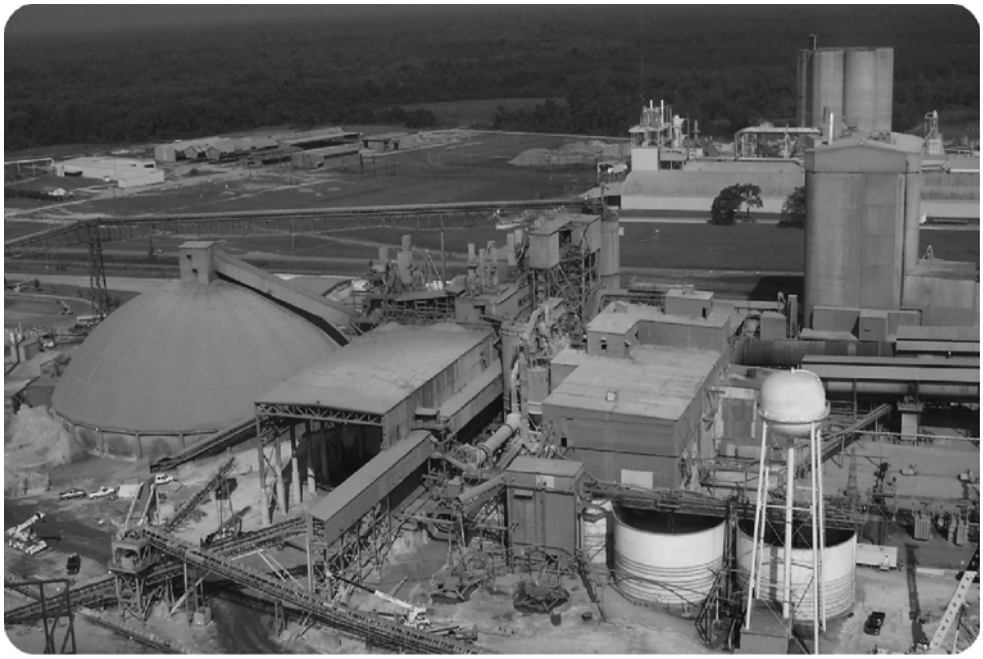
Specification Guide

Allen-Bradley

Medium Voltage Motor Controllers

Publication 1500-SR020I-EN-P



Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

This manual contains new and updated information.

New and Updated Information

This table contains the changes made to this revision.

Topic	Page
Added ground bus description to bus design	8
Edited arc resistant enclosure design from Type 2 to Type 2B	10
Added High Altitude Application heading	13
Update Final Drawings and Manuals delivery method	14
Added printed circuit board specification	15
Updated top entry and exit “Important” tables	19
Inserted Custom Colors information	19
Updated Arc Resistant Enclosure information	21
Updated Ground Bus dimensions	22
Added 240 VAC and all DC control circuit information	26
Updated SyncPro II input current specifications	32
Updated E1 to E1 Plus	38
Added PowerMonitor 5000 to Unit Protection options	38
Added clarification to Fault Withstand Current Rating, Specifications table	45
Removed Class E2 Controller ratings from Specifications table	45
Updated Main Horizontal Power Bus and Ground Bus in Specifications table	46
Added 80 kA ASYM to Short Circuit Withstand Rating	46
Updated Fuse Types in Specifications table	47
Updated Current Ratings in Bulletin 1502 MV 400 A Ratings table	48
Updated 1-unit specifications in Controller Ratings table	57
Updated 180 A Controller Deratings	58
Replaced 1-High, 800 A Controller (Arc Resistant) image	59
Updated horizontal ground bus dimensions	62
Added Index	65

Notes:

Chapter 1

Overview

Chapter 2

Equipment Design and Selection

Overview

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 contactors, to air break and vacuum contactors, to solid-state reduced voltage controllers such as Smart Motor Controllers (SMC) and AC Variable Frequency Drives, Rockwell Automation has developed and built a medium voltage (MV) product line that satisfies those industries demanding greater 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. The Allen-Bradley CENTERLINE® family of medium voltage controllers are available for system voltage ratings from 2400…6900V, and can be applied to motors ranging in size from 75…7500 kW (100…10,000 hp).

At Rockwell Automation, we know that there is more to being a world-class supplier than just having the right product. That is why we have developed a variety of flexible delivery programs. If speed is critical to your selection, our various delivery programs may be just what you require.

