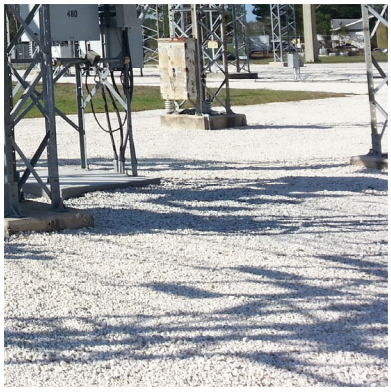
# Advanced Distribution Grid Solutions

## Increase Efficiency and Reliability in the Distribution System

BECKWITH ELECTRIC CO.INC.





# About Beckwith

**Beckwith Electric, founded in 1967, is a premier provider of innovative and high quality products, technical services and solutions that meet the needs of customers involved in the production, transmission, and distribution of electric power.**

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 creates solutions that protect power systems around the world. Beckwith's field-proven smart distribution automation controls for transformers, regulators and capacitor banks incorporate unique control strategies, advanced microprocessor architecture and cyber security compliant communications. Power systems protection solutions include generator, transformer, feeder, recloser and distributed energy resources. Additionally, Beckwith's fast motor bus transfer systems provide continuous, reliable motor protection, working to preserve process reliability. Beckwith also offers advanced synchronization systems for the automatic synchronizing of a generator with the best accuracy in the industry to assure safety for your most expensive asset.

Beckwith 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. With Smart Voltage Reduction and Smart Reverse Power, these can be applied as stand-alone controls with no communications, or as a critical part of an overall centralized IVVM system with extensive communications.

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.

Much of Beckwith's success comes from listening to customer feedback and using that information to influence the design features of its products. Even with over 25 patents, our core principal continues to be "Products defined by you, refined by Beckwith."

**For additional company or product information, please browse our website or contact a local Beckwith Sales Partner or Regional Sales Manager office near you.**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# Advanced Distribution Grid Solutions

## Advanced Distribution Protection, Automation, and Control Solutions

Beckwith Electric's solutions include field-proven smart grid strategies that provide huge energy savings and increased power delivery capacity by incorporating the latest technologies in microprocessor architecture and communications. Features include real time power quality monitoring capable of detecting damaging harmonics, sags, swells, faults, and sub-synchronous transients with massive nonvolatile memory for data recording including adherence to CBEMA voltage waveform criteria.

Communication options include encrypted Bluetooth for laptop connection in the field from the comfort of a fleet cab, and true Ethernet capability allowing multiple concurrent sessions using DNP, Modbus, and IEC 61850 for remote access. Beckwith Electric has developed SCADA heartbeat integrity checks and automatic change over algorithms on loss of communications to enhance system reliability. Beckwith Electric utilizes advances in cutting-edge communications technology providing maximum flexibility in the use of ports, protocols and media and the use of Ethernet over fiber optics, IEC 61850, mesh networks, unsolicited reporting, broadcasting capabilities for voltage collapse mitigation, and much more.

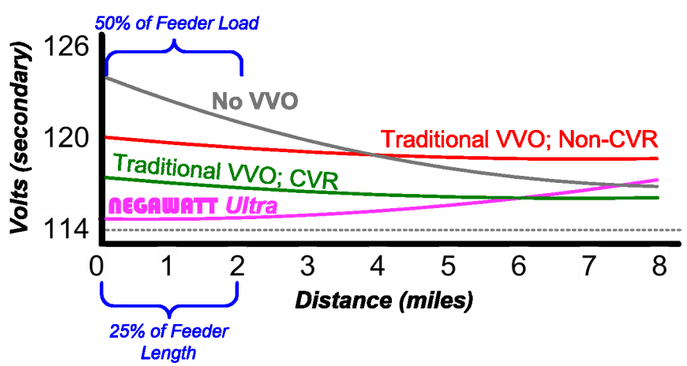
Our advanced distribution protection, automation, and control solutions include:

- LTC transformer control
- Substation and line regulator control
- Pole–top capacitor bank control (remotely and locally controlled)
- Feeder protection and bay control
- Recloser control
- Distributed generation and distributed resources protection
- Transformer protection

### NEGAWATT Ultra: A Revolutionary VVO/IVVC Method using Distribution Automation Controllers

*NEGAWATT ULTRA unifies LTC Transformer, Regulator and Capacitor Control*

LTC Transformer, Regulator and Capacitor Control is unified by measuring VAr flow in the voltage regulating devices to modify their control action, properly coaxing voltage controlled capacitors on or off to optimize power factor and voltage profile.
***Energy reduction optimization 24x7.***




# M-2001D Digital Tapchanger Control for Transformers and Regulators

***It's the longstanding standard for transformer LTC control!***


**Maintenance Problem Solver**

- Numerous Manufacturers - GE, Westinghouse, Allis Chalmers, McGraw, Ferranti-Packard, Prolec, Voltran, Asea, MR, Siemens, Cooper, and more.
- Numerous models for each manufacturer to manage
- Numerous technologies including balance beam, magnetic amplifier, solid-state, microprocessor, and more
- Helps when other manufacturers lack support for earlier designs
- Solves for the inability to find spare parts for earlier controls

**Reduces Maintenance Costs**

- Reduction of technician training needed for all the different types of old controls
- Reduction in inventory costs
- Use one control for all transformers and regulators
- Reduce the number of controls on the shelf and stock less expensive Adapter Panels instead

**Reduces Operational Costs**

- Eliminates costly manual mode operation because of control failure
- Self-test routines in the control report operating problems
- Metering, status, and event reports permit more efficient system operation
- TAP Usage Monitor– How many times the transformers have been on specific taps
- Smart Flash SD Card- No laptop needed for upgrades & data downloads
- Advanced methods for transformer paralleling

**Improves Power Quality**

- The ability to maintain a very precise voltage inside the desired band
- Prevent tapchanger runaway that results in an extreme output voltage at full buck or full boost
- Harmonic Analysis to detect Sags, Swells, Sub-Synchronous Transients & CBEMA Excursions
- Reduction of voltage fluctuations by use of more intelligent algorithms with faster response

**Extends Service Life**

- Prolong the life of the LTC mechanism by eliminating unnecessary operations
- Quickly return old transformers and regulators to service with modern controls
- No need to buy a new one just because an adequate replacement control is no longer available from the original equipment manufacturer

**Provides Automation and Communications**

- Power transformers and voltage regulators can be included in modern automation philosophies
- Communications by Multiple On-board Protocols through RS 232, RS485, Fiber Optics, or Ethernet
- Automatic reconfiguration of voltage regulators during reverse power conditions (*without a source side PT*)
- Automatic voltage reduction to lower system energy requirements

Advanced Distribution Grid Solutions

# M-6200A Digital Voltage Regulator Control

***Digital Regulator Control for General Electric, Siemens, Cooper and Howard Regulators***


The M-6200A Digital Voltage Regulator Control is a microprocessor-based step-voltage regulator, load tapchanger control that provides local intelligent control or remote automation, monitoring and control of voltage regulators. This control is designed for initial OEM installation on new regulators or to replace a particular existing manufacturer's regulator control.

Interrogation of the control and setting changes are made via onboard HMI, or through the communications ports. User interface consists of a backlit LCD display and six pushbuttons. Password security is available and accessible by the front panel pushbuttons or through the communications ports. All set points are stored in nonvolatile memory that is unaffected by control voltage disturbances.

