

AUTOMATED M-FORCE SWITCH TECHNICAL SPECIFICATIONS

Introduction

This specification describes the features of the Automated M-Force switch. The elements of the Automated M-Force switch are the M-Force switch with cross-arm mounted motor-operator, cables, iMC switch control, ProView software with the iMC Scheme, and SCADA communications functionality. The Automated M-Force switch shall be designed for use as a complete system to perform sectionalizing functionality, either by local, supervisory or network applications. The control shall be used in conjunction with a direct drive motor operator to open or close the M-Force on command. The Automated M-Force switch package shall not provide fault current interruption.

Standard features shall include front panel operation, two battery tests, phase and ground detection with inrush restraint, and numerous communication protocols including DNP3.0, 2179, and Modbus.

Analysis tools shall include Sequence of Events recording, Idea Workbench, Data Profiler, and oscillography functions, including oscillography replay.

The ProView application software shall include ProView technology to provide advanced automated switch control functionality including custom configuration of user-selected inputs and outputs, events and alarm data, and selectable communications points for serial communication.

Metering functions shall include demand and instantaneous current, instantaneous voltage and power factor, and power (real, reactive, apparent). Symmetrical components for both voltage and current metering shall be displayed along with kilowatt-hours for energy metering. Harmonics from the 2nd to the 15th harmonic shall also be included. Metering functions shall require the switch to be equipped with optional voltage and current sensors. All three phase CTs or PTs (optional) shall be present for respective current or voltage symmetrical components to function.

The front panel Human/Machine Interface HMI shall be used to configure the operating settings for the control. It shall also be used to display metering, counter information, control parameters, reset function, and provide diagnostic information.

Control parameters shall also be programmed via a personal computer connected to the control through the front panel RS232 port. Control programming, interrogation, and operations are to be performed with ProView interface software.

The control shall operate on 50 and 60 Hz systems.

Standards

The Automated M-Force switch shall be designed and tested in accordance with the following standards as applicable:

IEEE C37.34-1994™ standard. IEEE Standard Test Code for High-Voltage Air switches

IEEE 1247-2005™ standard. IEEE Standard for Interrupter switches for Alternating Current, Rated Above 1000 Volts

C37.90.1-2002 (ANSI®/IEEE®). American National Standard Guide for Surge Withstand Capability (SWC) Tests

C37.90.2/IEC61000-4-3 (ANSI®/IEEE®). Standard Withstand Capability of Relays Systems to Radiated Electromagnetic Interference from Transceivers

IEC61000-4-6/IEEC61000-4-4 EFT. Electromagnetic compatibility (EMC): Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields

IEC61000-4-2. Electromagnetic Compatibility (EMC – Electrostatic Discharge Immunity Tests, Level 4)

EN55022. European Generic Emissions Standards

IEC 68-2-30. Environmental testing: Damp heat, 100% Humidity

IEC 68-2-1, IEC 68-2-2. Cold and Dry Heat

IEC 255-21-1/MIL STD 810F514.C-1. Vibration tests on measuring relays and protection equipment

IEC-255-21-2. Shock and bump test on measuring relays and protection equipment

IEC 60529 PARA 14.2.6 /MIL STD 810F, Method 506.4. Degrees of protection provided by enclosures: Water Jet, Blown Rain

ANSI® Std C37.32-2002 High Voltage switches, Bus Supports, and Accessories, Schedules of Preferred Ratings, Construction Guidelines and Specifications.

M-FORCE SWITCH

Ratings

	Continuous Current	BIL
15 kV	600 A (900 optional)	110 kV BIL
27 kV	600 A (900 optional)	150 kV BIL

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Contacts

The stationary contact shall be silver-plated hard drawn copper in a reverse loop configuration. The reverse loop contact design shall be employed to insure that, if the switch is subjected to high fault currents, the resulting electro-magnetic force applies pressure to the blade added to the mechanical forces to provide reliable contact continuity. The stationary contact shall not incorporate and rely on backup springs to apply the contact pressure necessary to pass ANSI momentary tests.

