Typical Specification Guide

Medium Voltage Smart Motor Controllers (SMC)

Bulletin 1560D, 1562D

Allen-Bradley
RELIANCE ELECTRIC
DODGE
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Rockwell Automation

Bringing Together Leading Brands in Industrial Automation

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1.0 General

Introduction

Rockwell Automation has produced quality medium voltage products to meet the requirements of all types of industries for well over six decades.

From the original oil-immersed contactor, to air break and vacuum contactors, to solid-state controllers such as Smart Motor Controllers and AC Variable Frequency Drives, Rockwell Automation has developed and built a medium voltage product line that satisfies those industries demanding more safety, less maintenance, longer life and reliability in motor control equipment.

Added to those demands is the need for smaller and more flexible medium voltage products that are more efficient and that enable a reduction in building and expansion costs.

Rockwell Automation has met all of these demands with the MV Dialog Plus™ line of solid-state, reduced-voltage motor controllers. The MV Dialog Plus controller provides microprocessor controlled starting for standard three-phase squirrel cage induction motors (including wound rotor and synchronous). Four standard modes of operation are available within a single controller:

- Soft Start with Selectable Kickstart
- Current Limit Start
- Dual Ramp Start
- Full Voltage Start

Advanced Starting and Stopping Option Modules:

- Soft Stop
- Pump Control
- Preset Slow Speed
- SMB™ Smart Motor Braking
- Slow Speed with Braking

Features:

- Solid-state motor protection
- Metering
- SCANport™ communication
- LCD display
- Keypad programming
- Fiber optic control
- Self-powered gate driver boards
- Vacuum bypass contactor
- Starting optimized power stacks
- Centerline™ power bus

1.0 General (cont.)

Introduction (cont.)

The MV Dialog Plus controller is available for motors rated up to 800 amps, 2300 to 6900 volts AC, 50 and 60 Hz.

The MV Dialog Plus controller is a solid-state reduced voltage controller utilizing the SMC Dialog Plus™ control module. The SMC Dialog Plus is a microprocessor controlled digital control module that features programmable logic, metering and remote communication capabilities. This is the same digital control module used in the 480/600 V Bulletin 150 SMC Dialog Plus controller (excluding pump control). The Medium Voltage MV Dialog Plus Pump Control Module is unique to medium voltage applications.

MV Dialog Plus Motor Controllers	Bulletin Number
Retrofit Controller	1560D
Combination Starter, non-reversing	1562D
Combination Starter, VFD bypass	1562DM
Combination Starter, multi-motor bypass	1562M ❶
Combination Starter, reversing	1566D

❶ Requires a 1512M (output bypass starter) per motor to be functional.

We sincerely believe that your exact requirements can be fulfilled.

2.0 Scope

This specification outlines the overall fabrication, performance and functional requirements for a medium voltage solid-state, reduced-voltage motor controller for use with polyphase motors. The complete controller shall meet the overall design requirements as specified herein.

The solid state reduced voltage starter shall be _____ V, 3 phase, _____ hp or _____ kW rated, and used for the controlled starting and/or stopping of _____ motors (induction, synchronous, wound rotor).

3.0 Codes and Standards

The Seller's equipment shall be designed, manufactured and tested to meet or exceed the applicable requirements of the latest standards published by the following organizations:

- Canadian Standards Association (CSA) *"Industrial Control Equipment C22.2 No. 14"*
- American National Standards Institute (ANSI) *"Instrument Transformers C57.13"*
- Institute of Electrical & Electronic Engineers (IEEE)
- National Electrical Code (NEC)
- Electrical & Electronic Manufacturers Assoc. of Canada (EEMAC)
- Occupational Safety & Health Act (OSHA)
- Guide for Harmonic Control and Reactive Compensation of Static Power Converters (IEEE 519-1992)
- National Electrical Manufacturers Association (NEMA) *"Medium Voltage Controllers Rated 1501 to 7200V AC ICS 3-2 (formerly ICS 2-324)"*
- Underwriters Laboratories, Inc. (UL) *"High Voltage Industrial Control Equipment 347"*
- European Directives for Safety and EMC

Note: It shall be the responsibility of the user and/or installer to know and meet all local codes, standards, and OSHA requirements.

Environmental Conditions

The controller shall accept nominal plant power of 2400V, 3300V, 4200V, 6600V or 7200V AC (±10%), 3 phase 50/60 Hz (± 3%).

The controller shall operate in an ambient temperature range of 0°C to 40°C (32°F to 104°F) with a relative humidity of up to 95% (non-condensing).

The equipment shall be capable of being stored in an environment with an ambient temperature range of -20°C to 65°C (-4°F to 149°F).

The equipment shall operate at altitudes from 0 to 1000 m (3,300 ft) above sea level, without derating. For applications above 1000 m (3,300 ft), the maximum current and Basic Impulse Levels (B.I.L.) of the controllers shall be derated, and vacuum contactors shall be compensated for operation at the specified altitude (see page 28).

3.0 Codes and Standards (cont.)

Seismic Qualifications

The starter shall withstand certain horizontal and vertical accelerations (seismic zones 1, 2, 3 and 4) without overturning or lateral movement when bolted down (mounted) per the Seller's recommended installation instructions.

Note: The seismic qualification does not indicate that the equipment will operate properly during or after a seismic event.

4.0 Obligations of Seller

Deviations

Any exceptions or deviations shall be defined in writing at the time of bid.

5.0 Drawings and Manuals

Information Drawings

Orders shall include a submittal of three (3) bond paper prints of the dimension drawing and electrical drawings (two for customer and one for Seller's local representative), at the time engineering is finalized. These drawings shall be suitable for photo copying.

Approval Drawings

If requested at the time of order entry, approval drawings shall be available at no charge. The approval submittal shall include (3) bond paper prints of the dimension drawing and electrical drawings supplied at the published lead time after order receipt by the Seller. Submittal of approval drawings requires an additional _____ weeks. Approval drawings can be sent electronically via the Internet, as an alternative to sending them by mail.

Note: Seller shall allow the customer two (2) weeks to review the drawings. This period starts on the date that the drawings are shipped to the customer and ends on the date that the drawings must be back to the Seller. If drawings are returned earlier than two (2) weeks, then lead-time shall be adjusted accordingly.

Final Drawings and Manuals

Certified drawings, instruction and maintenance manuals (3 sets) shall be sent within 30 days of final product shipment. Final drawings shall be available in DXF format at no charge.

6.0 Spare Parts

Recommended spare parts list and prices shall be supplied with the bid. Also, the address of the manufacturer's closest parts stocking location to the user shall be provided.

Critical Spares

Critical spare parts are those associated with long lead times and/or are critical to the unit's operation. These spares should be held in reserve by the customer to limit unforeseen downtime.

Maintenance Spares

Maintenance spare parts are those required by customers to regularly perform scheduled maintenance on their equipment. These spares include, but are not limited to, consumable spares that are required to be exchanged during scheduled customer maintenance periods.

