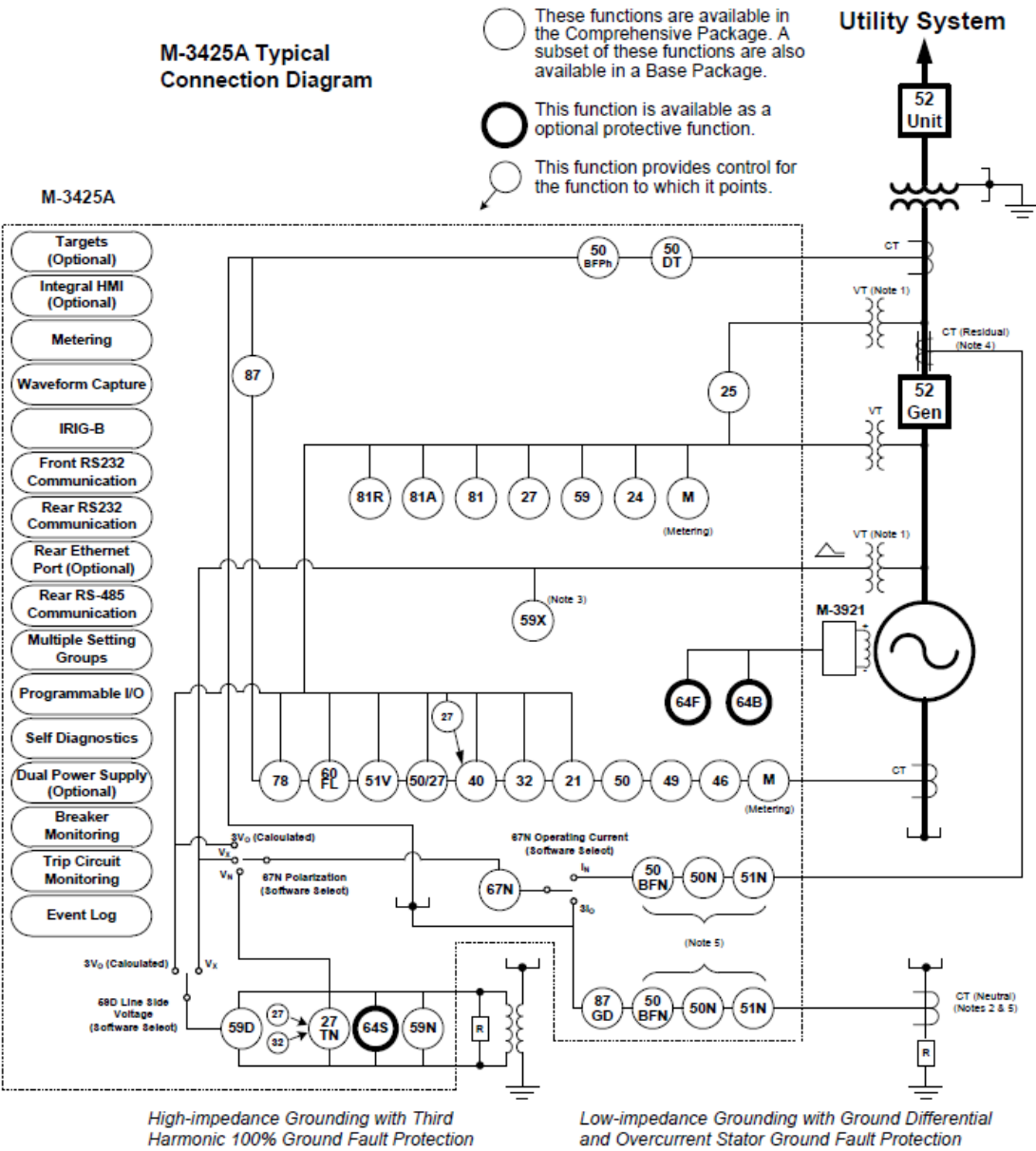
The M-3425A Comprehensive Generator Relay provides protection, control, monitoring and user interface functions for generator protection.

Stored targets and oscillography can be IRIG-B synchronized. Dual RS-232 ports and an RS-485 port provide user-interface communication capabilities. The S-3400 IPScom Communications Software is included for direct serial or remote communication access. Waveform data can be downloaded using the M-3801D IPSplot PLUS Oscillograph Analysis Software which allows for plotting and printing of the downloaded oscillographic data.

## Benefits

- Exceeds IEEE C37.102 and Standard 242 requirements for generator protection
- Protects generators of any prime mover, grounding and connection type
- Provides all major protective functions for generator protection including Out-of-Step (78), Split-Phase Differential (50DT), Under Frequency Time Accumulation (81A), Inadvertent Energizing (50/27) and Turn-to-Turn Fault (59X)
- Expanded IPScom® Communications Software provides simple and logical setting and programming, including logic schemes
- Simple application with Base and Comprehensive protection packages
- Load encroachment blinders and power swing blocking for system backup protection (21) to enhance security during system abnormal conditions
- Options: Ethernet Connection, Field Ground/Brush Lift-Off Protection (64F/B), 100% Stator Ground Fault Protection by low frequency injection (64S) and Expanded I/O (15 additional Output Contacts and 8 additional Control/Status Inputs)

M-3425A Typical Connection Diagram



M-3425A One-Line Diagram





## M-3311A Transformer Protection Relay

The M-3311A protects the distribution transformer, one of the most expensive and most valuable distribution assets.

The M-3311A provides protection, control, monitoring and user interface functions for two, three or four-winding transformers. Includes restrained and unrestrained differential protection, overcurrent protection, and optional voltage, and underfrequency protection. Multiple setpoint groups and user-implementable logic schemes provide flexibility. Dual RS-232 ports and an RS-485 port provide user-interface capabilities.