Blade

The hard drawn, silver-plated, alloy 110 copper blade shall be of solid blade design. Truss type design that requires backup springs to ensure contact pressure shall not be acceptable. The blade and contact design shall be self wiping and capable of 20,000 mechanical operations without detrimental wear.

Interrupter

The load interrupter shall be a Reliabreak type. The internal mechanism of the interrupter shall be manufactured from non-ferrous components insuring long-term resistance to corrosion in all environments.

The interrupter mechanism shall be capable of 2500 successful mechanical operations. The interrupter shall be capable of 50 successful 600 A interruptions at a rated 15 or 27 kV. The body of the interrupter shall be manufactured from UV stabilized Lexan 103 material and shall be easily replaced with a hotstick. The interrupter operating arm shall be stainless steel (304) with UV stabilized Lexan 103 insulation molded permanently onto the arm.

Phase Units

All current-carrying parts shall be manufactured from copper. Terminal pads shall be NEMA two-hole, silver or tin-plated.

The rotating insulator stack shall incorporate oil impregnated, silicon bronze bearings to ensure maintenance-free operation for the life of the switch. The spindle shall be manufactured from stainless steel and shall be supported by bushings spaced at four inches to eliminate rocking of the insulator, and ensure proper blade and contact alignment.

Each phase unit shall be secured to the crossarm with locking spacers to eliminate distortion of the phase unit base. Dead-end brackets shall incorporate locking tabs that will eliminate movement under side forces present when conductor is dead-ended at an angle. Insulators are available in silicone rubber, cycloaliphatic epoxy, and porcelain.

The 15 and 27 kV Automated M-Force switch shall have the capability of breaking ice up to 3/8" thick without ice shields and ice breaking capability of 1/2" with ice shields.

Crossarm Operator

The Crossarm Motor Operator shall be direct drive dc motor design. It shall include a normally disengaged clutch. The motor shall be powered by 24 V dc. The crossarm operator shall include two receptacles on the housing for removal of control and power cables as needed. The housing shall be rain resistant and include a 25 W heater for humidity control.

Crossarm

Steel or fiberglass crossarms are available.

Hotstick Operation

If the control is without power, the switch can still be manually operated via hotstick. A hotstick-operated bellcrank shall be included to allow manual operation.

Operating Power

Operational power for the switch control and switch motor shall be provided by two 26 Amp-hour, 12 V dc lead-acid batteries connected in series. 120 or 240 V ac shall be required to power an onboard battery charger and internal control heaters. The control inhibits operation when battery power is below 22 V dc.

Control Housings

The control housing shall be painted ANSI Grey mild steel with an option for stainless steel. The housing shall be tamper proof for outdoor installation and have pad-locking provisions for utility grade locks. The enclosure shall be designed to NEMA 4 requirements.

The control cabinet shall have a three-point latch on the door to ensure a weather tight seal. A nameplate shall be attached to the door. Front door entry shall allow access to the operating panel, batteries, and automation equipment.

The control housing shall have a provision for standard conduit or cable entry through the bottom of the cabinet. Two venting holes shall allow for ventilation.

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Temperature Range

The operating range of the control shall be -40 degrees C to +65 degrees C ambient.

Components selected in the design of the control shall have a temperature rating of -40 degrees C to +65 degrees C or higher. Validation of temperature range through production sorting is not acceptable.

Thermostatically Controlled Heater

The control shall have a standard 7 Watt thermostatically controlled heater (ON 70°F, OFF 85°F) for humidity control. The power supply board shall power the heater.

Front Operating Panel

The front panel shall be intuitively designed to minimize training costs and avoid potential misoperation. The front panel shall consist of an interactive programming panel, an informative LCD display, and LED status indicators for quick verification of key operational parameters and functions.