Seller shall assist in determining an appropriate level of spare parts in conjunction with the customer's bill of material (which may include circuit breakers, full voltage starters, load break switches and other auxiliary equipment, including variable speed drives) and the customer's current installed base.

On-site Inventory Agreement (Optional)

Seller shall offer an on-site inventory agreement, in which the Seller will stock and supply as needed all of the spare parts required by the user in the closest stocking location. The user shall have a controlled/immediate access to this inventory 365 days a year.

7.0 Quality Assurance

All inspection and testing procedures shall be developed and controlled under the guidelines of the seller's quality system. This system must be registered to ISO 9001 and regularly reviewed and audited by a third party registrar.

All incoming material shall be inspected and/or tested for conformance to quality assurance specifications.

All sub-assemblies shall be inspected and/or tested for conformance to vendor's engineering and quality assurance specifications.

All printed circuit boards with active components shall be burned-in for a minimum of 48 hours at 60ºC (140°F).

7.0 Quality Assurance (cont.)

Standard Testing

The following tests shall be carried out in accordance with applicable requirements and/or specifications of Canadian Standards Association (CSA), Underwriters Laboratories (UL), National Electrical Manufacturers Association (NEMA), European Standard (EN), and International Electrotechnical Commission (IEC).

Functional checks shall be performed wherever possible; otherwise, inspection and continuity checks shall be made.

A "HI-POT" dielectric withstand test shall be performed on all buswork and cables from phase to phase and phase to ground (except solid-state components, low voltage controls and instrument transformers). The voltage level used for this test depends on the product's nominal AC voltage.

Component devices shall be functionally operated in circuits as shown on electrical diagrams or as called for by specific test instructions.

Instruments, meters, protective devices and associated controls shall be functionally tested by applying the specified control signals, current and/or voltages.

Medium Voltage solid-state controllers shall be inspected for the following:
- Electrical interlocking
- Motor protection and ground fault
- Motor start tests

Physical Inspection

The product must meet all applicable engineering and workmanship standards and specifications. All components shall be verified against engineering documentation to be present and correctly installed.

Warning plates, isolation barriers, and mechanical interlocks must provide sufficient safety/isolation for personnel and equipment.

- Warning labels and nameplates must be present and in their specified positions to advise personnel of possible hazards.
- Isolation barriers must be in place within the cabinet. Such barriers protect personnel from touching live medium voltage components in an area that otherwise does not have power supplied to it.
- Operation of isolation switch handle (if supplied) and door interlocks must be verified. The interlocking prevents the opening of any medium voltage door on a medium voltage cabinet when the isolation switch handle has been moved to the full ON position.

All bus and bus connections shall be checked for proper clearance, creepage, phasing, and torque.

7.0 Quality Assurance (cont.) Factory Inspections (Optional)

Visual Inspection of Equipment

If requested, a review of the electrical and mechanical drawings for the purchased equipment will be done with the Applications Engineer or Project Manager prior to commencing the inspection.

The visual inspection consists of a customer visit to the factory, with prior notification and coordination with the Customer Service Coordinator or the Project Manager, with the intent to view the customer-specific equipment at the various stages of build during the visit. There is no preparation of the equipment in any way for this inspection. It is a means to allow the customer to verify the progress of the order without any disruption to the manufacturing cycle.

Witness Testing

A review of the electrical and mechanical drawings for the purchased equipment will be done with the Applications Engineer or Project Manager prior to commencing the tests. Any questions or clarifications prior to commencing the test will be addressed at this time. The Test Facility will then host the customer for the duration of the actual testing. At the conclusion of the test the customer will reconvene with the Applications Engineer or Project Manager to discuss any concerns or issues that arose during the test. The Project Manager or Applications Engineer will respond back to the customer at the earliest possible time with an outline of the financial and/or schedule impact of the changes

The Medium Voltage solid-state, reduced-voltage testing consists of:

- demonstrating an AC high pot test to the customer;
- applying control power at the rated voltage to the equipment; then, a functional demonstration of customer-purchased options and control devices is completed with the starter in the TEST position.
- operation of the vacuum contactor .
- connection of equipment to a medium voltage input source and the test motor in the manufacturing facility. The motor starting functionality is demonstrated by starting and stopping the test motor.

Custom Testing

The Seller shall be prepared to provide custom testing of the equipment. The customer specifications for the customer test must be provided to the Seller at least two months prior to the testing date at which time the Seller will provide a cost and schedule impact for completing the testing requirements.

8.0 Equipment Design and Selection

General

The controller shall be manufactured by a single vendor.

The medium voltage, solid-state controller shall consist of a metal-enclosed, free-standing, dead front, vertical steel structure.

Each structure shall be suitable for future expansion at each end. Each structure shall also have two (2) non-removable base sill channels and removable lifting angles or brackets for ease of handling and installation.

The controller shall be of modular design to provide for ease and speed of maintenance. The modules are to be manufactured by one supplier, designed to allow ease of maintenance, including removal of medium voltage components and power electronic components.

The structure shall be divided into isolated compartments as follows:

- Main power bus and ground bus compartment
- Power cell compartment
- Low voltage compartment

Metal or glastic barriers shall be provided between the low voltage compartment and the power cell and/or main power bus compartment, and between the power cell and main power bus compartment. Personnel shall have access to the low voltage compartment, with the controller energized, without being exposed to any medium voltage.

8.0 Equipment Design and Selection (cont.)

Structure and Controller

Each structure shall contain the following items:

Retrofit Controller *(For use with existing isolating controller)*

- Tin-plated copper horizontal power bus (optional)
- A continuous bare copper ground bus
- Power electronics
- A vacuum bypass contactor
- A low voltage control panel complete with microprocessor-based control module
- Top and bottom plates to accommodate cable entry/exit

Combination Starters *(Includes isolating controller)*

- Tin-plated copper horizontal power bus (optional)
- A continuous bare copper ground bus
- Power electronics
- A main non-load-break isolation switch and operating handle
- A vacuum isolation contactor
- A vacuum bypass contactor
- Three (3) current limiting power fuses for NEMA Class E2 operation
- Three (3) current transformers
- A control power transformer
- A low voltage control panel complete with microprocessor-based control module
- Space for necessary auxiliary control and metering devices
- Top and bottom plates to accommodate cable entry/exit

Enclosure Types

The medium voltage product line shall be available in a NEMA Type 1 (IEC IP40) general purpose enclosure as standard. Optional enclosures are NEMA Type 1 with door gasketing (IEC IP30), NEMA Type 12 dust tight and drip proof (IEC IP54) or NEMA Type 3R outdoor (IEC IP34) non-walk-in styles. Each enclosure shall be properly sized to dissipate the heat generated by the controller within the limits of the specified environmental operating conditions.

8.0 Equipment Design and Selection (cont.)

Structure and Controller (cont.)

Structure Finish

As standard, all exterior and interior metal parts (except for the power cell back plates and low voltage panel) shall be painted ANSI 49 medium light gray (3R shall be ANSI 61). All metal back plates in the power cell and low voltage compartments shall be painted high gloss white for high visibility. Optional field touch-up spray can(s), matching the enclosure color, shall be supplied when requested.