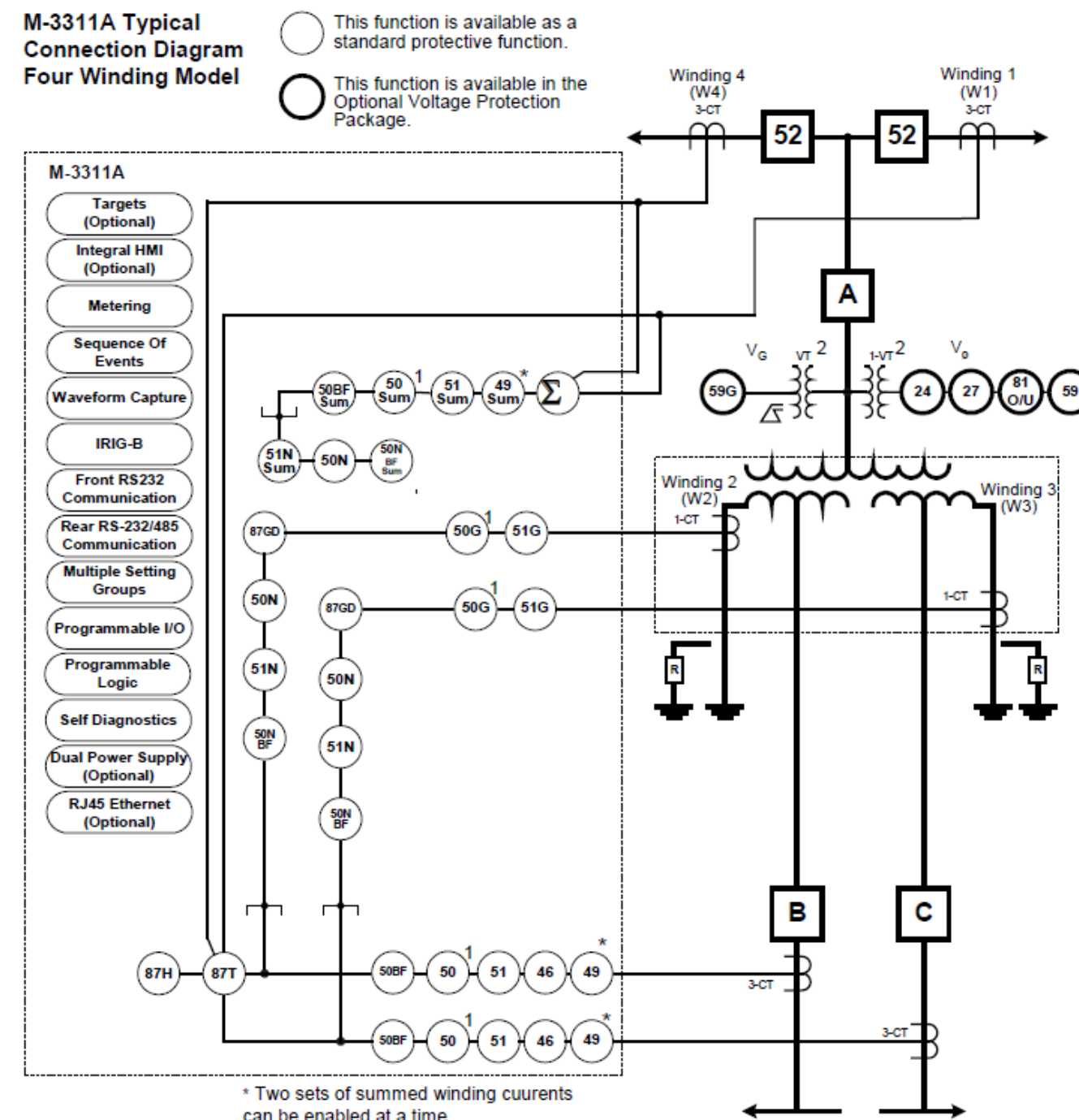
### Benefits

- For Transformers of All Sizes: 2, 3 or 4 winding Transformers for Transmission and Distribution
  - Generator-Transformer Unit Overall Differential
  - Unit Protection of Other Electrical Apparatus and certain Bus Arrangements (including those with a transformer in the zone)
- Additional Applications: System Backup Protection, Load Shedding (voltage and frequency), Bus Protection, and individual Breaker Failure Protection for each winding input
- Available voltage configurations include zero, two or four voltage inputs
- Ground Differential configurations include one, two or three current inputs
- Through-Fault Monitor Event Log—Includes a recorder that saves separate Through Fault events. The record contains the serial number of the fault, duration of the event, maximum RMS fault current magnitude for each phase of the fault,  $I^2t$  and the fault time stamp.

### Features

- Negative-sequence inverse time overcurrent (46)
- Winding thermal protection (49)
- Four winding instantaneous phase overcurrent (50)
- Breaker Failure (50BF)
- Instantaneous ground/residual overcurrent (50G/N)
- Four winding inverse time phase overcurrent (51)
- Inverse time ground/residual overcurrent (51G/N)
- Two, three or four winding phase differential (87T) and high set instantaneous (87H)
- Ground differential (87GD)
- Sequence of Events Log
- Oscillographic recording
- Includes MODBUS and DNP 3.0 protocols
- Summing Currents from multiple sources for 49, 50, 51, 50N, 51N, 87 GD and Through Fault functions
- Supports four profiles that allow multiple setpoint profiles to be defined for different power system configurations.
- Optional Ethernet Connection and Expanded I/O (8 additional outputs/12 additional inputs)
- Optional Voltage Package includes, 24 Volts/Hz Overexcitation, 27 Phase Undervoltage, 59G Ground Overvoltage and 81O/U Over/Under Frequency