Overview of CENTERLINE MV Controller Features

Low Voltage Compartment

Control Circuit

- Provision is made to connect external control power during TEST mode
- A Test Mode selector switch allows offline testing and troubleshooting of the power cell without exposing personnel to medium voltage
- Prevents backfeeding medium voltage through the control power transformer

Isolated Compartments

- All low voltage components are located in the low voltage panel
- Low voltage panel interior is painted white for better visibility
- Power cell, low voltage panel, and bus compartment are isolated from each other for improved safety

Swing Out Low Voltage Panel

- Allows for easy access to install load cables
- Maximizes low voltage panel space

Power Bus Compartment

CENTERLINE Bus Design

- All three phases mounted on a vertical plain
- Designed as an integral part of the structure
- Dissipates heat more efficiently
- Edge-to-edge configuration maximizes resistance to magnetic forces and minimizes moisture or dust collection
- Unique molded bus brace reduces maintenance and provides better distribution of forces during a fault
- A common bare copper ground bus, mounted below the power bus, runs parallel to main power bus
- Accessible without a ladder, for installation and maintenance
- Allows for incoming line cables to enter through the top or bottom of the compartment

Power Cell Compartment

Non-Load Break Isolation Switch

- Electrical and mechanical interlocks prevent the switch from opening or closing when the medium voltage vacuum contactor is energized.
- Facilitates normal medium voltage vacuum operation only when the switch is fully closed.
- Provides isolation of separate sources of power for testing when in the off position.
- Blades are grounded in the off position.

Visible Isolation

- When in the open position, a visible barrier isolates the power cell compartment from the power bus compartment.
- Status of the isolation switch can be viewed through a viewing window in the power cell door.

Handle and Interlock Mechanism

- A simple, heavy duty, direct drive mechanism improves reliability and ensures superior operator safety.
- All mechanical interlock mechanisms remain part of the enclosure to eliminate setup adjustment.

- Power cell door is interlocked with the handle mechanism to prevent the door from being opened when the cell is energized.

Isolated Cable Ducts

- Easy access for cable installation
- Ample room for stress cones
- Provides isolated load cable compartments between top and bottom power cells (two-high structures)

Current Transformers

- Donut current transformers are supplied as standard for overload protection and optional metering. (Bar-type available as an option.)

Vacuum Contactors

Modular Construction

- Horsepower rated devices are located elsewhere in the power cell, so the contactor does not limit unit ratings
- Easily removed for maintenance and repair
- Integrated control or potential transformer(s) primary fuse holders

Vacuum Bottles

- Designed to industry specifications
- Arcing confined inside vacuum bottles for ionized gas protection
- Accessible from the front of the contactor for easy inspection or maintenance
- Contact wear indicators located on each bottle eliminates the need for special wear measurement tools
- Excellent dielectric recovery provides high switching frequency (up to 600 operations per hour)

Long Electrical and Mechanical Life

- 1,000,000 electrical operations (400 A)
- 2,500,000 mechanical operations (400 A)

Low Current Chop

- No surge suppression required for most applications
- Reduces the chance of cable or motor insulation failure caused by voltage spikes

Fixed-Mounted Devices

- Fixed-mounted design eliminates the safety issues typically associated with drawout contactors

- Compact design of the contactor eliminates the need for it to be removed for maintenance
- No drawout stab-and-finger assemblies, which require additional routine maintenance

Enclosures

- Choice of NEMA (IP) environmental classification:
  - Type 1 (IP10)
  - Type 1 with gasket (IP21)
  - Type 12 (IP52)
  - Type 3R (IP34)
- Optional arc resistant design (tested to IEEE C37.20.7, Type 2B Accessibility)
  - During an arc flash, the ArcShield controller safely redirects the arc flash energy out the top of the unit and away from personnel. This level of protection is also maintained when the low voltage door is open for maintenance purposes.
- Standard, removable, lifting brackets to facilitate installation
- Two non-removable sill channels
- Full floor plates on all structures
- Paint Finishes ANSI 49, or optional ANSI 61 or other special colors available:

The medium voltage product line shall provide various starting methods and options:

Squirrel-Cage, Induction Motor Controllers	**Bulletin Numbers**
Full Voltage Reversing	1506
Full Voltage Non-Reversing	1512
Multi-Speed, Non-Reversing	1522
Solid-State Reduced Voltage	1562
Reduced Voltage Autotransformer, Non-Reversing(1)	1572
Reduced Voltage Autotransformer, Reversing	1576
Reduced Voltage Reactor, Non-Reversing	1582
Brush and Brushless Synchronous Motor Controllers	
Full Voltage Non-Reversing	1912
Full Voltage Reversing	1906

(1) Rockwell Automation also offers MV solid-state reduced voltage soft starters. Refer to publication 1560-SR022 for details.

The following custom engineered units are available upon request (for example, for wye delta, wound rotor applications, etc.)

Custom Engineered Units	
Static Exciter	1271
Multi-Speed, Reversing	1526
Part-Winding, Non-Reversing	1532
Part-Winding, Reversing	1536
Wye-Delta, Non-Reversing	1542
Wye-Delta, Reversing	1546
Reduced Voltage Reactor, Reversing	1586
Potential Transformer Disconnect	1596B
Auxiliary Component Cabinet	1599
Power Bus Corner Transition Unit	1599CU
Synchronous Part-Winding, Non-Reversing	1932
Synchronous Part-Winding, Reversing	1936
Synchronous Reduced Voltage Autotransformer, Non-Reversing	1972
Synchronous Reduced Voltage Autotransformer, Reversing	1976
Synchronous Reduced Voltage Reactor, Non-Reversing	1982
Synchronous Reduced Voltage Reactor, Reversing	1986

Scope

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

The starter shall be _____ V, 3 phase, _____ hp or _____ kW rated, and used for the starting of _____ motors (induction, synchronous, wound rotor).