Description	Hybrid epoxy powder paint - high gloss.
Standard color	ANSI 49 medium light gray (optional ANSI 61 light gray)
Procedure	Continuous paint line. All parts are painted before assembly.
Preparation	Alkaline wash/rinse/iron phosphate rinse/iron-chrome sealer rinse/recirculated de-ionized water rinse and virgin de-ionized water rinse.
Painting	Air-atomized electrostatic spray. Total paint thickness - 0.002" (0.051 mm) minimum
Baking	Natural gas oven at 179°C (355°F) minimum.

Notes:

1. When optional custom paint color is specified (including ANSI 61), all external surfaces shall be painted to the custom color requirement, except for the external isolating switch handle assembly, lifting angles and lifting brackets.
2. All unpainted steel parts shall be plated with a zinc plate/bronze chromate process for corrosion resistance.

8.0 Equipment Design and Selection (cont.)

Structure and Controller (cont.)

Main Power Bus (optional)

The main horizontal power bus shall be located at the center rear of the structure to provide for optimum heat distribution, ease of maintenance and splicing. The power bus shall be mounted on edge to a molded bus support insulator in a common vertical plane. This shall provide better short circuit withstandability and protect against tracking between phases and the accumulation of dust. The power bus shall be made of tin-plated copper and be available in one of the following continuous current ratings: 1200, 2000 or 3000 amps.

Access shall be provided to the bus compartment from the front or the rear of the structure to allow for installation and regular maintenance of the power and ground bus splice connections.

The horizontal buswork, the cabling/bus from the main power cell shall be braced and tested in accordance with NEMA ICS 3-2 and UL 347 (paragraph 30).

When optional insulated power bus is specified for the main horizontal bus, a sleeve-type, heat shrink insulating material with good flame resistance and self-extinguishing properties, shall be used. This material shall have a minimum wall thickness of 1.4 mm (0.055 in.)

Bus Bracing

The horizontal/vertical buswork and the cabling/bus in the main power cell(s) shall be braced and tested in accordance with NEMA ICS 3-2 and UL 347.

The buswork and cabling shall be braced to withstand the let-through energy allowed by the largest fuse during a short circuit fault.

Ground Bus

A continuous copper ground bus shall be provided along the entire length of the controller line-up. A mechanical lug for #8 to #1/0 AWG or #6 to 250 MCM cable shall be supplied at the incoming end of the line-up. The ground bus shall be 6.4 x 51 mm (1/4 in. x 2 in.) bare copper.

8.0 Equipment Design and Selection (cont.)

Vacuum Contactor Specifications (Input and Bypass)

The electrically (magnetically) held medium voltage contactor shall be the Allen-Bradley Bulletin 1502 vacuum type or equivalent.

The following (open) current ratings shall be available:
- 400 A
- 800 A

The contactor shall have visual contact wear indicators. No special tools are required for checking contact wear.

Vacuum bottle and coil maintenance shall be performed on the contactor while it is mounted. Removal of contactor is not required.

Vacuum Input Contactor (Combination Controller Only)

The vacuum input contactor shall be fixed mounted inside the power cell. Fixed mounting provides solid, continuous contact while lowering maintenance requirements considerably. The contactor shall be interlocked with the non-load-break isolating switch, both electrically and mechanically, which shall provide the following safety features:

- Prevent the isolating switch from being opened or closed when the contactor is in the closed position.
- Prevent the opening of the medium voltage door when the isolating switch is in the closed position.
- Prevent the closing of the isolating switch when the medium voltage door of the controller is open.
- Remove control power from the control power transformer (CPT), power transformers (PTs) or external power source to the control circuit when the isolating switch and contactor are in the open position.

Vacuum Bypass Contactor

A contactor shall be provided to bypass the SCRs once the motor is up to full speed. When a stop option is selected, the bypass contactor will open, bringing the SCRs back into the power circuit. It shall be fixed mounted in the main power cell.

The bypass contactor shall be capable of providing a full voltage start in case of emergency bypass. A separate overload relay shall be provided to protect the motor while in emergency bypass.

8.0 Equipment Design and Selection (cont.)

Control Wire Specification

The control wire shall be an insulated (with a flame retarding thermoplastic compound), flexible stranded, bare copper wire supported and neatly bundled. Red wire shall indicate AC power, blue wire shall indicate DC power and green wire shall indicate ground. Other colors or combinations may be used for specific applications. The control wire shall be isolated from high voltage components in the power cell (whenever possible), and wire tube markers which are numbered according to the electrical diagram, shall be provided at each end of the wire.

All of the control wire terminations shall be a screw-type, copper-compression -type terminal block or connector which firmly grips the conductor. Non-insulated, locking-type, fork tongue lugs shall be provided on the control wire terminating on the control power transformer(s) and current transformers.

Low Voltage Wireway

An optional low voltage wireway shall be available across the top of the structure. There are two (2) sizes of low voltage wireway available: 51 mm × 102 mm (2 in. × 4 in.) or 152 mm × 152 mm (6 in. × 6 in.) The low voltage wireway shall allow a convenient method of interconnecting control wire from one controller to another, when interfacing with a master panel or with programmable controller circuits.

Low Voltage Control Panel

Each controller shall have a separate, front accessible, low voltage control compartment. The compartment shall be completely isolated, using metal barriers between the low voltage compartment and the power cell and/or main power bus compartments for utmost safety.

Optional meters, protective relays, selector switches, operators, indicating lights, etc., shall be mounted on the front of the low voltage control panel, and arranged in a logical and symmetrical manner. The low voltage panel shall provide the following features:

- Space shall be provided for low voltage control devices, transducers and metering.
- There shall be necessary terminal blocks supplied. Extra terminal blocks can be supplied as an option.

8.0 Equipment Design and Selection (cont.)

Control Wire Specification (cont.)

Low Voltage Control Panel (cont.)

- There shall be low voltage control panel access without turning the controller "OFF" when opening the low voltage control panel door.
- All remote low voltage cables shall be able to enter from the top or bottom of the structure. Access to the wireways shall be by means of removable entry plates on the top and bottom of the structure.
- As standard, the combination controllers shall incorporate a swing-out low voltage panel which provides easier access to the power cell to make bus splicing and load cable connections. All products shall have a swing-out low voltage panel, which is interlocked with the power cell compartment (the panel shall not have the ability to swing open until the power cell is "OFF" and isolated from the main power bus) to allow easy access to medium voltage equipment, i.e. power stacks, power bus, power factor correction capacitor, or other similar equipment.
- Pilot control relays shall be used to operate and economize the vacuum contactor.
- The control panel supply voltage shall be 120 V AC, 50/60 Hz. It shall be rectified to provide a DC operating voltage for the vacuum contactor coils and economizing relay.
- There shall be a two-pole, three-conductor (with a grounding prong) male plug to provide a means for connecting a two-pole, three-conductor receptacle from a remote 120 V AC, 50/60 Hz supply to operate the control circuit when it is in the TEST position (combination controllers only).
- The low voltage control panel door shall have a viewing window, allowing the user to monitor controller operation via the control module.