### M-3311A Typical Connection Diagram Four Winding Model



M-3311A One-Line Diagram



Learn more at [www.beckwithelectric.com/products](http://www.beckwithelectric.com/products)

# M-3410A Intertie/Generator Protection Relay

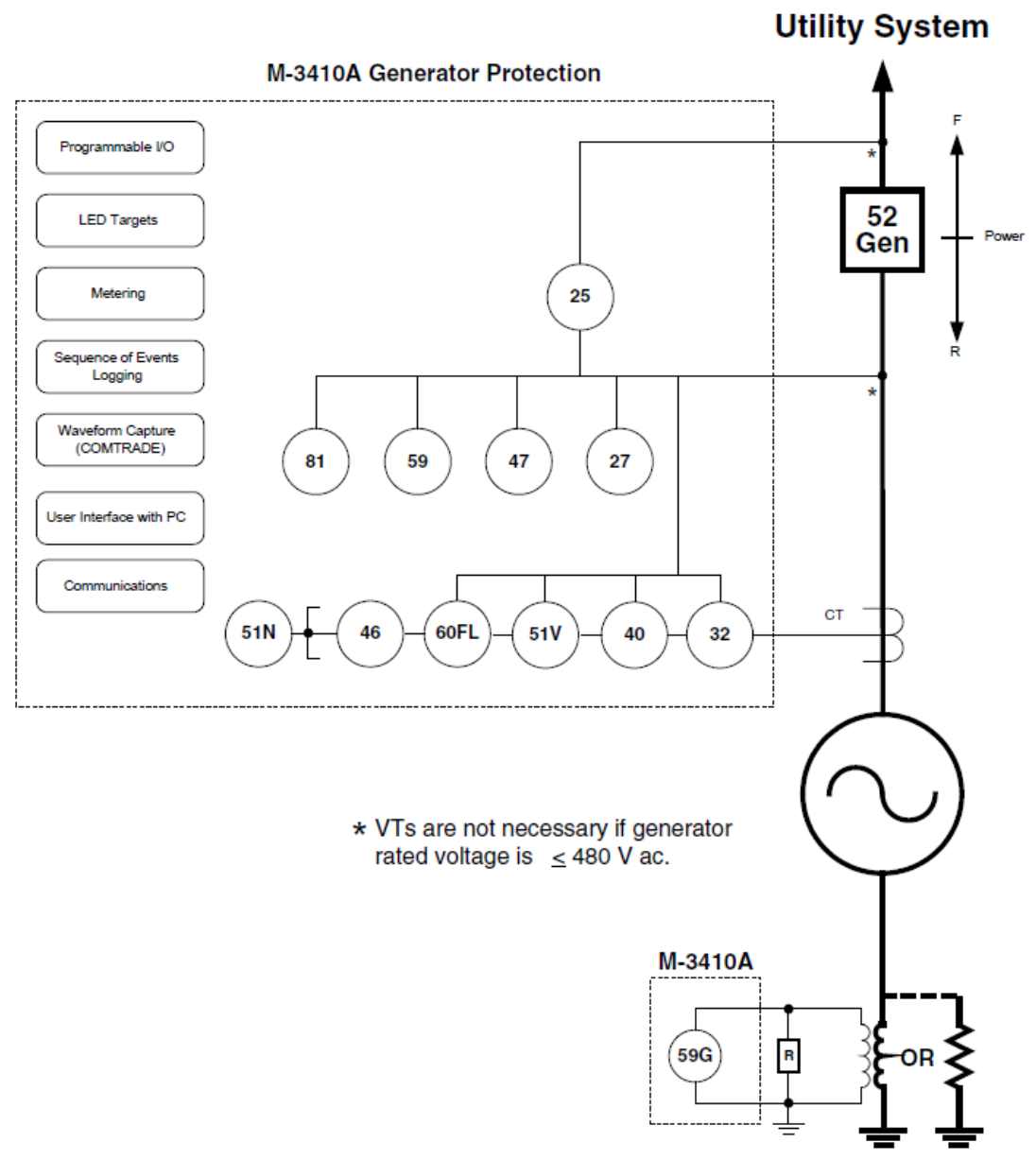
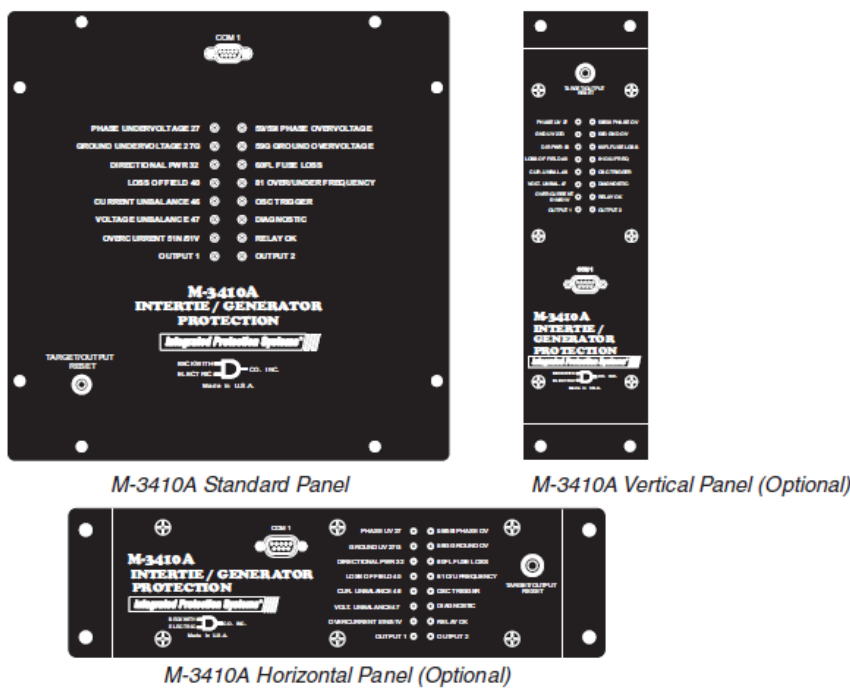
The M-3410A Intertie/Generator Protection Relay is a microprocessor-based unit that uses digital signal processing technology to provide up to twelve protective relaying functions for intertie protection or up to eleven protective relaying functions for generator protection.