**M-6200A Features**

- True Ethernet connection which supports unlimited concurrent sessions and simultaneous multiple protocols.
- Patented Autodaptive® algorithms are selectable to further enhance smart grid capabilities.
- Patented VAr Bias algorithm for downstream cap control coordination with the regulator control.
- Patented method facilitates VAr Exportation from the distribution system into the transmission system.
- Operator has real time, remote access to all functions for of the regulator control.
- The control can act as the monitoring point for all voltage, current, and related power quantities, thereby simplifying operating while avoiding transducers and multiple RTU analog inputs.
- Protocols implement 2-way communications to allow all functions which would normally require an operator at the control, to be performed remotely.
- Smart Flash SD Memory card interface allows the user to transfer Setpoint files, DNP configuration file, data logger and oscillography files. It can also be used to accomplish firmware updates.
- Smart Grid enabled for Wired or Wireless networks with either DNP3.0 or MODBUS protocols.
- Elegantly simplistic, intuitive, and easy to use software.
- LED indication for Tapchanger RAISE and LOWER command status, Reverse Power, Reverse Power Detection, CPU OK, ALARM, V/RED Voltage Reduction in Effect, Manual, Local, and TX/RX and Neutral Position Indicator.
- Alphanumeric display and six pushbutton interface provides complete front panel access to the menu.
- Customizable DNP Mapping
- Remote DNP Setpoint Write Ability

# M-6280A Digital Capacitor Bank Control

***Digital capacitor control designed for single-phase applications***

The M-6280A Digital Capacitor Bank Control provides local intelligent control or remote automation, monitoring, metering and control of distribution pole top capacitor banks. Available as Voltage based, Current based, or VAr based, offering three operating modes:

- Automatic
- Remote (with or without voltage override)
- Manual

In addition, minimum and maximum voltage levels can be applied to all three operating modes and a 200 mA Neutral unbalance current detection circuit provides for bank/ switch failure reporting.


**M-6280A Features**

- Maximum Communication Options For Wired or Wireless Networks
- RS-232, RS 485, & Serial Fiber Optic (ST or V-Pin)
- Ethernet Over Copper or Fiber Optic @ 10/100 Base-T
- Embedded Bluetooth®, Class 1 (v2.0), 1Mbps, 128 bit encryption, up to 1/2 mile transmission (with antenna)
- Supports DNP3.0 & MODBUS® Protocols
- Time sync via DNP3.0 Set Time Command
- No need for a battery to back up clock
- DNP mapping templates to match SCADA historical databases
- Sequence of Events (SOE) Recording Of Events - Stores 132 events, ms time-stamped
- Oscillography Capture – Selectable 16, 32, or 64 samples per cycle. Captures sags, swells, CBEMA events and sub-synchronous transients
- FULL DNP implementation – DNP File Transfer, multi-addressing, unsolicited response, source address validation
- Harmonics Detection, Recording, Protection and Suppression with Current and Voltage Tripping
- DNP SCADA HeartBeat – Integrity check of communications media and/or Master. Fully programmable
- TRUE Ethernet – Full 10/100Mbps auto-negotiable concurrent multi-session and multi-protocol support
- Smart Flash SD Card Slot for Quick Uploading of Configurations, Settings, Firmware Upgrades, and Supports Control Cloning
- Setpoint Profile Switching (8 Profiles)
- Cyber Security – Comprehensive cyber security tools to implement NERC CIP requirements, including IPsec and RADIUS server security
- Data Logging Continuous Recording – Data stored in non-volatile memory requiring no battery backup
- DNP+Ethernet – Device Discovery using CapTalk

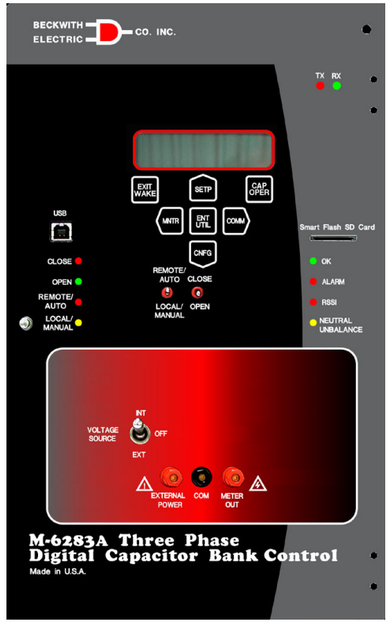
Advanced Distribution Grid Solutions

# M-6283A Three Phase Digital Capacitor Bank Control

***Three Phase Digital Capacitor Bank Control for Remote Capacitor Automation, Monitoring and Protection***

Depending on the control mode of operation, the control parameter can be either voltage, VArs or current. The control parameter shall be user selectable. The three user selectable options are:

- Single Phase Selection (A, B, or C)
- Three Phase Average/Total
- Optional Single Independent Phase Switch




**M-6283A Features**

**Control**

- Universal control offering automatic Voltage, VAr, Current, Time (seasonality) or Temperature operation with programmable voltage override
- Full three phase voltage and current sensing
- Compatible with traditional VT's, Line Post Sensors and multi-core LPS
- Three phase (Ganged) capacitor switch operation with optional Independent Phase switching
- 8 Setting profiles with programmable automatic or SCADA controlled profile switching
- Proprietary neutral current detection algorithm

**Automation/Communications**

- Front panel USB port for local programming and data transfer
- Smart Flash SD Card Slot for Quick Uploading of Configurations, Settings, Firmware Upgrades, and Supports Control Cloning
- Flexible Communication Options for Wired or Wireless Networks with two independent serial ports (232, 485, Fiber or Bluetooth)
- Optional full 10/100 Mbps auto-sensing, autonegotiable true Ethernet (copper or fiber) port with multi-user and multi-protocol support
- Protocols supported include MODBUS, DNP3.0
- Full DNP implementation with support for read/ write of digital and analog values, file transfer, multicasting, unsolicited response, monitoring and remote control
- Compatible with Volt-Var Optimization (VVO) and Conservation Voltage Reduction (CVR) implementations
- Security tools to implement NERC CIP requirements, including IPsec and Radius server security
- IEEE 1686 Compliant

**Monitoring**

- Advanced metering with integrated Power Quality monitoring including voltage and current harmonics up to the 31st, THD, detection of sags, swells and sub-synchronous transients
- Advanced Data Logging and Load Profile Recorder- Data stored in non-volatile memory– No battery required
- 129 Event Sequence of Events (SoE) Recorder
- Oscillographic records with adjustable sampling rate up to 64 s/c
- Three phase overcurrent detection for through fault monitoring

**CapTalk**

- Uncomplicated Windows based application software for easy local or remote programming, monitoring, operation or downloading of recorded information

**Flexibility**

- Optional M-2980A Control Cabinet offers a wide range of Pole top mounting options and accessories for communication hardware

Advanced Distribution Grid Solutions

Transmission Lines

LTC Transformer

M-7651A D-PAC

M-2270B Adapter Panel

M-3311A Transformer Protection Relay



M-2001D Digital Tapchanger Control

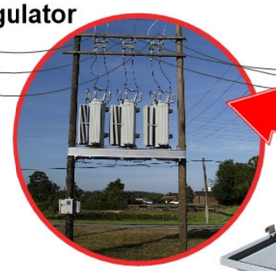

Cell/Radio Tower



Recloser

M-7679 R-PAC

Line Regulator

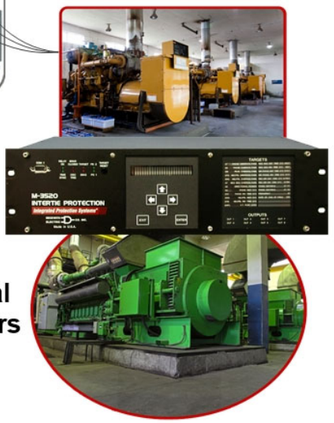


M-6200A Digital Voltage Regulator Control

Switched Capacitor Bank

M-6280A Single-Phase Capacitor Bank Control

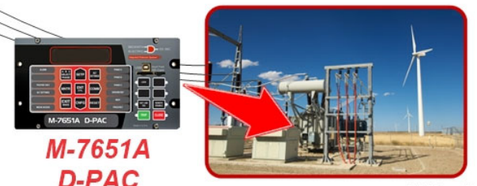
M-6283A Three-Phase Capacitor Bank Control