8.0 Equipment Design and Selection (cont.)

Main Isolating Switch (Combination Controller Only)

The main power cell shall have an externally operated, three-pole, gang-operated, fixed-mounted, non-load-break isolating switch providing the following features:

- The isolating switch shall isolate the power bus compartment from the power cell by means of a positively driven shutter mechanism to prevent accidental contact with line terminals in the power bus compartment.
- The main power cell door shall have a viewing window through which the operator can verify that the isolating switch is open.
- The isolating switch shall only have the ability to interrupt the no-load (magnetizing) current of the control power transformer(s) (CPT) and/or potential transformers (PTs) supplied inside the controller power cell.
- In the OFF position, the isolating switch shall provide a means of grounding appropriate medium voltage power cell components, bleeding off hazardous stored energy, thus providing safe operation and maintenance.
- Three rating sizes shall be available: 400 amp, 600 amp, and 800 amp.
- One or more normally open (N-O) and normally closed (N-C) auxiliary contacts shall be arranged to open the secondary circuit of the control power transformer (CPT) and/or potential transformers (PTs), to de-energize the control circuit. This is to ensure there is no load on the isolating switch when it is opened or closed. The contacts shall also prevent backfeeding through the CPT and/or PTs and isolate the power cell when the control circuit is in the TEST mode. It shall only be possible to operate the TEST control circuit when the isolating switch is in the open position.
- The isolating switch shall remain connected to the external operating handle at all times.
- The isolating switch must be mechanically and electrically interlocked with the main contactor.
- The external isolating switch operating handle shall have provisions to be padlocked, with up to three (3) padlocks in the open position and one (1) padlock in the closed position. The closed position shall be located and marked, but shall be drilled out by the USER to allow insertion of the padlock.
- The power cell door on each controller shall be interlocked with the isolating switch such that the door(s) cannot be opened when the isolating switch is fully closed, and the isolating switch cannot be closed with the door(s) open (without circumventing the interlock using a tool).

8.0 Equipment Design and Selection (cont.)

Main Isolating Switch (Combination Controller Only) (cont.)

Interlocking

Mechanical interlocking, including cable interlocks, horizontal and vertical ram interlocks, shall be provided to prevent the opening of any power cell door or medium voltage compartment until the non-load-break isolating switch is fully in the open position and power is removed (the external operating handle must be in the OFF position).

Optional key interlocks configured to operate with the operating handle or power cell door shall be available when interlocking is required with another specified device, i.e. main breaker, load-break switch, starter, etc.

Vertical Bus (Combination Controller Only)

Vertical power bus risers shall be provided from the main horizontal power bus to the isolating switch line terminals. Cabling from main horizontal power bus to isolating switch is not acceptable. If cabling must be used, ensure the cable is braced appropriately to withstand a fault condition, and is a minimum of 76 mm (3 inches) from the nearest component.

Power Fuses and Fuse Holders (Combination Controller Only)

R-rated current limiting power fuses shall be provided. R-rated fuses shall be used for the short circuit protection of medium voltage motors and motor controllers.

The medium voltage product shall have fixed power fuse holders that are separately mounted in the power cell, not on the contactor, and be located to allow easy inspection and replacement without any disassembly. The power fuses shall have a spring actuated blown fuse indicator. The power fuse size shall be selected when motor data and the protective device characteristics are known.

8.0 Equipment Design and Selection (cont.)

Control Power Transformer

The control power shall be 120 V AC and shall be obtained from a control power transformer (CPT) located in each controller power cell, or from a separate control source. As standard, the dry-type CPT shall be 500 VA in size with 350 VA extra capacity for the customer's use when the standard control circuit is supplied and shall have primary and secondary fuses. Optional sizes of 1000 VA, 2000 VA and 3000 VA control power transformers shall also be available.

The secondary circuit of the transformer(s) shall be disconnected from the control circuit by means of the isolating switch auxiliary contacts. This is to prevent backfeeding through the transformer(s) and to isolate the power cell when the control circuit is in the TEST mode.

The standard control power transformers used in the controller shall be a compensated type with an output accuracy of approximately 4% over nominal at no load. They shall be designed to maintain voltage at in-rushes of up to 600%, which results in a 2% overvoltage at full load.

Primary Fuses

The primary side of the control power transformers and/or potential transformers shall be protected by current limiting fuses sized according to requirements. The interrupting rating of the primary fuses shall be 50 kA symmetrical.

Secondary Fuses

The secondary side of the control power transformer and/or potential transformers shall be fused appropriately to protect the transformer(s) from overloads. The standard control circuit shall have one leg of the secondary grounded.

8.0 Equipment Design and Selection (cont.)

Current Transformer

The medium voltage power cell shall include three (3) current transformers of sufficient VA capacity to meet the requirements of all the devices connected to them.

Each current transformer shall have the primary rating sized appropriately in relation to the full load current rating of the motor or feeder. The secondary of the current transformers shall have a five (5) amp output and an accuracy suitable for the type and quantity of protection or metering devices connected to it. All current transformer control wiring shall be terminated on the current transformer with locking type, fork tongue lugs.

An appropriate load termination location shall be provided to accommodate lugs with single or two- (2) hole mounting, for connection of the load cables, when either bar or donut type current transformers are supplied.

The power cell shall have provisions to locate a toroid (donut) style, ground fault sensing current transformer, when the zero sequence ground fault protection feature is required.

8.0 Equipment Design and Selection (cont.)

Control Module • Logic Design Feature

Mechanical

The control module shall be designed for integral mounting on the power structure and shall be compatible with the full range of current ratings – up to 800 A.

The control module shall consist of a power supply, logic control circuitry, silicon controlled rectifier (SCR) firing circuitry, I/O circuitry, a digital programming keypad, a backlit LCD display, and a serial communication port.

The control module shall be easily removed from the power structure, without the need to disassemble associated printed circuit board assemblies.

Programming and Display

Digital parameter adjustment shall be provided through a built-in keypad. Analog potentiometer adjustments are not acceptable. A built-in alphanumeric, backlit LCD display shall be provided for controller set-up, diagnostics, status, and monitoring. The display shall be two-line, 16-characters minimum.

Communications

A serial communications port shall be provided as standard. Optional communications protocol interface modules shall be available for connection to Remote I/O, DH485, DeviceNet™, ControlNet™, RS-232/422/485, Modbus Plus and Profibus.

8.0 Equipment Design and Selection (cont.)

Control Module • Logic Design Feature (cont.)

Electrical

The control module shall provide digital microprocessor control and supervision of all controller operation, including SCR pulse firing control.

The logic provides one of the following sets of functions within a single controller:
- Soft Start with Selectable Kick-Start
- Current Limit with Selectable Kick-Start
- Dual Ramp
- Full Voltage

Any one of the following options may be added to the MV Soft Start Controller standard functions listed:
- Soft Stop
- Pump Control
- Preset Slow Speed
- SMB™ Smart Motor Braking
- Slow Speed with Braking

The acceleration ramp time shall be programmable from 0 to 30 seconds.