The controller shall be manufactured by a single vendor.

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. 253 (harmonized with UL 347 5th Ed)
- American National Standards Institute (ANSI), Instrument Transformers C57.13
- Institute of Electrical & Electronic Engineers (IEEE)
- National Electrical Code (NEC)
- Occupational Safety & Health Act (OSHA)
- 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

IMPORTANT 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 must accept nominal plant power of 2400V, 3300V, 4200V, 4800V, 5500V, 6600V, 6900V (+5/-15%), or 7200 (+0/15%), 3 phase 50/60 Hz (± 3%).

The standard controller must operate in an ambient temperature range of 0...40 °C (32...104 °F) with a relative humidity of up to 95% (non-condensing). Higher ambient temperature conditions are supported with factory assistance.

The equipment shall be capable of being stored in an environment with an ambient temperature range of -40...85 °C (-40...185 °F).

If storage temperature fluctuates or if humidity exceeds 85%, space heaters must be used to prevent condensation. The equipment must be stored in a heated building having adequate air circulation.

WARNING: The equipment should never be stored outside.

Rockwell Automation products are built using materials that comply with Class 1: Industrial Clean Air sulfur environments as defined in IEC Standard 60654-4 (Operating Conditions for Industrial-Process Measurement and Control Equipment), and G1 as defined in ISO-S71.04-1985 (Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants).

High Altitude Application

The equipment shall operate at altitudes from 0...1000 m (0...3300 ft) above sea level, without derating. For applications above 1000 m (3300 ft), the maximum current and basic impulse levels (BIL) of the controllers shall be derated, and vacuum contactors may be compensated for operation at the specified altitude (see Table 16).

Seismic Qualifications

The controller can be provided such that it 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.

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

Obligations of Seller

Deviations

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

Drawings and Manuals

Information Drawings

Orders shall include a submittal of three 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 photocopying.

Approval Drawings

If requested at the time of order entry, approval drawings shall be available at no charge. The approval submittal shall include bond paper prints of the dimension drawing and electrical drawings supplied at the published lead time after order receipt by 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.

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

Final Drawings and Manuals

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

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 on request.

Critical Spares

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

Maintenance Spares

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

The 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) and the customer's current installed base.

On-site Inventory Agreement (Optional)

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

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 (either 100% or on a sampling basis) for a minimum of two hours at 65 °C (149 °F).

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)
- 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 medium voltage 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 starters shall be inspected for the following:

- Electrical interlocking
- Motor protection and ground fault, if applicable

Physical Inspection

The product must meet all applicable engineering and workmanship standards and specifications. All components are 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. These 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 tightness (torque).

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 Rockwell Automation Application Engineer and/or Project Manager prior to commencing the inspection. Any questions or clarifications prior to commencing the factory inspection will be addressed at this time. The Rockwell Automation Application Engineer and/or Project Manager will also review what occurs during the factory inspection.

The factory inspection consists of a customer visit to the factory with the intent to view the customer specific equipment at various stages of building existing at time of the visit. There is no preparation of the equipment in any way for the inspection, and is a means to allow the customer to verify the progress of the order without any disruption to the manufacturing cycle. No power is applied during the factory inspection.

At the conclusion of the factory inspection, the customer will reconvene with the Rockwell Automation representative to discuss any concerns or issues that arose during the inspection. The representative advises the customer at the earliest possible time with an outline of financial and/or schedule impact of the changes.

Witness Testing

A review of the electrical and mechanical drawings for the purchased equipment will be done with the Rockwell Automation representative prior to commencement of the witness test. Any questions or clarifications will be addressed at this time. The Rockwell Automation representative will also review what will occur during the witness test.

The witness test will be broken down into two individual elements:

- Equipment physical inspection
- Electrical inspections

Physical Inspection

The physical inspection consists of the following items:

- Ensure all power and ground bus connecting hardware is present and labeled
- Ensure correct engraving of unit and master nameplates
- Equipment physical layout and dimensions verified against engineering documentation
- All components are verified against engineering documentation to be present and correctly installed
- Warning nameplates, isolation barriers, and mechanical interlocks must provide sufficient safety/isolation for personnel and equipment
- Verify operation of isolation switch handle and door interlocks

Electrical Inspection

The electrical inspection consists of the following items:

- A Hi-Pot dielectric withstand test is performed on all bus work and power cables from phase-to-phase and phase-to-ground
- Control power at the rated voltage is applied to the equipment, and a functional demonstration of customer purchased options and control devices is completed
- Instruments, meters, protective devices, and associated controls are functionally tested by applying the specified control signals, current and/or voltages
- The operation of the vacuum contactor is demonstrated
- Ethernet I/P, DeviceNet, or IntelliCENTER system operation, where applicable

- **MV Reduced Voltage Solid State Controllers only**: Applying rated voltage to the equipment and connecting to a test motor in our medium voltage test facility.
  - Motor control is functionally demonstrated by starting and stopping the test motor.
- **Synchronous Starters only**: Voltage is injected into the power circuit within the controller at the secondary, and operation is demonstrated using a resistive load.