## Benefits

- Available in four different Mounting configurations
- Facilitates standardization for small/medium intertie and generator protection applications
- Microprocessor-based relay provides 15 protective relay functions, including Sync-Check, 2 programmable outputs and 2 programmable inputs
- Relay voltage inputs can be directly connected (no VT required) for voltages 480 V or less
- Local and remote serial communications (MODBUS protocol) capability for monitoring and control functions

## Features

- Sync-check with Phase Angle,  $\Delta V$  and  $\Delta F$  with dead line/dead bus options (25)
- Phase undervoltage (27) protection
- Ground undervoltage (27G) protection
- Dual-setpoint, single or three phase, directional power detection that can be selected as over/under power protection (32)
- Dual-zone, offset-mho loss-of-field for generator protection (40)
- Sensitive negative sequence overcurrent protection and alarm (46)
- Negative sequence overvoltage (47)
- Inverse time neutral overcurrent (51N)
- Phase overcurrent with voltage restraint/control (51V) protection
- Phase overvoltage (59) protection
- Ground overvoltage (59G) protection
- Peak overvoltage (59I) protection
- VT fuse-loss detection and blocking (60FL)
- Reconnect enable for intertie protection (79)
- Four-step over/under frequency (81) protection



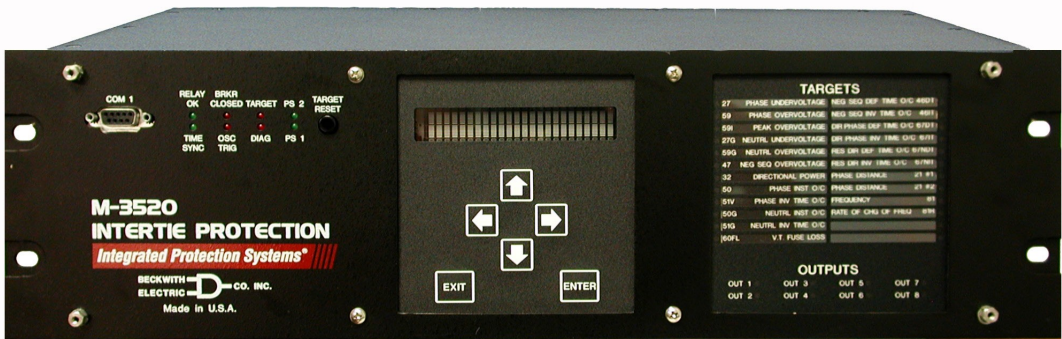
**M-3410A One-Line Diagram (Intertie Protection)**





## M-3520 Intertie Protection Relay

The M-3410A Intertie/Generator Protection Relay is a microprocessor-based unit that uses digital signal processing technology to provide up to twelve protective relaying functions for intertie protection or up to eleven protective relaying functions for generator protection.



Apply Integrated DG Interconnection Protection to Reduce Costs and Facilitate Standardization Economically meet utility interconnection requirements for DG applications.

### Benefits

Reduce Project Costs—

- ◆ Standardization for most utility and power pool interconnection requirements
- ◆ Commissioning tools to speed factory acceptance testing and field start-up
- ◆ Trip dispute resolution and warranty investigation tools
- ◆ Programmable I/O to meet different breaker trip assignment requirements

Meet Utility and Power Pool Protection Requirements—

- ◆ Utility-grade relay passing pertinent ANSI and IEC specifications
- ◆ Meets UL and CSA compliance standards; M-3410A is CE compliant
- ◆ Ability to be applied with grounded or ungrounded primary interconnection transformer configurations
- ◆ Configurable and selectable elements to meet protection challenges for different size, machine type, DG interconnection transformer arrangement and utility requirements