The initial torque shall be programmable from 0% to 90% of locked rotor torque.

Kick-start, selectable with soft start or current limit function, shall provide an adjustable time pulse of current limit prior to the normal start mode. The current shall be held at 550% of the full-load current for a time between 0.0 and 2.0 seconds. This feature shall be field selectable.

SCR Pulse Firing Control

The SCRs shall be protected from voltage transients with an R-C snubber network to prevent false SCR firing.

The SCRs shall be protected from overvoltage with voltage threshold gating circuitry.

The SCR firing circuitry shall be fully isolated from the control circuits. Fiber optic cables shall be used for isolation from the logic circuits.

Self-powered gate driver boards shall be utilized to increase efficiency of the controller, reducing power consumption and heat.

8.0 Equipment Design and Selection (cont.)

Control Module • Logic Design Feature (cont.)

Monitoring

The controller shall provide the following monitoring functions indicated though the built-in LCD display:

- Phase-to-phase supply voltage
- Three-phase line current
- Elapsed time
- Motor thermal capacity usage

Protection and Diagnostics

The following protection shall be provided as standard with the controller:
- Power loss (with phase indication; pre-start)
- Line fault (with phase indication; pre-start) advising:
  - Shorted SCR
  - Missing load connection
- Line fault (running protection) advising:
  - Power loss
  - Shorted SCR
  - Missing load connection
- Voltage unbalance ❶
- Phase reversal ❶
- Undervoltage ❶
- Overvoltage ❶
- Stall ❶
- Jam ❶
- Overload ❶
- Underload ❶
- Excessive starts/hour ❶
- Open gate (with phase indication)
- Overtemperature

❶ These protective features shall be defeatable.

When these conditions are detected, starting the controller shall be inhibited or the controller shall be shut down if it is operating.

8.0 Equipment Design and Selection (cont.)

Control Module • Logic Design Feature (cont.)

Overload Protection

- The control module shall meet applicable standards as a motor overload protective device
- Three-phase current sensing shall be utilized; the use of two current transformers shall be unacceptable.
- Overload trip classes of 10, 15, 20 and 30 shall be provided and user-programmable.
- Electronic thermal memory shall be provided for enhanced motor protection
- Protection shall be available through the controller while in bypass configuration
- Separate overload relay shall be provided for emergency bypass operation

Control Options

Soft Stop

- The Soft Stop option shall provide a voltage ramp down for extended motor stopping times.

- Soft Stop shall be initiated by a dedicated Soft Stop input. A coast-to-rest stop shall still be possible with a separate stop input.

- The Soft Stop time shall be user adjustable from 0 to 60 seconds.

Pump Control

- The Pump Control option shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping. This shall aid in eliminating the phenomena commonly referred to as "water hammer". Methods utilizing Soft Start with Soft Stop shall not be acceptable.

- Closed loop control shall be achieved without using external sensors or feedback devices.

- Pump Stop shall be initiated by a dedicated Pump Stop input. A coast-to-rest stop shall still be possible with a separate stop input.

- The Pump Stop time shall be user adjustable from 0 to 120 seconds.

8.0 Equipment Design and Selection (cont.)

Control Options (cont.)

Preset Slow Speed

- The Preset Slow Speed option shall provide two jog speeds in the forward direction: high (15% of base speed), and low (7% of base speed).
- Two jog speeds shall also be available in the reverse direction: high (20% of base speed), and low (10% of base speed).
- Reverse operation of the motor shall be achievable in the jog mode without the use of a reversing contactor.
- The starting current for the slow speed operation shall be user adjustable from 0 to 450% of the motor's full-load current rating.
- The running current for the slow speed operation shall be user adjustable from 0 to 450% of the motor's full-load current rating.

SMB Smart Motor Braking

- The SMB Smart Motor Braking option shall provide braking torque to the motor to shorten the time period for the motor to come to rest.
- Braking shall be achieved without using additional equipment such as resistors or contactors.
- The controller shall bring the motor to rest and automatically shut it down when zero speed is sensed.
- Additional equipment, such as tachometers, encoders or speed switches shall not be required for sensing a zero-speed condition.
- Braking shall be initiated by a dedicated brake input. A coast-to-rest stop shall still be possible with a separate stop input.
- The strength of the braking torque shall be user adjustable from 0 to 400% of the motor's full load current rating.

Note: Only one control option may be selected when ordering.

Note: Soft Stop, Pump Control and SMB Smart Motor Braking are not intended to be used as emergency stopping means. Refer to the applicable standards for emergency stop requirements.

Note: Dual Ramp Starting is not available when a control option is specified.

9.0 Transportation and Equipment

Delivery Times

Estimated drawing and shipment delivery times are based on receipt of all information at time of order.

Shipment of equipment will commence approximately ____ weeks after the Seller receives a written purchase order. Actual on-site delivery will depend on where the site location is.

Unless specified, transportation is determined by the Seller based on shipment by the lowest cost carrier.

Loading Equipment

As standard, the Seller must utilize tractors and trailers equipped with air-ride features, reducing the chance of damage and the need for extra packaging. All trailers shall have logistic posts allowing the most secure loading.

Special Packaging Requirements (optional)

The Seller must use custom-designed crates to reduce the possibility of air or sea transit damage, and offer vacuum shrink-wrap to eliminate moisture or humidity damages.

10.0 Commissioning

Start-Up Commissioning Services (Optional)

Start-up will be performed at the User's site.

The Seller will provide the following:

- A pre-installation meeting with the User to review:
  – The start-up plan
  – The start-up schedule
  – The starter's installation requirements
- Inspect the starter's mechanical and electrical devices enclosed.
- Perform a tug test on all internal connections within the starter and verify wiring.
- Verify critical mechanical connections for proper torque requirements.
- Verify and adjust mechanical interlocks for permanent location.
- Confirm all sectional wiring is connected properly.
- Re-verify control wiring from any external control devices.
- Set up auxiliary equipment with customer supplied parameters.
- Exercise the starter in Test Mode (combination controllers).
- Confirm cabling of starter to Motor and Line Feed.
- Apply Medium Voltage to the starter and perform operational checks.
- Run the starter motor system throughout the operational range to verify proper performance.
- User's personnel shall be required on-site to participate in the start-up of the system.

Start-up service is to be quoted at a per diem rate with an estimate of time required for commissioning.

On-site Training (Optional)

The Seller shall provide a qualified instructor to provide the User's personnel with training that is specific to the Starter system installed at the User's facility. The training session will be one (1) day in duration and will be customized for the User's needs. Manuals and documentation are provided for each participant, to a maximum of eight participants per class.

The training will cover the following topics:

- Basic motor theory
- Starter hardware
- Contactor hardware
- Hardware replacement procedures
- Power device replacement procedures
- Fault analysis and troubleshooting
- Preventative maintenance procedures

Time will be spent on lecture and hands-on training if user's equipment is available. Demos are not provided.