IMPORTANT There will be no medium voltage applied and the testing will be conducted in the low voltage test bay for all products except Reduced Voltage Solid State Controllers.

At the conclusion of the witness test, the customer will reconvene with the Rockwell Automation representative to discuss any concerns or issues that arose during the test. The representative advises the customer at the earliest possible time with an outline of financial and/or schedule impact of any changes identified during the witness test.

Please refer to the current Medium Voltage Price Book (publication 1500-PL030) for relative charges.

Custom Testing

The customer specifications for the customer test must be provided to Rockwell Automation at least two months prior to testing date, at which time Rockwell Automation will provide a cost and schedule impact for completing the testing requirements. This test will be priced on a per project basis, based on the scope of the test and location.

Equipment Design and Selection

Structure and Controller

The medium voltage motor controllers must consist of a single structure or a line-up of structures containing the following:

- An isolated compartment for horizontal power and ground bus
- A terminal provision to feed the bus
- Removable backplates
- An allowance for top or bottom entry of the power and/or control cables

IMPORTANT Top entry may require slightly larger arc resistant structures.

- An allowance for top or bottom exit of the load cables from the controller through isolated metal wireway

IMPORTANT Top exit may require slightly larger arc resistant structures.

- Viewing window in the power cell door
- Removable lifting angles or brackets
- Non-removable sill channels
- Paint Finishes:
  - Description: Hybrid epoxy powder paint
  - Color: ANSI 49 medium light grey (standard)
ANSI 61 light grey (optional)
Custom colors available (optional)
  - Painting: Air-atomized electrostatic spray
Total paint thickness = 0.002 in. (0.051 mm) minimum
- Appropriate starter units to meet the application requirements

The motor control center (MCC) must have provisions to enable the center to be bolted together to form a rigid, free-standing assembly, and designed to permit bus extension for future controller additions to the left and/or the right.

Each structure must have two non-removable base sill channels and removable lifting angles or brackets for ease of handling and installation.

The medium voltage controllers must be designed in two basic styles:

- 1-High: One medium voltage controller in one vertical section
- 2-High: Two medium voltage controllers in one vertical section

The structure must be divided into three isolated compartments:

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

Metal or insulating barriers must be provided between each vertical section, 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 must have access to the low voltage compartment, with the controller energized, without being exposed to any medium voltage

The medium voltage motor controllers must be for 3-phase, 3-wire, 50/60 Hz applications, rated 2400, 3300, 4160, 4800, 5500, 6600, 6900, or 7200 volts.

The medium voltage motor controller must consist of a metal-enclosed, free-standing, dead front, vertical steel structure. Each structure must contain the following items:

- Tin-plated copper horizontal power bus (optional)
- A continuous bare copper ground bus
- A main non-load break isolating switch and operating handle
- Vacuum contactor(s)
- Three current limiting power fuses for NEMA Class E2 operation
- Three current transformers
- A control power transformer
- A low voltage control panel
- Space for necessary auxiliary control and metering devices
- Top and bottom plates to accommodate cable entry/exit

Enclosure Types

The medium voltage product line must be available in a NEMA Type 1 (IEC IP10) general purpose enclosure as standard. Optional enclosures are NEMA Type 1 with door gasketing (IEC IP21), NEMA Type 12 dust tight and drip proof (IEC IP52), NEMA Type 3R outdoor (IEC IP34) non-walk-in styles or Arc Resistant. Each enclosure must be properly sized to dissipate the heat generated by the controller within the limits of the specified environmental operating conditions.

Arc Resistant Enclosure

The medium voltage motor controller must be provided with an arc resistant enclosure design (select units – consult factory for availability).

The arc resistant units will meet the requirements per IEEE C37.20.7, Type 2B Accessibility, and provide the following benefits:

- Reinforced structure, to contain arc flash material, at faults up to 40 kA, 0.5 seconds
- Plenum or chimney to redirect arc flash material
- Reinforced low voltage panel, sealed to prevent entry of arc flash material
- Full arc protection is also maintained when the low voltage door is open for maintenance purposes

Structure Finish

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

Description	Hybrid epoxy powder paint
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 in. (0.051 mm) min
Baking	Natural gas oven at 179 °C (355 °F) min

IMPORTANT When optional custom paint colors are specified (including ANSI 61), all external surfaces must be painted to the custom color requirement, except for the external isolating switch handle assembly, lifting angles, and lifting brackets.

All unpainted steel parts must be plated for corrosion resistance

Power Bus

Horizontal Bus

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

Access must 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.

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 must be used. This material must have a minimum wall thickness of 1.4 mm (0.055 in.), and provide a minimum dielectric strength of 49.5 kV.