Control Setup Settings

The control shall include a setup menu within the ProView software that enables the user selection and specification of key operational control characteristics and applicable parameter ranges. The control and setting parameters shall include:

- Phase Fault Pickup
- Ground Fault Pickup
- Inrush Restraint Duration
- Auto Fault Target Reset
- Enable Auto Fault Target Reset Time
- Phase Voltage Present Percent
- Manual Close Delay
- CT/PT Ratio
- CT/PT Present
- CT/PT Correction Angles
- Loadbreak Motor Inhibit

Programming/Status

The control programming section shall allow the user LED status indication. Each LED shall be rated for high visibility under direct sunlight. The control shall have a total of

25 LEDs available for direct control and recloser status information. As a minimum, dedicated LEDs shall include status indication as follows:

- Control OK
- Alarm
- Battery Test in Progress
- Battery Recovery
- Motor Inhibit
- A-Phase Fault
- B-Phase Fault
- C-Phase Fault
- Ground Fault
- Loss of AC power
- Low Battery Voltage
- Supervisory Off
- Switch Open
- Switch Closed
- A-Phase Voltage
- B-Phase Voltage
- C-Phase Voltage
- Indicators 1, 2, 3, 4, 5, 6, 7, 8 (user-configurable)

The user shall be able to remove all insert labels to customize the LEDs as required. Removable inserts and labels shall be designed to enable the user to change inserts without the use of adhesives, label makers, or temporary labels.

An electronic label template with font type and size shall be included in the control software to allow the customer to easily customize the labels.

The user shall have the ability to access critical operation functions through the use of eight analysis one touch keys. It is not acceptable to scroll through a series of menus for the following functions:

- Motor Inhibit
- Battery Test
- Reset Targets
- Lamp Test
- Supervisory On/Off
- Open switch
- Close switch
- Alarms

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A sharp, backlit 4-line x 20-character display shall be included in the control front panel. The LCD shall provide extensive status information regarding the distribution system and switching system using a minimum of eight navigational keypads in an organized menu structure. The navigational keypads shall include accelerated scroll up, down, left and right keypads; along with immediate enter and menu keypads for direct operation.

Operating Section

For quick and easy interaction with the Automated M-Force switch, the lower front swing-panel pushbutton option will allow direct access to open and close operation of the switch, as well as an option for a Motor Battery Test.

The optional Open, Close, and Motor Battery Test pushbuttons shall have a minimum surface area of one square inch with a protective guard around the perimeter of each button to prevent incidental open or close. The Open button shall be green and the Close button shall be red. The Motor Battery Test pushbutton shall be yellow.

Control Security

The iMC switch control shall have multiple customer programmable security codes to limit control programming and viewing function access to authorized personnel.

The Human/Machine Interface shall include a user-selected security code to access the settings. Three levels of password protection shall be available. A password shall be required when communicating between the control and a personal computer.

Discrete SCADA Communications

The control shall provide five configurable output status contacts and three configurable input status contacts as standard. Default output status contacts shall be:

- Switch Status
- Control OK Status
- Motor Inhibit Status (on/off)
- Operation Fail (SS1)
- RIF Com Failure

One output status contact shall be a solid state output (SS1) with a pickup time no longer than two milliseconds.

The switch control shall also provide a minimum of three configurable input control contacts. Each contact shall be configurable using a graphical interface software. Contacts shall accept a whetting voltage range of 12-250 V dc, 120/240 V ac. Standard default input control contacts shall be:

- Supervisory Close
- Supervisory Open
- Battery Test

Protocols

Five communication protocols shall be supported in the control:

- Modbus
- DNP3 Serial
- DNP3 TCP/IP
- 2179
- IEC870-5-101

One communications protocol can be selected for either the back panel RS-232 or the optional communications port and shall be specified by the customer at time of order. A standard IRIG-B port shall be included for user time syncing.

All protocols shall be selected and configured by the user with the ProView software Communications Workbench.