Peak Shaving Generators

M-3520 Intertie Protection Relay

Industrial Generators





M-7651A D-PAC

Wind Generation

Photovoltaic Smart House

M-7651A D-PAC

DISTRIBUTION SUBSTATION

FEEDERS

USERS AND DISTRIBUTED GENERATION

SMART GRID ROADMAP

# M-7651A D-PAC

**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
- Arc Flash Protection including: Maintenance Mode, Reverse Interlock Bus Protection, Optional Optical with Overcurrent Protection
- Compatible with Optical Point and Loop Sensors


**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 for NERC CIP Compliance
- IEEE 1686 Compliant

**Control**

- (4) programmable Inputs and Outputs, expandable to (12) Inputs and (12) Outputs, plus three Virtual Inputs
- 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 each with an adjustable sampling rate up to 128 s/c

**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

**Flexibility**

- Fast and easy retrofitting for most popular relays in existing cutouts using Beckwith's Adapter Panel Technology™

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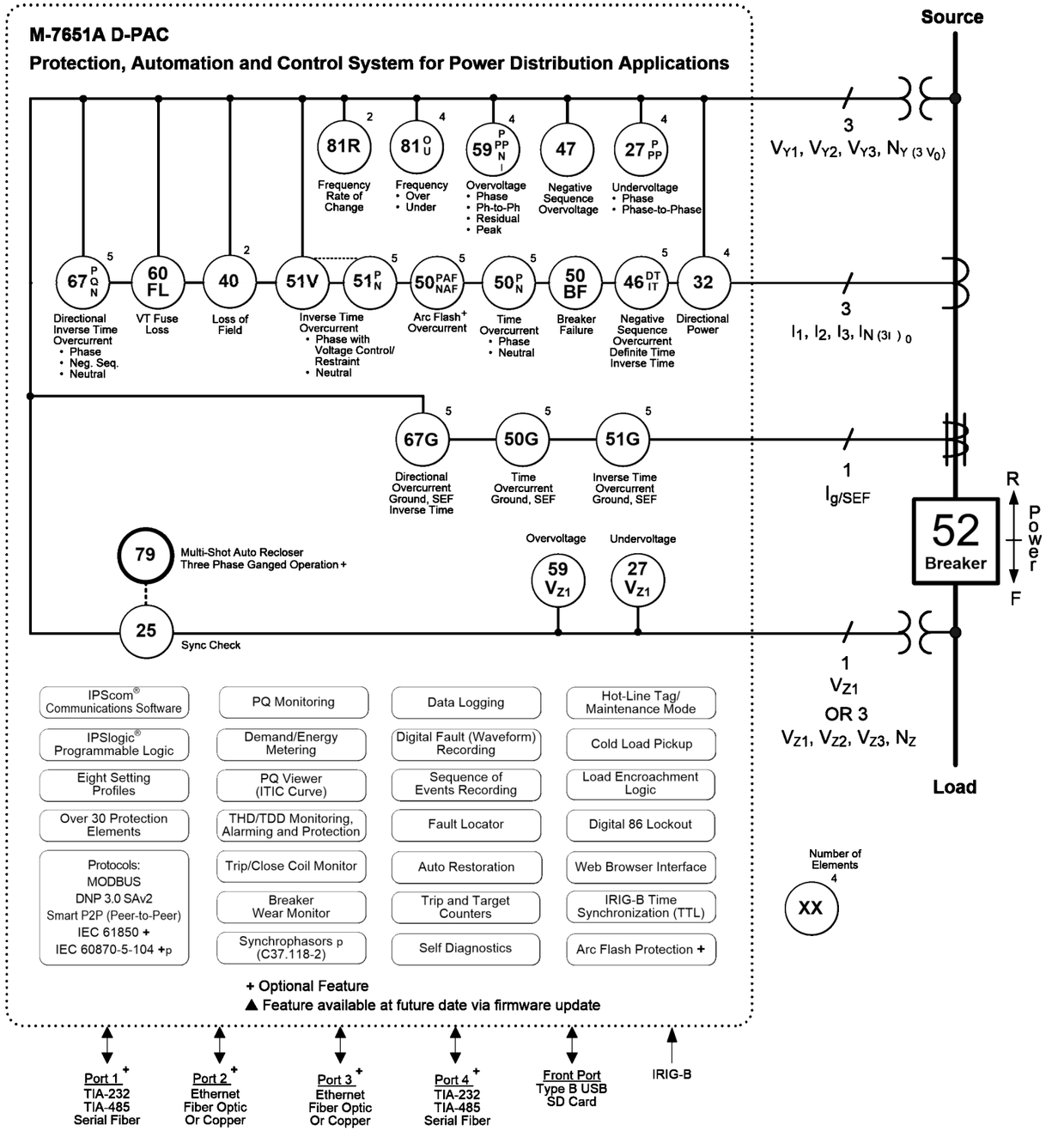