Vertical Bus

Vertical power bus risers must be provided from the main horizontal power bus to the unit isolating switch line terminals. It must be made of tin-plated copper and rated according to the unit size.

Bus and Cable Bracing

The horizontal/vertical bus work and the cabling/bus in the main power cell must be braced and tested in accordance with NEMA ICS 3-2 and UL 347.

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

Ground Bus

A continuous bare copper ground bus must be provided along the entire length of the controller lineup. A mechanical lug for 8 - 1/0 AWG or 6 - 250 MCM cable must be supplied at the incoming end of the lineup. The standard ground bus must be 9.5 x 51 mm (3/8 x 2 in.) bare copper. Optional tin plating must be available.

Main Isolating Switch

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

- The isolating switch must 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 must have a viewing window through which the operator can verify that the isolating switch is open.
- The isolating switch must only have the ability to interrupt the no-load (magnetizing) current of the control power transformer (CPT) and/or potential transformers (PT) supplied inside the controller power cell.
- In the off position, the isolating switch must provide a means of grounding appropriate medium voltage power cell components, discharging stored energy, thus providing safer operation and maintenance.
- Three rating sizes must be available: 400 amp, 600 amp, 800 amp.
- One or more N.O. and N.C. auxiliary contacts must be arranged to open the secondary circuit of the CPT and/or PT, de-energizing the control circuit. This is to make sure there is no load on the isolating switch when it is opened or closed The contacts must also prevent backfeeding through the CPT and/or PT, and isolate the power cell when the control circuit is in the TEST mode. It must be possible to operate the TEST control circuit only when the isolating switch is in the open position. The auxiliary contacts must have a NEMA contact ratings of 2 x A600 and 2 x P600.
- The isolating switch must remain connected to the external operating handle at all times
- The isolating switch must also be mechanically and electrically interlocked with the main contactor.
- The external isolating switch operating handle must have provisions to be padlocked, with up to three padlocks in the open position, and one padlock in the closed position The closed position must be located and marked, but must be drilled out by the user to allow insertion of the padlock.
- The external isolating switch operating mechanism must have provision for a keyed mechanical locking bolt device interlock to facilitate a Locked-On or Locked-Off position
- The power cell door on each controller must be interlocked with the isolating switch such that the door cannot be opened when the isolating switch is fully closed, and the isolating switch cannot be closed with the door open (without circumventing the interlock using a tool).

Interlocking

Mechanical interlocking, including cable interlocks, horizontal, and vertical ram interlocks, must 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 mechanical key interlocks, configured to operate with the operating handle or power cell door, must be available when interlocking is required with another specified device, for example, main breaker, load-break switch, starter.

Power Fuses and Fuse Holders

Depending on the type of load, R-rated or E-rated current limiting power fuses must be provided. R-rated fuses must be used for the short-circuit protection of medium voltage motors and motor controllers. E-rated fuses are general purpose fuses and must be used in combination with an overload relay, under certain conditions, for the short-circuit protection of non-motor loads (when possible), for example, primary protection of power transformers. (R-rated fuses may also be applied to feeder type loads)

The medium voltage controller must 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 must provide visual condition indication by way of a spring-actuated blown fuse indicator. The power fuse size must be selected when load data and the protective device characteristics are known.

Vacuum Contactor Specifications

The electrically (magnetically) held or mechanically latched (optional) style medium voltage contactor must be the Allen-Bradley Bulletin 1502 vacuum type.

The following current ratings must be available:

- 400 A
- 800 A

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

Vacuum bottles and coil maintenance must be facilitated while the contactor is mounted within a power cell. Removal of contactor should not be required.

The contactor must be fixed-mounted inside the power cell. Fixed mounting provides solid, low resistance continuous contact while lowering maintenance requirements considerably. The contactor must be interlocked with the non-load-break isolating switch, both electrically and mechanically. The mechanical interlock must 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 CPT, PT, or external power source to the control circuit when the isolating switch and contactor are in the open position.

Control Wire Specifications

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

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

Low Voltage Wireway

An optional low voltage wireway must be available across the roof of the structure. There are two sizes of low voltage wireway available:

- 51 x 102 mm (2 x 4 in.)
- 152 x 152 mm (6 x 6 in.)