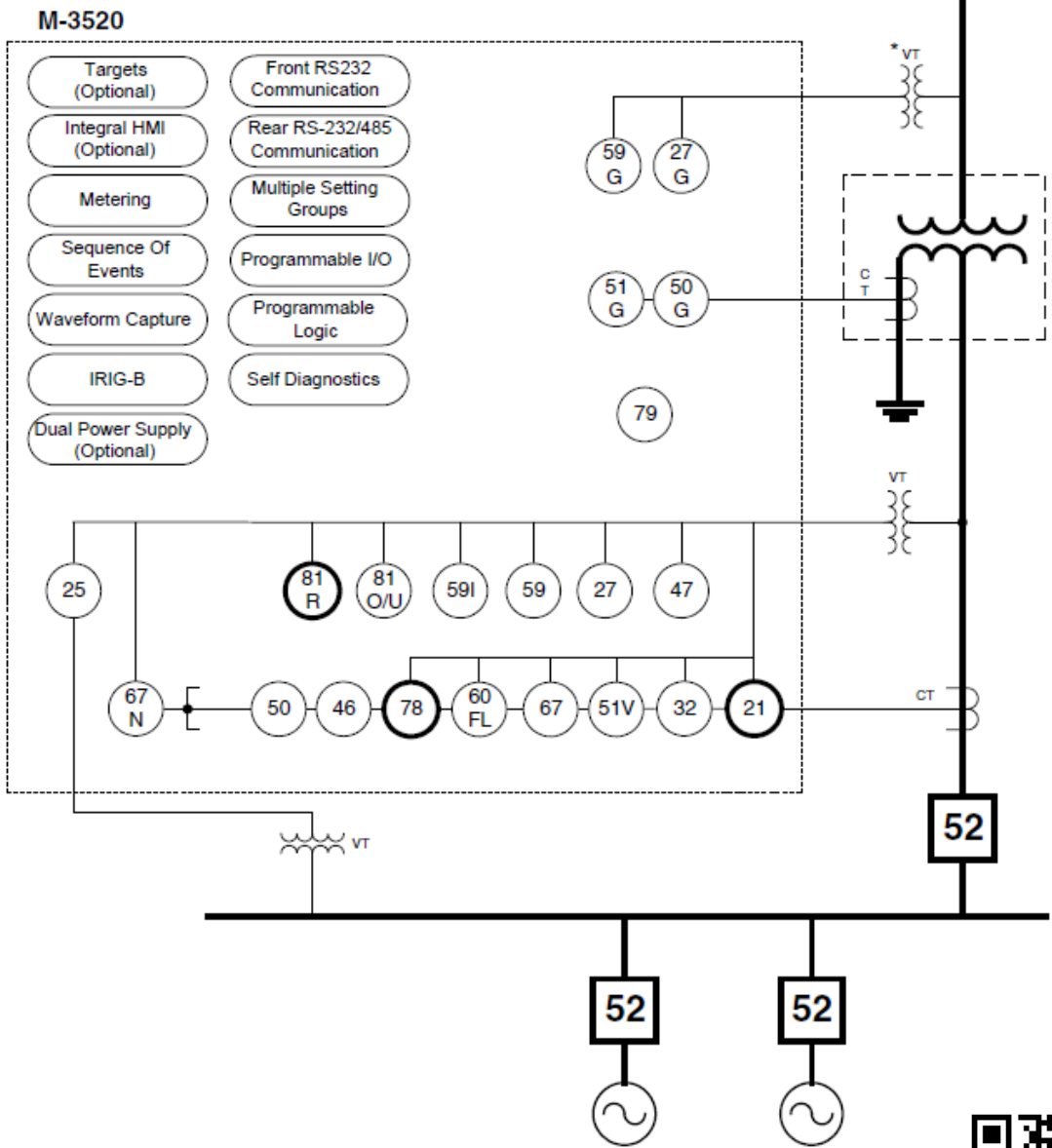
### Features

- ◆ Integrated Protection System for DR/DG Intertie, Providing:
  - ◆ Loss of parallel utility operation protections
  - ◆ Abnormal power flow protections
  - ◆ Comprehensive suite of phase and ground fault backed protections
  - ◆ Abnormal operating protections
  - ◆ Reconnect and Sync Check functions
- ◆ Microprocessor-based Intertie Protection Relay integrates protection, metering, monitoring and waveform capture
- ◆ Provides 18 base protective relay functions and 3 optional protective functions
- ◆ Local and remote serial communications capabilities, plus IRIG-B interface

### M-3520 Typical Connection Diagram

- This function is available as a standard protective function.
- This function is available as an optional protective function.

*Note: M-3520 may be purchased as a base protection system with 59, 27, 81O/U, 79 and 60FL functions only.*



M-3520 One-Line Diagram



Digital Motor Bus Transfer System for Medium Voltage (MV) and Low Voltage (LV) Switchgear Applications

Maintain your process and preserve your motor assets

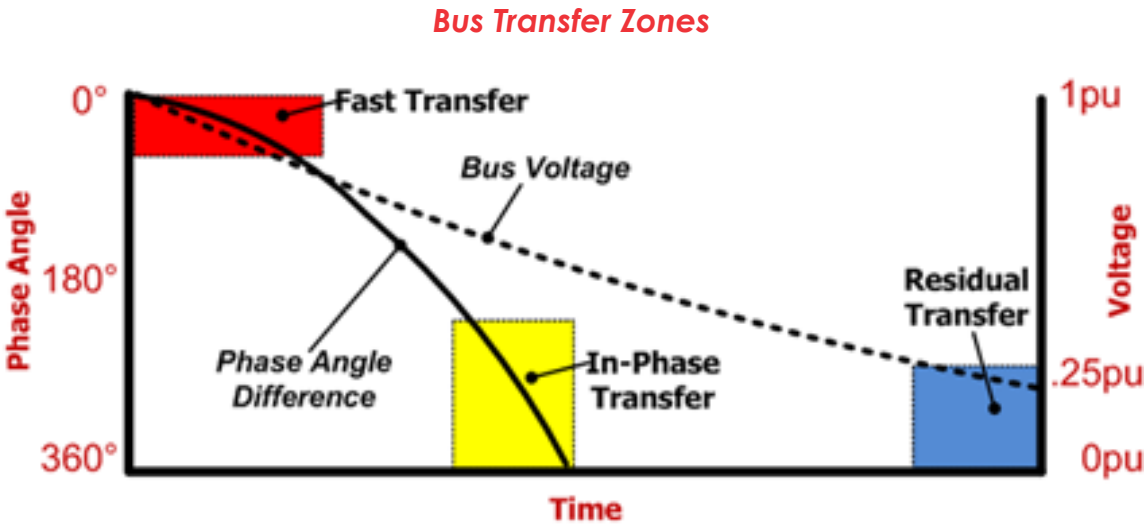
Avoid motor damage and costly shutdowns by ensuring the orderly transfer of the sources to your motors. Our complete Motor Bus Transfer System and relays properly execute the transfer of your critical motor loads.