# M-7679 R-PAC

**Protection, Automation and Control System for Recloser, Switch, Sectionalizer and Advanced Distribution Automation Applications**


## Protection and Control

- Over 30 Protection Elements for optimal protection of Power Distribution Systems
- Compatible with Three-Phase Ganged (Std) and Independent Phase Capable Switching devices such as Reclosers, Switches, Sectionalizers and Breakers
- Four (std) or Six (optional) Low Energy Analog (LEA) or VT voltage inputs
- Recloser Settings Wizard assists in creating file for most common settings for Recloser applications
- Comprehensive I/O Matrix provides visual confirmation of enabled functions and selected outputs improving security

## Automation/Communications

- Pre-built functions for Advanced Distribution Automation Applications including Recloser, Switch, Sectionalizer, and Loop Schemes
- Comprehensive Embedded Cyber Security tools to implement NERC CIP requirements, including IPsec and Radius server security
- Front panel USB and SD Card ports for local programming and data transfer
- 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
- IEEE 1686 Compliant
- One or two optional serial ports (TIA-232, TIA-485 or Serial Fiber)

## 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

- Recloser Status Monitoring tool displays real time reclosing sequence and fault clearing time
- Power Quality Monitoring up to the 63rd Harmonic including THD and TDD
- PQ Viewer (ITIC Curve)
- Sags, Swell and Sub-Synchronous Transient Detection
- Comprehensive Suite of Advanced Diagnostic Tools
- Advanced Data Logging and Load Profile Recorder
- 3500 Event Sequence of Events (SOE) Recorder
- 100 DFR quality records (up to 480 cycles) with adjustable sampling rate up to 128 s/c


## Flexibility

- Two ways to upgrade your existing control:
- M-2979 Cabinet for replacement of select complete recloser or switch controls
- M-2400 series Adapters for retrofit of some of the most popular controls in the existing cabinet