The low voltage wireway must 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 must have a separate, front accessible, low voltage control compartment. The compartment must 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, protection relays, selector switches, operators, indicating lights, for example, must be mounted on the front of the low voltage control panel and arranged in a logical and symmetrical manner. The low voltage panel must provide the following features:

- Space must be provided for low voltage control devices, transducers, and metering.
- Necessary terminal blocks must be supplied. Extra terminal blocks can be supplied as an option.
- The low voltage control panel must be accessible from the front without turning the controller off.
- All remote low voltage cables must be able to enter the low voltage control panel from the top or bottom of the structure. Access must be by means of removable entry plates on the top and bottom of the structure.
- Some controllers must incorporate a swing-out low voltage panel which provides easier access to the power cell to make bus splicing and load cable connections. When present, the swing-out low voltage panel must be interlocked with the power cell compartment (the panel must not have the ability to swing open until the power cell is off and isolated from the main power bus).
- The control panel supply voltage must be 120V AC or 230V AC, 50/60 Hz (as specified at time of order).
- There must be a 15 A two-pole, three-conductor (with a grounding prong) male flanged inlet plug to provide a means of connecting a two-pole, three-conductor straight blade connector from a remote 120V AC, 60 Hz supply to operate the control circuit when it is in the TEST position. 240 VAC and all DC control circuits will have segregated terminal blocks provided for test power from a remote source in lieu of the receptacle.
- IntelliVAC contactor control must be used as standard, with the following features:
  - Universal input voltage range (110...240V AC, 50/60 Hz or 110...250V DC)
  - Consistent vacuum contactor pick-up time, ensuring optimal synchronization
  - Selectable and repeatable vacuum contactor drop-out times (50, 75, 100, 130, 150, 175, 200, or 240 ms) for tighter coordination with power fuses
  - Altitude compensation (-1000...5000 m) to eliminate mechanical hardware changes at high altitude (400 A vacuum contactors)
  - Power loss ride-through (TDUV) with selectable drop out time (0.2, 0.5, 1.0, or 2.0 s)

  - Anti-kiss and anti-plugging protection
  - Status indication (LEDs and relay outputs) allows integration in control system and aids troubleshooting
  - Temporary motor jog function (separate input) to allow process set-up
  - Delayed motor re-start prevents rapid cycling of vacuum contactor, protecting the connected motor and avoiding nuisance clearing of power fuses
  - Capable of field upgrade to either IntelliVAC Plus or IntelliVAC MC (if desired)
- IntelliVAC Plus contactor control must be available as an option, building on the capabilities of IntelliVAC with the following additional features:
  - DeviceNet communication
  - DeviceLogix control
  - Eight digital inputs rated for 110...250V AC or V DC, and two outputs rated up to 250V AC or V DC, all with LEDs indicating status
  - Support for multi-contactor (MC) control schemes, with up to four slave IntelliVAC MC units connected on RS485, and DeviceLogix pre-configured for standard medium voltage controller logic (can also define Custom MC control configurations)
  - Enhanced operational information and diagnostics with features such as real-time clock, extended contactor close time monitoring, and tracking of contactor usage
  - IntelliCENTER software compatibility
  - Configurable using either RS Networx or handheld configuration terminal (Bulletin 193-DNCT) for DeviceNet
- IntelliVAC MC contactor control must be available as an option, for use in multi-contactor applications (one IntelliVAC Plus can control up to four IntelliVAC MC control modules in a master-slave configuration), with the following features incremental to IntelliVAC:
  - Communication board (with RS485) to allow IntelliVAC MC to be controlled by IntelliVAC Plus
  - Address indication (seven segment LED) for RS485

Electro-mechanical Relay Control (Optional)

- Control panel complete with electromechanical pilot control relays and DC economizing circuit to control the vacuum contactor

Control Power Transformer

The control power must be 110/120V AC or 220/240V AC, and must 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 must be 500 VA in size, with approximately 350 VA extra capacity for the customer's use when the standard control circuit is supplied. Appropriately sized primary and secondary fuses will be supplied. Optional sizes of 1000 VA, 2000 VA and 3000 VA control power transformers must also be available.

The secondary circuit of the transformer must be disconnected from the control circuit by means of the isolating switch auxiliary contacts to prevent backfeeding through the transformer and to isolate the power cell when the control circuit is in the test mode.

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

IMPORTANT	The control power transformers may be used for metering, but only if the accuracy of the application does not require conformance to any potential transformer accuracy ratings. The maximum quantity/size of the CPT available in a two-high FVNR controller rated 7200 volts is two 500 VA (with bolt-on power fuses), or one 1000 VA and one 500 VA (with clip-on power fuses).

Primary Fuses

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

Secondary Fuses

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

Primary Current Transformers

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

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

Ground Fault Current Transformer

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

Load Cable Terminations

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

Power Wire Specification

As standard, the power cell must be wired with the appropriate size of power wire based on the controller current rating. Power wire must be rated for 8 kV, regardless of the unit voltage rating.

Motor Protection Devices

For each starter unit, a Bulletin 592 thermal electromechanical, E1 Plus, E3/E3 Plus, Bulletin 825P, or Bulletin 857 solid-state motor protection overload relay must be supplied. The overload protection relay must be connected to the secondary of the three current transformers.

IMPORTANT Alternate motor protection relays must also be made available.

Undervoltage Protection

Optional undervoltage protection devices or circuits serve to protect the motor by not permitting the starter to remain energized in an undervoltage condition.

Instantaneous undervoltage protection is supplied as standard. The IntelliVAC can be configured to provide time delay undervoltage (TDUV) protection. This feature is available to keep electrically held contactors closed during a voltage dip or brief power loss. If the undervoltage condition persists beyond the set delay time, the contactor will be opened and an undervoltage fault condition will occur.