To maintain plant operation and process continuity in power plants and industrial facilities, motor buses may require transfer from a present (old) source to a new source. Motor Bus Transfer (MBT) schemes and systems are employed to maintain process continuity in processes served by large motors or aggregates of smaller and large motors. Larger motors, of both the synchronous and induction variety, may require comprehensive, integrated source transfer strategies in order to avoid mechanical damage.

The coast down period and resultant voltage and frequency decay may take seconds, and unsupervised source transfer may cause damage. During improper transfer, mechanical damage may occur in the motor, the coupling to the load or the load itself, and is primarily caused by excessive shaft torque.

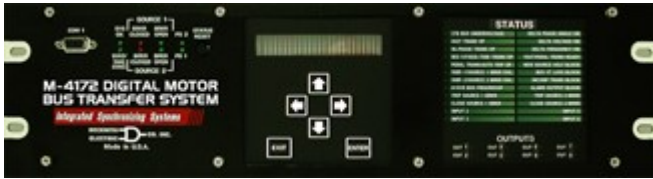
The total mission of a MBT system is—Maintain process continuity and Effect source transfers so as not to cause damage to motors and connected loads



Two Models... Same Performance!

M-4172

Digital Motor Bus Transfer System for Low Voltage (LV) Switchgear Applications



M-4272

Digital Motor Bus Transfer System for Medium Voltage (MV) and Low Voltage (LV) Switchgear Applications



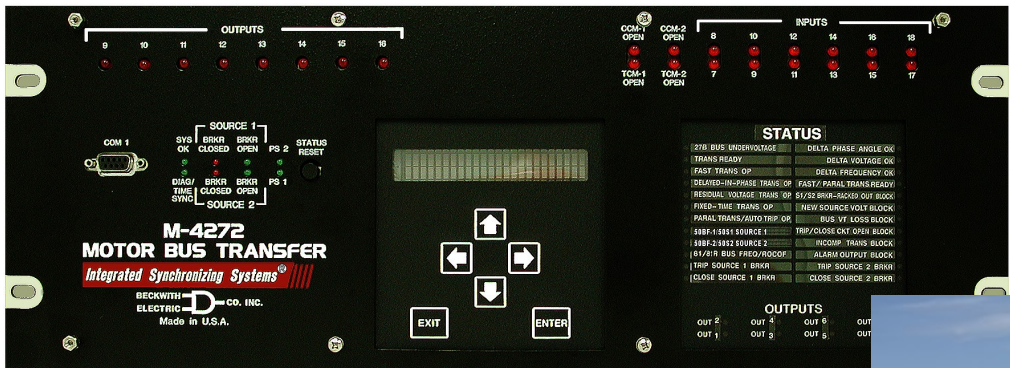
All Transfer Methods Supported Simultaneously

Fast Transfer | In-Phase Transfer | Residual Voltage Transfer | Fixed Time Transfer

M-4172	M-4272
Application	
More economical and affordable device designed for Low Voltage switchgear motor bus transfer applications typically found in large industrial and petrochemical facilities.	Designed for both Medium Voltage and Low Voltage switchgear motor bus transfer applications in all industry types and utilities.
Inputs	
6 Inputs:	18 Inputs:
<ul style="list-style-type: none"><li>2 dedicated inputs for S1 and S2 breaker status contacts: 52a or 52b</li><li>4 programmable inputs</li></ul>	<ul style="list-style-type: none"><li>6 dedicated inputs for S1 and S2 breaker status contacts: 52a, 52b and 52sp (TOC)</li><li>12 programmable inputs</li></ul>
Outputs	
8 Outputs:	16 Outputs:
<ul style="list-style-type: none"><li>5 dedicated outputs for Trip &amp; Close S1 breaker, Trip &amp; Close S2 breaker and Lockout/Blocking Alarm</li><li>3 programmable outputs</li></ul>	<ul style="list-style-type: none"><li>5 dedicated outputs for Trip &amp; Close S1 breaker, Trip &amp; Close S2 breaker and Lockout/Blocking Alarm</li><li>11 programmable outputs</li></ul>
Power Supply	
1 standard power supply 1 optional redundant power supply	2 standard power supplies
Trip/Close Circuit Monitors	
No Trip/Close Circuit Monitors	Includes Trip/Close Circuit Monitors
Size (Height)	
5.21 inches (3 Rack Units)	6.96 inches (4 Rack Units)



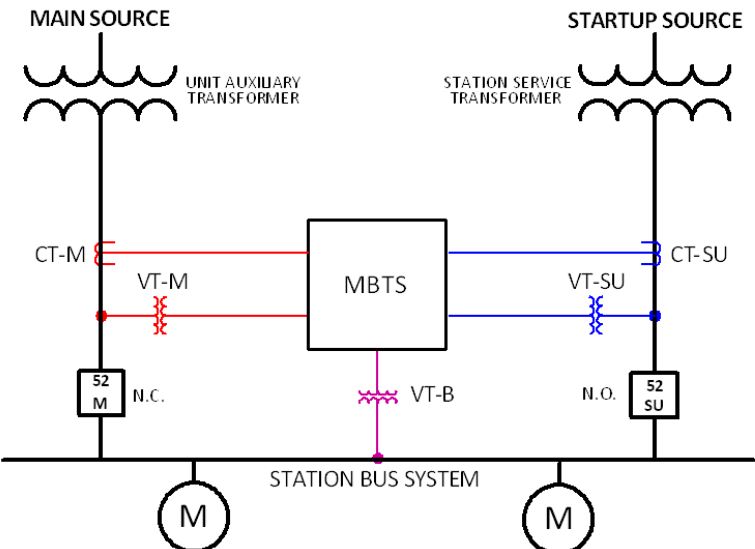
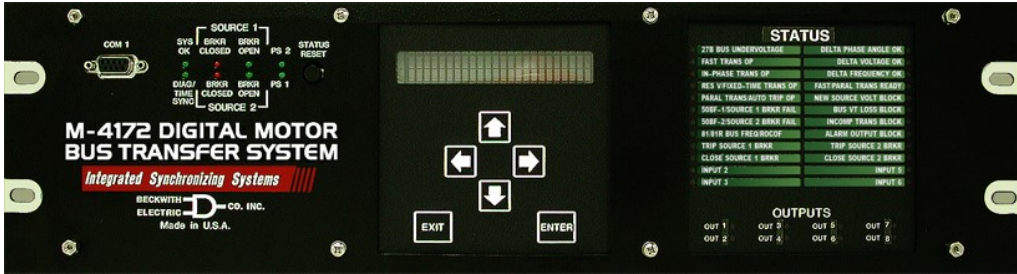
M-4272 Digital Motor Bus Transfer System for Medium Voltage (MV) and Low Voltage (LV) Switchgear Applications