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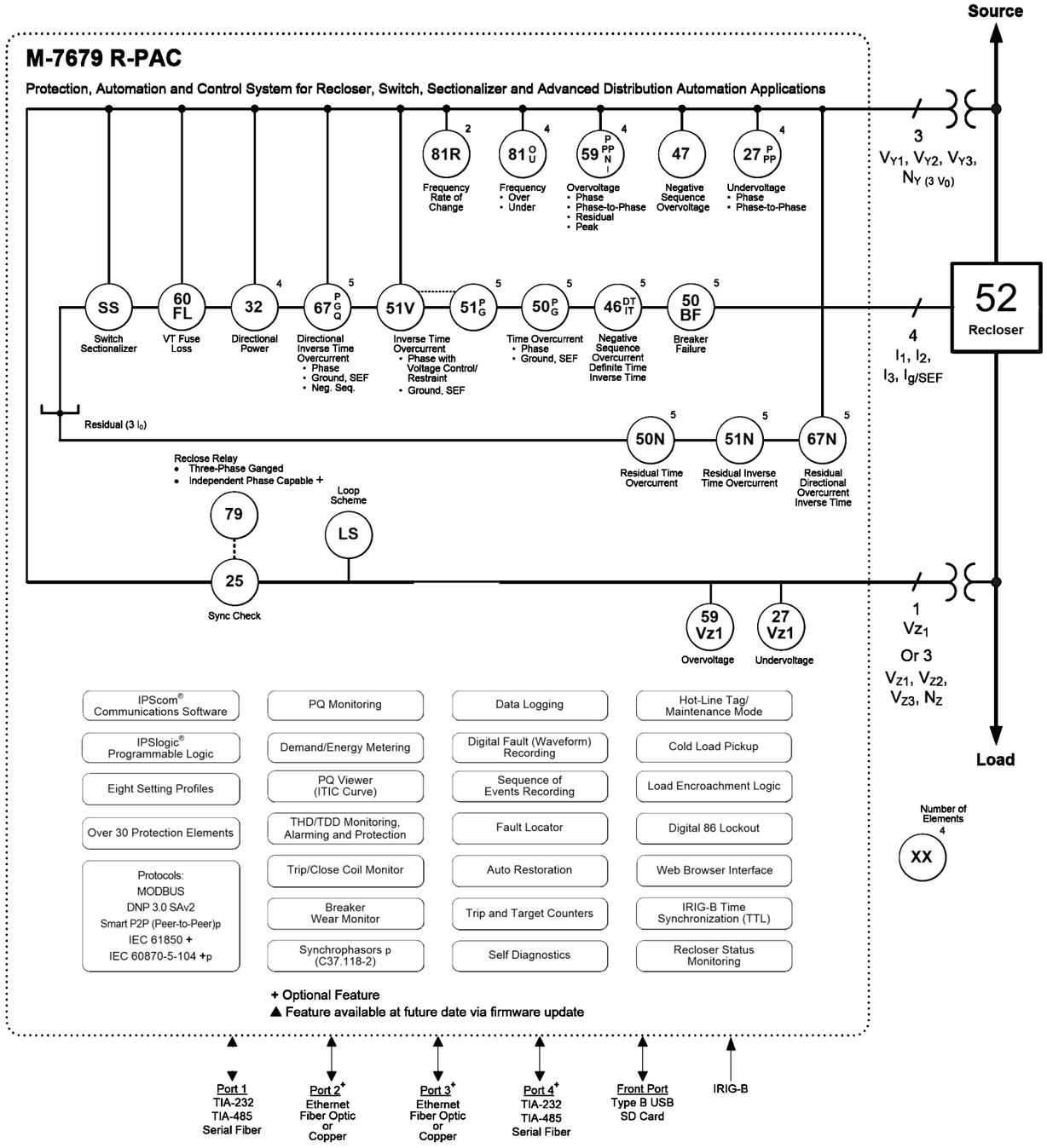
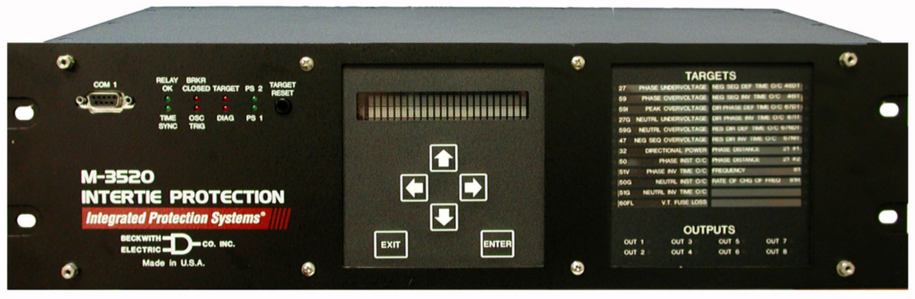