11.0 Basic Data Sheets Specifications

Electrical Ratings	UL/CSA/NEMA	IEC
Power Circuit		
Method of Connection	Motor in delta or star; SCRs between windings and supply	
Number of Poles	Equipment designed for three phase loads only	
Rated Voltage (Ur)	2400 V AC (-15%, +10%) 3300 V AC (-15%, +10%) 4200 V AC (-15%, +10%) 6900 V AC (-15%, +10%)	3.6 kV 7.2 kV
Rated Insulation Voltage (Ui)	2500 V 5000 V 7200 V	3.6 kV 7.2 kV
Rated Impulse Voltage (Uimp)	60 kV	(3.6 kV) 40 kV (7.2 kV) 60 kV
Dielectric Withstand	(2500 V) 7,625 V AC (5000 V) 13,250 V AC (7200 V) 18,200 V AC	(3.6 kV) 10 kV (7.2 kV) 20 kV
Repetitive Peak Inverse Voltage Rating	2500 V max. 6,500 V (2 SCRs per phase) 5000 V max. 13,000 V (4 SCRs per phase) 7200 V max. 19,500 V (6 SCRs per phase)	
Output Rating	100 to 9000 hp	75 to 6714 kW
Semi-Conductor Isolation	Fiber optic	
Operating Frequency	50/60 Hz	50/60 Hz
dv/dt Protection	RC Snubber Network	
Transient Protection	Integrated overvoltage trigger circuit	
Rated Current	180 A 360 A 800 A	
dv/dt	180 A 1000 V/µs 360/800 A 2000 V/µs	
di/dt	180/360/800 A 200 A/µs	
Voltage Drop «L» to «T»	2.5 V per SCR without bypass; Less than 1.0 V with bypass, total	
Overall Efficiency	99.95% with bypass	
Starting Torque	0 to 90% of motor torque	
Thermal Capacity	600%, 10 seconds (2 starts per hour, 5 minutes between starts) 450%, 30 seconds (2 starts per hour, 5 minutes between starts)	
Ramp Time	0 to 30 seconds (Consult Factory for Longer Time)	
Acceleration Kick	550% for 0.0 to 2.0 seconds	
Approvals	UL E102991 CSA LR12235-368	Safety : C703ALB1-ABS Ref : BSEN 61010-1 :1993 BSEN 60204-1 :1997 EMC : TI/061/1198 Ref : EN 50081-1 :1993 EN 50082-2 :1995

11.0 Basic Data Sheets (cont.) Specifications (cont.)

Electrical Ratings (cont.)	UL/CSA/NEMA	IEC
Short Circuit Protection		
The power electronics unit must be protected by current-limiting fuses (included in existing customer starter with 1560D). The combination controller includes appropriate fusing (coordinated with motor).		
Fault Level Withstand as a Fused (E2) Controller NEMA E2	2400 V 4160 V 4600 V 6900 V	200 MVA Sym 350 MVA Sym 400 MVA Sym 570 MVA Sym
Control Circuit		
Rated Operation Voltage	120/240 V AC (-15%, +10%)	110/230V ~ (-15%, +10%)
Dielectric Withstand	1600 V AC	2000 V ~
Operating Frequency	50/60 Hz	50/60 Hz
Power Requirements		
Control Module	40 VA	
Gate Driver Boards	Self-powered	
Contactor	See Contactor Specifications	
Enclosure		
Enclosure Type	NEMA Type 1, 1G, 12 and 3R	IP 40, 30, 54 and 34
Auxiliary Contacts (Control Module)		
Rated Operation Voltage (Max.)	240 V AC 28 V DC (resistive)	240 V ~ 28 V DC (resistive)
Rated Insulation Voltage	N/A	240 V ~
Dielectric Withstand	1600 V AC	2000 V
Operating Frequency	50/60 Hz	50/60 Hz
Utilization Category	B300 (terminals 18-19) C300 (terminals 18-20) C300 (terminals 29-30)	AC-15
Mechanical Ratings		
Terminals	Control Terminals : M 3.5 x 0.6 Pozidriv screw with self-lifting clamp plate	
SCPD Performance	Type 2	
SCPD List	Class CC 8A @ 1000 A Available Fault Current	
SCANport		
Maximum Output Current	110 mA	

11.0 Basic Data Sheets (cont.)

Specifications (cont.)

Environmental Ratings	UL/CSA/NEMA	IEC
Operating Temperature Range	0°C to 40°C (32°F to 104°F)	
Storage and Transportation Temperature Range	-20°C to +75°C (-4°F to 149°F)	
Altitude	1000 meters (3,300 feet)	
Humidity	5% to 95% (non condensing)	
Pollution Degree	2	
Seismic (UBCRating) ❶	1, 2, 3, 4	

❶ Some units may require special bracing. Contact factory for more information.

❶ Starter Deratings

Altitude Range	Power Cell Rating				Reduce B.I.L. Withstand Rating By:
	180 A	360 A	600 A	800 A	
	Reduce Max. Continuous Current Rating By:				
1000 to 2000 m (3,300 to 6,600 ft.)	5 A	10 A	15 A	20 A	6.0 kV
2001 to 3000 m (6,601 to 9900 ft.)	10 A	20 A	30 A	40 A	12.0 kV
3001 to 4000 m (9,901 to 13,200 ft.)	15 A	30 A	45 A	60 A	18.0 kV
4001 to 5000 m (13,201 to 16,500 ft.)	20 A	40 A	60 A	80 A	24.0 kV

11.0 Basic Data Sheets (cont.) Specifications (cont.)

Area Available for Cable Entry/Exit

Structure Code	Voltage	Top		Bottom	
		Line	Load	Line	Load
14.1	2300 – 4160 V	5.68 X 9.00 (144 X 229)	Combined with line	5.68 X 9.00 (144 X 229)	Combined with line
14.3	6900 V	5.68 X 12.55 (144 X 319)	Combined with line	5.68 X 12.55 (144 X 319)	Combined with line
14.5	All	5.68 X 12.55 (144 X 319)	Combined with line	5.68 X 12.55 (144 X 319)	Combined with line
14.21	2300 – 4160 V	5.68 X 5.68 (144 X 144)	5.68 X 9.00 (144 X 229)	5.68 X 9.00 (144 X 229)	5.68 X 9.00 (144 X 229)
14.23	6900 V	5.68 X 9.00 (144 X 229)	5.68 X 9.00 (144 X 229)	5.68 X 5.68 (144 X 144)	5.68 X 9.00 (144 X 229)
14.25	2300 – 4160 V	5.68 X 9.00 (144 X 229)	5.68 X 9.00 (144 X 229)	5.68 X 9.00 (144 X 229)	5.68 X 9.00 (144 X 229)
14.27	All	5.68 X 9.00 (144 X 229)	7.25 X 15.88 (184 X 403)	5.68 X 9.00 (144 X 229)	7.25 X 15.88 (184 X 403)

Dimensions are in inches (mm).