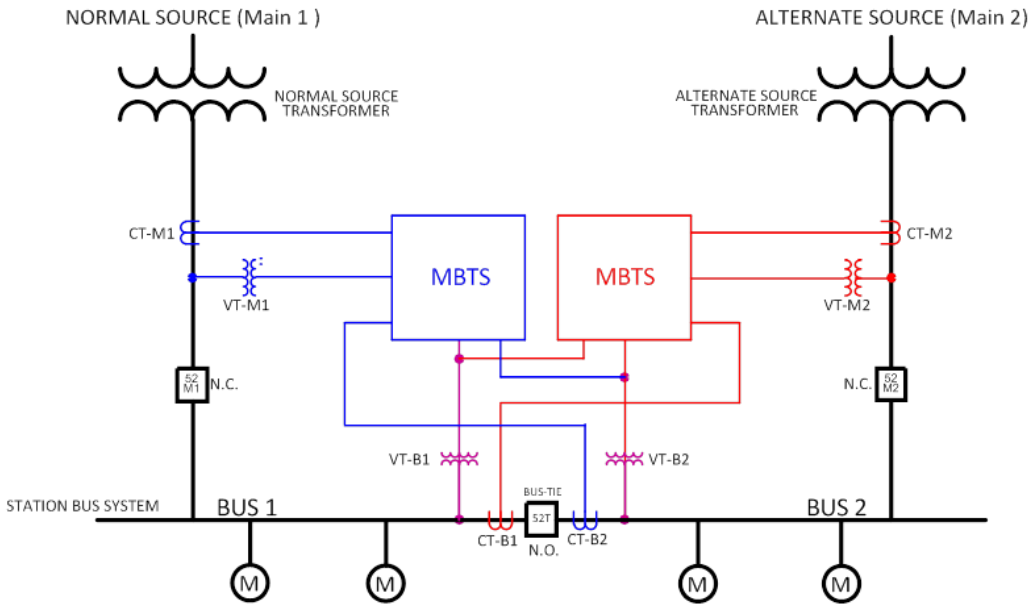
- ◆ The M-4272 provides Automatic and Manual transfers of motor bus systems in power plants and industrial processing plants to ensure process continuity
- ◆ The M-4172 provides Automatic and Manual transfers of motor bus systems on Low Voltage Switchgears in power plants and industrial processing plants to ensure process continuity
- ◆ Automatically selects Fast, In-Phase, Residual Voltage, and Fixed Time motor bus transfers, based on varying system conditions
- ◆ Applicable for one way and bi-directional Manual and Automatic transfers
- ◆ Can be expanded to accommodate multiple breaker configurations
- ◆ Multiple setpoint profiles for various application requirements
- ◆ Integrated control, supervisory functions, sequence of events, and oscillograph recording in one device
- ◆ Extensive commissioning tools
- ◆ Optional M-3919A Graphic Display Unit (GDU) and Touch Screen Human Machine Interface (HMI) for communicating with one or two M-4272 units
- ◆ Optional M-5072 Retrofit Kit for M-4272 Replacement of M-0272/M-0236B Analog Transfer Logic Controller



M-4172 Digital Motor Bus Transfer System For Low Voltage (LV) Switchgear Applications

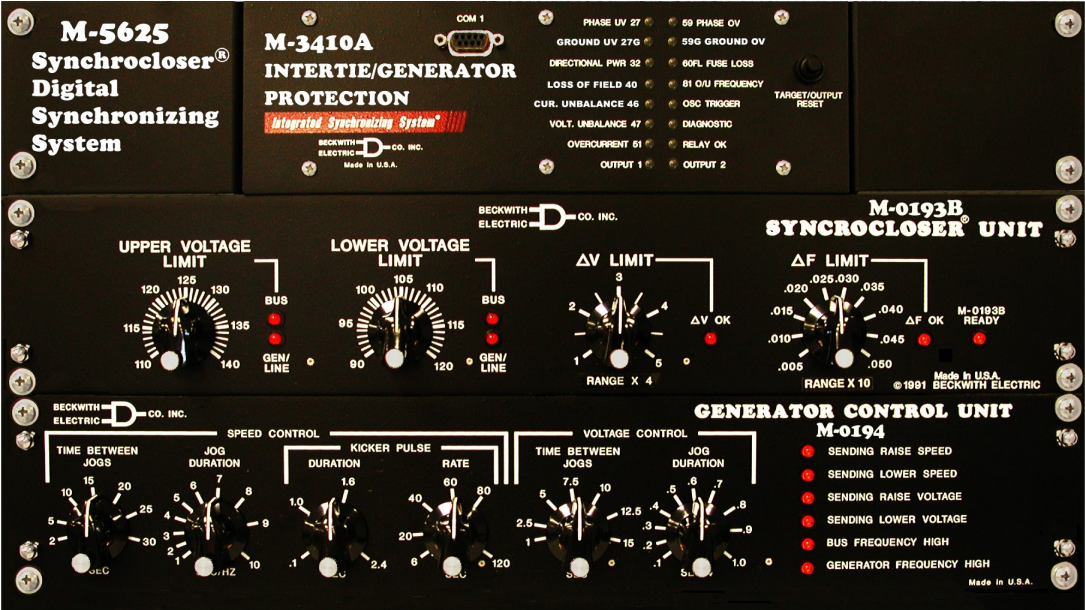


Two-Breaker Configuration  
(Primary-Backup)