## M-3520 Intertie Protection Relay




***Integrated Protection System®***

Integrated Protection System for distributed generation intertie, providing loss of parallel utility operation protections, abnormal power flow protections, comprehensive suite of phase and ground fault backed protections, abnormal operating protections, and reconnect and sync check functions. The M-3520 microprocessor-based relay integrates protection, metering, monitoring and waveform capture. Provides 18 base protective relay functions and 3 optional protective functions. Includes local and remote serial communications capabilities, plus IRIG-B interface.

**M-3520 Features**

- Sync check with Phase, ΔV and ΔF with deadline/deadbus options (25)
- Phase undervoltage (27) protection
- Neutral over/undervoltage (59G/27G) protection
- Sensitive dual-setpoint, reverse power detection (32)
- Sensitive negative-sequence overcurrent protection and alarm (46)
- Negative sequence voltage (47)
- Instantaneous overcurrent (50) protection
- Instantaneous neutral overcurrent (50G) protection
- Three-phase inverse time overcurrent (51V) with voltage control/voltage restraint
- Neutral inverse time overcurrent (51G) protection
- Phase overvoltage (59) protection
- Peak overvoltage (59I) protection
- VT fuse-loss detection and blocking (60FL)
- Directional inverse and definite time phase overcurrent (67)
- Directional inverse and definite time neutral overcurrent (67N)
- Reconnect enable (79)
- Over/Underfrequency (81 O/U)
- Dual–zone phase distance protection for phase fault backup (21)
- Out of Step (78)
- Rate of change of frequency (81R)
- Eight programmable outputs and six programmable inputs
- Oscillograph recording
- Metering of all measured parameters
- Three communications ports (two RS-232, one RS-485)

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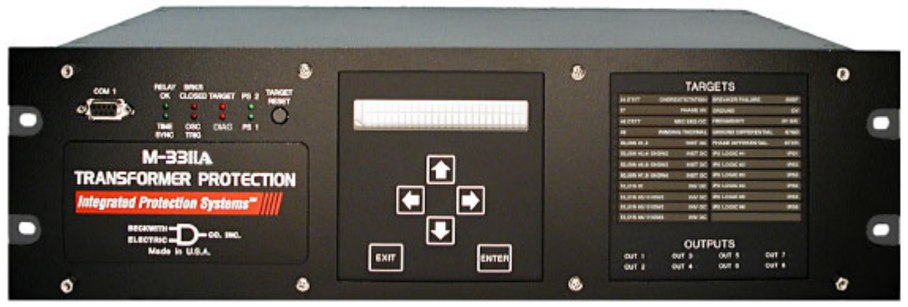
## M-3311A Transformer Protection (2, 3, or 4-Winding) Relay




***Protect Transformers and Other Important Power System Apparatus***

The M-3311A Transformer Protection Relay is more than your average transformer differential relay, protecting 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 transformers of all sizes. This includes restrained and unrestrained differential protection, overcurrent protection, and optional voltage and underfrequency protection. It also includes multiple set point groups and flexible user implementable logic schemes. RS-232 and RS-485 ports accommodate user interface requirements.

Options include the HMI Module for front panel operations, the Target Module to indicate trip target status, and a redundant power supply.

IPScom® software is included for direct or remote communications access to download waveform data, while the M-3801D IPSplot® PLUS Oscillographic Analysis Software allows for plotting and printing of the downloaded Oscillographic data.

**M-3311A Features**

- 2, 3 or 4 winding Transformers for Transmission and Distribution applications
- 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
- Optional Ethernet Connection and Expanded I/O
- Optional Voltage Package includes 24 Volts/Hz
- Overexcitation, 27 Phase Undervoltage, 59G Ground
- Overvoltage and 81O/U Over/Under Frequency

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