Metering

If CTs or PTs are present, the control shall provide instantaneous and/or demand metering with programmable integration intervals for the following functions:

- Real and reactive power for each phase and total, including directional (import and export), on an individual basis.
- Total power (kVA) for each phase and total (3-phase).
- Demand currents on a per phase basis.
- Instantaneous voltage on a per phase basis.
- Instantaneous frequency.
- Positive, negative, and zero sequence voltages and currents.
- Instantaneous power factor on a per phase basis.

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Data Profiler

A fully configurable data profiler shall be available that allows the customer to collect analog information by sampling data at selectable intervals with ranges from 1 minute to 24 hours for all selected parameters. The selectable parameters shall be time-stamped and allow the user to determine weekly load profiles, daily harmonic disturbances, or hourly fluctuations. The data profiler shall present the data in a table form and allow exporting to external spreadsheet application software.

Event Recorder

The iMC switch control Event Recorder shall contain capabilities to perform Sequence of Events time stamping for up to 64 event types. An additional 32 inputs shall be user-defined through the ProView software.

Factory-defined event types include:

- Maintenance Alarm
- Motor Inhibit Status
- Alarm Status
- Switch Status (Open/Closed)
- Fail to Open
- Fail to Close
- Control Status (OK/Not OK)
- Volts Status (per phase)
- Fault (A, B, C phase, Ground)
- Supervisory On/Off
- No ac Power
- Battery Recovery Status
- Partial Close
- Auto Motor Battery Test
- Loss of Status
- Control Battery Test
- Control Temperature Invalid
- 50DCB Alarm
- Status Disagreement
- Battery Alarm
- Motor Battery Test
- RAM Refresh
- Power Supply Alarm

The Event Recorder shall maintain a minimum of 90 event records. The last 25 events shall be viewable on the front panel LCD display.

Oscillography

Oscillography shall be provided to present current and voltage waveforms, along with protection element and switch response status changes. Filtered and unfiltered data shall be provided for viewing.

The recorded values shall be super-imposed on the protection scheme, and the state or value at any point in the scheme shall be displayed. The user shall have the capability to move through the event and view the response of all available functions. All analog signals, digital inputs, and contact outputs shall be monitored. The oscillography sampling rate shall be a minimum of 16 samples per cycle. The default setting shall show two cycles of data before the trigger point and eight cycles of data after the trigger point.

CONTROL HARDWARE SPECIFICATIONS

Frequency

- 50/60 Hz

Control Power Supply

- Idea Relay Supply Voltage: two 12 V dc, 26 Amp-hour batteries
- Power Supply: 120 / 240 V ac \pm 15%,

Control Contact Inputs (Optically Isolated)

- 9 V dc – 290 V dc (default range)
- 7 V ac – 265 V ac (default range)

Status Contact Output

- Make: 30 A peak, 8 A continuous
- Break: 0.2 A peak
- Pickup Time: <8 ms
- Dropout Time: <5 ms

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Solid-State Contact

- 240 V ac / 250 V dc
- Make: 30 A peak, 8 A continuous
- Break: 10 A peak
- Pickup time: <2 ms
- Dropout time: <15 ms

Local/Remote Communications

- Two EIA-RS-232 serial ports
 - Front Panel – used exclusively with ProView protocol (DCE)
 - Rear Port – Factory configured for communication or ProView protocol (DTE)
- RS-485 Port, serial fiber optic and Ethernet – Factory configured for communication

Baud Rate

2400/9600/38400/56800/115200 baud

Front Panel Display

The front panel display shall be a 4 x 20 LCD contrast-adjustable display with LED Backlight.

Front Panel Targets

- 25 High-Intensity LED targets
- 23 LED targets are user configurable

Front Analysis Keypad

There shall be eight momentary contact one-touch keypads for immediate system analysis (user configurable).

Operating Temperature

The operating temperature range shall be -40 °C to +65 °C.

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