Three-Breaker Configuration  
(Main-Tie-Main)

## M-5625 Syncrocloser® Digital System



### Ensure Safe and Quick Synchronizing in Power Plant Applications

The M-5625 Syncrocloser® Digital Synchronizing System is suitable for the automatic synchronizing of a generator to the electric power network. The system provides speed and voltage "jogs" to bring a generator to proper conditions of matching voltage and frequency, prior to safely and accurately closing a breaker into a bus energized by an electric power network.

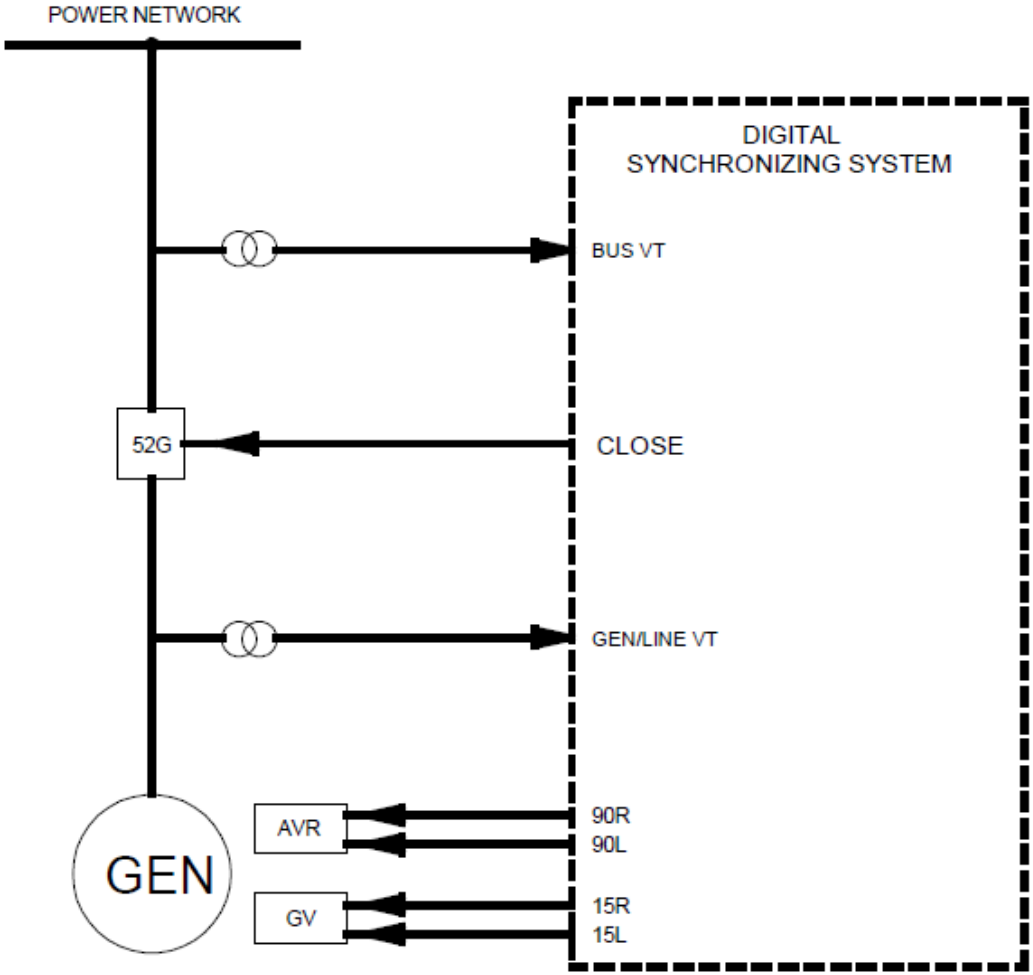
The Digital Synchronizing System is intended for three general classes of application:

- ◆ Initial connection of a generator to a power network
- ◆ Closure of a network breaker where there is a possibility of a split of the system into two isolated networks having different frequencies
- ◆ Breaker closure applications with a static phase angle
- ◆ Automatic Synchronizing
- ◆ The system can also be used for manual synchronizing application.

The M-0193B Syncrocloser Unit closes the generator breaker at the point of synchronism. It initiates the close command in advance of phase coincidence using breaker closing time and slip frequency.

The M-0194 Generator Control Unit matches the generator speed and voltage to system conditions in minimum time with output control jogs that use a proportional pulse width algorithm.

The M-0188A Syncrocloser Check Relay is used as a permissive relay for secure reclosing of a circuit breaker by verifying that voltage and phase angle conditions are within pre-set limits before allowing the breaker to close.



### Automatic Synchronizing of a Generator to a Power Network

The M-5625 Syncrocloser Digital Synchronizing System is suitable for the automatic synchronizing of a generator to the electric power network. The system provides speed and voltage "jogs" to bring a generator to proper conditions of matching voltage and frequency, prior to safely and accurately closing a breaker into a bus energized by an electric power network.

The Digital Synchronizing System is intended for three general classes of application:

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