Synchronous Control (Brush-Type)

Synchronous exciter (optional) must be sized based on motor information. The table in Chapter 5 outlines the exciter sizing and SCR bridge output capability details.

- The assembly must be either three-phase or single-phase depending on the output current requirements.
  - It must have an integral single-phase or three-phase firing board
- The bridge rectifier must incorporate a solid-state field switch mounted directly on the bridge assembly. This switch must remove the discharge resistor connection at the appropriate time.
  - An integral field switch snubber assembly must be provided to provide protection and diagnostics for proper operation of the solid state switch
- The exciter must be regulated using a closed loop feedback from the DC field current. This provides a constant current based on the user setting.
  - A DC current transducer (DCCT) must be used to measure current
  - A field current adjustment potentiometer must be provided on the front of the low voltage door
  - A 3½ in. field DC ammeter must be provided on the front of the door

Rectifier Transformer

- The rectifier transformer must be integral to the controller
- It must be sized according the requirements of the field and rectifier bridge load
- The transformer must be energized/de-energized by the main MV contactor
- The transformer must have a minimum 25 kV basic impulse level (BIL) rating
- It must be dry type
- Appropriately-sized primary and secondary fuse protection must be provided
- Main power fuses for the motor controller must not be used as the primary protection for the rectifier transformer

Field Discharge Resistor

- The field discharge resistor must be mounted internal to the main structures.
  - If the resistor is too large to be mounted internally, it must be mounted on the roof of the structure in a protective enclosure.
  - If roof-mounted, the resistor and its enclosure must be removed for shipment.
- The resistor is sized-based on the motor data provided by the user at the time of order placement.
- The resistor is steel grid or wire edge wound type.

Field Application and Protection

The Bulletin 1902 SyncPro II™ programmable field application and protection system must be used for brush-type synchronous motors.

This system must consist of a Rockwell Automation programmable small logic controller (MicroLogix™ 1200) with the following additional peripheral items:

- PanelView™ 300
- Phase Angle Transducer
- Analog/Digital Pulse Board
- Conditioning Resistors
- Interposing Relays FCR and ESR
- Specialized firmware for synchronous control and protection

This system must provide supervisory protection and field control to a brush-type synchronous motor controller, proper field application timing, squirrel-cage protection against long acceleration, and stall conditions, as well as running pull-out protection by monitoring motor power factor. It must provide the following:

Protection/Control to be provided by SyncPro II

- Squirrel-cage winding protection
- Field winding application control
- Incomplete sequence
- Field voltage failure
- Auto load
- Stall protection
- Pull-out protection (power factor)
- Restart lockout

Display/Metering to be provided by SyncPro II

The product in conjunction with the PanelView 300 Micro Terminal (PV) performs the following metering/display functions:

- Display all detected fault conditions
- Display the slip frequency and starting time during startup
- Display the power factor during run mode.
- Accept set points for the following:
  - Maximum% asynchronous speed [% of synchronous speed]
  - Power factor set point and trip delay
  - Maximum allowable time at stalled state (maximum slip)
  - Maximum allowable time at 50% speed
  - Maximum allowable time at synchronizing speed (typically at 95% speed)
  - Function order (allows adjustment of the slope of the acceleration/stall time trip curve).
  - Incomplete sequence timer trip delay
  - Fault mask for PF transducer diagnostics

SyncPro II Operating Power

- Input Line Voltage
  - between 115...230V AC ±10%, 50 or 60 Hz
- Input Power Requirements
  - 5 VA
- Input Current
  - 0...5 A

Synchronous Control (Brushless Type)

- Exciter must be sized based on motor information. The following table outlines the standard exciter sizing and output capacity details.

Voltage	Maximum Current
125V DC	10 A
	20 A

- The exciter must be made up of:
  - A single phase bridge rectifier
  - A power rheostat (low voltage door-mounted)
  - A 3½ in. DC ammeter
  - DC Application Contactor
  - Timing relay
- The exciter must be powered from the main control circuit transformer of the controller.
- Control Circuit Transformer size is a minimum of 500VA

Prepared Spaces

When specified, a controller must be factory constructed with a prepared space to enable the addition of a FVNR controller, or to complete a fused load-break switch feeder (200 or 400 A) in the future, on site, using a starter/transformer kit or a load-break switch feeder kit. (Not available for arc resistant controller.)

IMPORTANT The two-high structure is the most common structure offering this prepared space feature. However, it must also be available for the one-high, 400 A FVNR structure.

Starter Prepared Spaces

When a prepared space (for a future controller) is ordered for a one or two-high structure, the following items must be supplied:

- The main non-load break isolating switch and external operating handle. A mechanical interlock must be installed to keep the switch in the open position (a label is included with each prepared space to indicate this).
- The electrical and mechanical interlocks, including the contactor interlock rod assembly and hardware.
- Appropriate barriers and wire duct for load cables.
- The power cell door with door screws and viewing window. The anodized clip on the power cell that interlocks with the operating handle is removed. This prevents the switch from closing whether the power cell door is open or closed.
- A blank low voltage door.