Cable Quantity and Size

Bulletin	Size	Structure Code	Unit Size Inches (mm)	Max. No. & Size of Incoming cables-no bus	Max. No. & Size of Incoming Cables-w/bus	Max. No. & Size of Exiting Load Cables
1560D	200/400A	14.1	26 W X 91 H (660 X 2311)	(1) 500/ (2) 250mcm/phase	(1) 500/ (2) 250mcm/phase	(1) 500/ (2) 250mcm/phase
1560D	200/400A	14.3	36 W X 91 H (914 X 2311)	(1) 500/ (2) 250mcm/phase	(1) 500/ (2) 250mcm/phase	(1) 500/ (2) 350mcm/phase
1560D	800A	14.5	44 W X 91 H (1118 X 2311)	(1) 500/ (2) 250mcm/phase	(1) 500/ (2) 250mcm/phase	(1) 500/ (2) 350mcm/phase
1562D	200/400A	14.21	36 W X 91 H (914 X 2311)	(1) 500/ (2) 250mcm/phase	(1) 750/ (2) 500mcm/phase	(1) 500/ (2) 350mcm/phase
1562D	200/400A	14.23	62 W X 91 H (1575 X 2311)	(1) 500/ (2) 250mcm/phase	(1) 500/ (2) 250mcm/phase	(1) 500/ (2) 250mcm/phase
1562D	600A	14.25	80 W X 91 H (2032 X 2311)	(1) 750mcm/phase	(1) 750/ (2) 500mcm/phase	(1) 500/ (2) 350mcm/phase
1562D	800A	14.27	100 W X 91 H (2540 X 2311)	(1) 750mcm/phase	(1) 750/ (2) 500mcm/phase	(1) 1000/ (2) 750/ (4) 500mcm/phase

Notes:

1. Restrictions based upon single conductor cable.
2. Please contact factory for multiple conductors, shielded, or other specialized cables.
3. Please contact factory if the maximum number/size needs to be exceeded. We can accommodate special requests by incorporating landing pads (if room is available) or cable terminating units.
4. The customer is responsible to size the cables and conduits in accordance with applicable installation codes.

11.0 Basic Data Sheets (cont.) Specifications (cont.)

Shipping Weights and Dimensions ❶

Current Rating	Horsepower (kW)					Dimensions in inches (mm)			Shipping Weight	
	2400 V	3300 V	4200 V	6600 V	6900 V	Width	Depth	Height	lb	kg
Bulletin 1560D										
200 A	800 (600)	1000 (746)	1250 (933)	–	–	26 (660)	36 (914)	91 (2315)	800	363
400 A	1500 (1119)	2250 (1679)	2750 (2051)	–	–					
Bulletin 1560D										
200 A	–	–	–	2250 (1678)	2500 (1865)	36 (914)	36 (914)	91 (2315)	1220	554
400 A	–	–	–	4500 (3357)	5000 (3730)					
800 A	3500 (2611)	5000 (3730)	6000 (4476)	9000 (6714)	9000 (6714)	44 (1117)	36 (914)	91 (2315)	1330	590
Bulletin 1562D										
200 A	800 (600)	1000 (746)	1250 (932)	–	–	36 (914)	36 (914)	91 (2315)	1400	636
400 A	1500 (1119)	2250 (1679)	2750 (2051)	–	–					
Bulletin 1562D										
200 A	–	–	–	2250 (1676)	2500 (1865)	62 (1575)	36 (914)	91 (2315)	2295	1042
400 A	–	–	–	4500 (3357)	4500 (3357)					
Bulletin 1562D										
600 A	2750 (2051)	4000 (2984)	4500 (3357)	–	–	80 (2032)	36 (914)	91 (2315)	2325	1056
800 A	3500 (2611)	5000 (3730)	6000 (4476)	9000 (6714)	9000 (6714)	100 (2540)	36 (914)	91 (2315)	4000	1816

❶ Weights and dimensions are approximate. Certain options (such as PFCC) will change weight and dimensions. Contact factory for certified dimensions and weights.

Note: Contact factory for dimensions and weights for 1562M, 1562DM and 1566D.

11.0 Basic Data Sheets (cont.)

Specifications (cont.)

Description	Specifications	
Main Horizontal Power Bus		
Bus Bar Material	Tin-plated copper	
Optional Bus Bar Material	Silver-plated copper	
Continuous Current Rating at 40°C (104°F)	1200, 2000 and 3000 A	
Maximum Full Load Temperature Rise	65°C (149°F)	
Maximum Full Load Temperature	105°C (221°F)	
Fault Withstand Current Rating (4.5 Cycles)	60 kA RMS SYM (96 kA ASYM)	
Type of Bus Bracing	Molded glass polyester Anti-hygroscopic	
Dimensions per Phase	1200 A	Qty 1 – 6 x 100 mm (1/4 x 4 in)
	2000 A	Qty 2 – 6 x 100 mm (1/4 x 4 in)
	3000 A	Qty 2 – 9.5 x 127 mm (3/8 x 5 in)
Cross Sectional Area per Phase	1200 A	65 mm^2 (1.0 in^2) total
	2000 A	129 mm^2 (2.0 in^2) total
	3000 A	242 mm^2 (3.75 in^2) total
Insulating Material Between Phases and Ground	Air (Standard)	
Optional Insulation Material for Main Horizontal Bus	Type :	Sleeve, heat shrink
	Material :	Polyolefin
	Thickness :	1.4 mm (0.055 in)
	Anti-hygroscopic :	0.5 to 1%
	Electrical Strength :	900 V/mil
Vertical Power Bus		
Bus Bar Material	Tin-plated copper	
Continuous Current Rating at 40°C (104°F)	400, 600 and 800 A	
Fault Withstand Current Rating (½ cycle)	50 kA RMS SYM (80 kA ASYM)	
Insulation Material for Vertical Bus	Type :	Sleeve, heat shrink
	Material :	Polyolefin
	Thickness :	1.14 mm (0.045 in)
	Anti-hygroscopic :	0.5 to 1%
	Electrical Strength :	900 V/mil
Ground Bus		
Ground Bus Material	Bare copper	
Optional Ground Bus Material	Tin-plated copper	
Continuous Current Rating at 40°C (104°F)	600 A	
Dimensions per Phase	600 A	6 x 51 mm (1/4 x 2 in)
Cross Sectional Area	600 A	32 mm^2 (0.5 in^2) total

11.0 Basic Data Sheets (cont.)

Specifications (cont.)

Description	Specifications
Power Fuses and Fuse Holders	
This section details the power fuse and fuse holder technical information that each medium voltage product conforms to. It includes information on R-rated fuses, as well as mounting dimensions.	
Fuse Types	
R Rated : 2R to 24R	A480R – 5.0/2.4 kV
2R to 24R	A072 – 7.2 kV
19R, 38R	A051B – 5.0/2.4 kV
Interrupting Ratings : 2.4 kV to 7.2 kV	50 kA RMS SYM (80 kA RMS ASYM)
Mounting (Center) Dimensions	
Clip-On	304.8 mm (12.0 in)
Bolt-On	454.2 mm (17.88 in)

Maximum Heat Dissipation (kW) (Convection)

Controller Rating	Start or Stop Cycle (@ 450% Starting Duty)			Continuous
	180 A	**360 A**	**800 A**	
2500 V	13.5	19.2	45.3	.250
5000 V	27.0	38.5	90.5	.250
7200 V	40.5	57.7	136.0	.250

Power Losses

	Current (A)	Fuse Size	Losses (kW) ± 10%
Power Cell Losses	90	6R	.125
	180	12R	.350
	240	18R	.510
	360	24R	1.000
	600	57X	1.500
	800	76X	2.000

	Bus Rating (A)	Fully Loaded Bus Losses per 915 mm (36 in.) Section (Watts) ±%
Power Bus Losses	1200	150
	2000	200
	3000	200
Control Power Transformer Losses	The losses from a 500 VA control power transformer fully loaded is approximately 50 W per controller.	
Low Voltage Panel Losses	The losses from the standard control circuit is approximately 25 W per controller.	

11.0 Basic Data Sheets (cont.)

Specifications (cont.)

Description		Specifications	
Vacuum Contactors			
The following specification outlines the minimum requirements of the 400 Amp and 800 Amp vacuum contactor design used in the medium voltage product line.			
		Contactor Ratings	
		400 A	**800 A**
Rated Open Continuous Current (Amps)		400	800
Maximum Rated Voltage (kV)		7.2	7.2
Short-Circuit Interrupting Current Rating	2400 V (RMS SYM Amps)	6300	12000
	5000 V (RMS SYM Amps)	6300	12000
	7200 V (RMS SYM Amps)	6000	12000
Short-Circuit Interrupting MVA Rating	2400 V (SYM MVA)	25	50
	5000 V (SYM MVA)	50	100
	7200 V (SYM MVA)	75	150
Short-Circuit Withstand at Rated Voltage	Current Peak ½ cycle (kA)	60	85
Dielectric Voltage Withstand Rating	For 60 seconds (kV)	18.2	18.2
Make and Break Capability at Rated Voltage (kA)		4.0	8.0
Short Time Current Rating Capability	For 1 second (kA)	6.0	12.0
	For 30 seconds (kA)	2.4	4.8
Basic Impulse Level (B.I.L.) Withstand	Phase to Ground, Phase to Phase (kV)	60	60
Mechanical Life (Operations) x 1000	Electrically Held	1000	200
	Mechanical Latch	100	100
Electrical Life (Operations) x 1000		1000	200
Standard Altitude Rating	(Meters)	1000 ❶	1000 ❷
	(Feet)	3300 ❶	3300 ❷
Chopping Current (Average RMS Amps)		0.5	0.5
Switching Frequency (Operatings per hour)	Electrically Held	600	600
	Mechanical Latch	300	300
Coil Inrush Current at 120 V AC (Amps)	Electrically Held	7.3	12.8
	Mechanical Latch	11.5	12.8
Coil Continuous (Economized) Current at 120 V AC (Amps)		0.13	0.31
Coil Pick-Up Voltage (V AC)		102 ❸	102 ❸
Coil Drop-Out Voltage (V AC)		75	75

❶ The maximum altitude rating is 5000 m (16,500 ft) with factory-installed spring options.

❷ The maximum altitude rating is 5000 m (16,500 ft.) with field adjustable spring adjustment.

❸ The AC control voltage is rectified for the contactor coils.

11.0 Basic Data Sheets (cont.)

Specifications (cont.)

Description		Specifications	
		400 A	800 A
Vacuum Contactors (cont.)			
Maximum Closing Time (Input)	120 V AC (60 Hz) (Cycles)	13	13
	110 V AC (50 Hz) (Cycles)	11	11
Maximum Opening Time (Normal Drop Out) (Input)	120 V AC (60 Hz) (Cycles)	10	15
	110 V AC (50 Hz) (Cycles)	8	12.5
Maximum Closing Time (Bypass)	120 V AC (60 Hz) (Cycles)	13	13
	110 V AC (50 Hz) (Cycles)	11	11
Maximum Opening Time (Fast Drop Out) (Bypass)	120 V AC (60 Hz) (Cycles)	< 3	< 6
	110 V AC (50 Hz) (Cycles)	< 3	< 5
Contact Gap (New Bottle)	(mm)	4.8	6.3
	(inches)	0.190	0.25
Contactor Weight	(kg)	21.8	42
	(lb)	48	93
Auxiliary Contacts on the Vacuum Contactor	Normally Open	2	2
	Normally Closed	2	2
Auxiliary Contact Rating		A600	2 x 600 ❶

❶ Two auxiliary contacts rated at 10 amps, 600 V.

Description	Specifications
Control Wire	
All Medium Voltage structures shall be equipped with control wire which meets the following specifications:	
Type	TEW, Stranded Copper Wire
AWG Size (Control Circuit)	#14 AWG – 1.5 mm^2
AWG Size (Current Transformer Circuit)	#12 AWG – 2.5 mm^2
Number of Strands	19
Maximum Voltage Rating	600 V
Maximum Rated Temperature	105°C (221°F)
Terminal Blocks	1492-CA1, -CA3
Control Relays	700F, 700P

11.0 Basic Data Sheets (cont.)

Specifications (cont.)

Description	Specifications
Power Wire	
Power wire used to feed the primary of the control power transformer or potential transformers is as follows :	
AWG Size	#8 AWG
Type	Alcatel Excelene XLPE MV90
Insulation Rating ❶	5.0 kV
Maximum Temperature Rating	90°C (194°F)

The controller shall be wired with the following non-shielded, stranded wire type, based on the current ratings :

Controller Rating (Amps)	AWG Size	Type	Insulation Rating ●	Maximum Temperature Rating
200	#2	EP-CSPE MV90	5.0 kV	90°C (194°F)
400	#4/0	EP-CSPE MV90	5.0 kV	90°C (194°F)
600	(2) x #4/0	EP-CSPE MV90	5.0 kV	90°C (194°F)
800	(2) x 350 kcmil	EP-CSPE MV90	5.0 kV	90°C (194°F)

❶ For 7.2 kV rated controllers, #8 AWG — 8.0 kV EP-CSPE MV90, non-shielded stranded cable is used.

❷ For 7.2 kV rated controllers, #2 AWG, #4/0 AWG, or 350 kcmil MCM — 8.0 kV EP-CSPE MV90, non-shielded stranded cable is used.

12.0 References

Publication Number	Title
1500-2.0	Specification Guide • Motor Starters
1500-2.20	Test Procedures for Medium Voltage Products
1557-2.2	Specification Guide • Variable Frequency Drives
1560D-1.0	Product Brochure • MV Dialog Plus
1560D-1.2	Product Profile • MV Dialog Plus
1560D-5.1	User Manual • MV Dialog Plus 1560/1562D
150-1.9	Utilizing Solid-State Reduced Voltage Starters for Electrical Pump Control
150-2.6	Starting Solutions – Solid-State vs. Electromechanical Starters
6222	Rockwell Automation Quality System
6500	Terms and Conditions
Internet	www.ab.com/mvb

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