Load-Break Switch Prepared Spaces

When a prepared space for a 400 A fused load-break switch feeder is ordered for a two-high structure, the following items must be supplied:

- The 400 A load-break switch, shipped in the open position, including interphase barriers and Lexan cover connected to the external operating handle.

IMPORTANT	A mechanical interlock must be installed to keep the switch in the open position (a label is included with each prepared space to indicate this).

- The top power fuse support assembly without the fuse clips.
- Appropriate barriers and wire duct for load cables.
- The power cell door with door screws and viewing window. The anodized clip on the cell that interlocks with the operating handle is removed. This prevents the switch from closing whether the power cell door is open or closed.

IMPORTANT	A circuit diagram must be sent with each prepared space compartment. No structural modifications must be required when installing the starter kit or fused load-break switch feeder kit. The prepared space must be required when installing the starter kit or fused load-break switch feeder kit. The prepared space must be located in the top power cell when the load cables exit through the bottom of the structure. Installation of starter kits into prepared space locations must be completed in compliance with NFPA-70E (or equal) guidelines.

Starter/Transformer Controller Kits

When a starter/transformer controller kit is ordered to convert a prepared space power cell into a functioning medium voltage controller for motor or transformer loads, the following parts must be provided:

- The main power fuse clips, bottom fuse support, interphase barriers, and main current limiting power fuses.
- The control power transformer including current limiting power fuses.
- The main current transformers complete with barrier plates and hardware for the mounting.
- All of the necessary power and control wiring.
- The low voltage door complete with optional controls, meters, and wiring.
- The low voltage panel with the interconnecting control wiring, labels, relays, and terminal blocks.
- The main vacuum contactor mounted on a base plate, allowing for easy installation in the power cell. The contactor must include the mechanical interlocking plate ready for connection of the interlock rod assembly.

- The anodized clip for the power cell door. This allows the external operating handle to work properly.
- Instructions and identification nameplates.

The power circuit to and from the vacuum contactor must be connected in accordance with the circuit diagram provided with the starter kit. Starter kits are not available for arc resistant controllers.

400 A Feeder Load Break Kits

When a feeder kit is ordered to convert a load-break switch prepared space power cell into a functioning medium voltage 400 A fused load-break switch, the following parts must be provided:

- The main power fuse clips, bottom fuse support, interphase barriers, and main current limiting power fuses.
- The control power transformer including current limiting power fuses.
- The load terminal assembly complete with mounting/barrier plates and hardware for the mounting.
- All of the necessary power and control wiring.
- The anodized clip for the power cell door. This allows the external operating handle to work properly.
- Instructions and identification nameplates.

Feeder load break kits are not available for arc resistant controllers.

Ethernet/IP, DeviceNet, and IntelliCENTER Options

General

The medium voltage motor controller (MV MCC) must have Ethernet/IP or DeviceNet cabling integrated throughout the sections if specified. Each motor starter and soft starter in the MV MCC line-up can communicate via Ethernet/IP or DeviceNet, and has the capability of monitoring at least two devices in each starter.

Cable

Ethernet/IP

The Ethernet cable used must be 600V shielded UL listed Ethernet cable.

The addition or removal of a unit from the Ethernet/IP network must not interrupt the operation of other units in the network.

DeviceNet

The DeviceNet cable, used for the trunk line and drop lines, must be a flat cable rated 8 A, 600V, Class 1. The DeviceNet cable used to connect a DeviceNet device to a DeviceNet port must be a round cable rated 8 A, 600V, Class 1.

The addition or removal of a unit from the DeviceNet system must not interrupt the operation of other units within the system.

Cable Layout

Ethernet/IP

Etherent cables will be routed through the low voltage wireway, located on the top of each MV MCC section, to prevent accidental mechanical damage during MV MCC installation.

Ethernet cables will be routed into the low voltage control panel of each MV MCC unit. The EtherNet/IP devices within each low voltage compartment are factory connected to a managed Ethernet switch in the LV compartment, with the 600V UL PLTC rated cable outlined above in the EtherNet/IP Cable section.

DeviceNet

A DeviceNet trunkline will be routed through the low voltage wireway, located on the top of each MV MCC section, to prevent accidental mechanical damage during MV MCC installation.

A DeviceNet dropline must be routed into the low voltage control panel of each MV MCC unit.

Two DeviceNet ports must be provided in the low voltage control panel of each unit to simplify installation of DeviceNet products.

Power Supplies

EtherNet/IP DC Power Supply (Optional)

The EtherNet/IP system in the MCC has a built-in 24V DC power supply and 24V DC power distribution wire bus. All the EtherNet/IP switches, as well as some of the components in various units, are powered from this 24V DC supply. There are several configuration options for this power supply:

- User-supplied 115V AC source
- 115V AC power supplied by an optional control power transformer
- Power supply output shall be rated for a minimum of 8 A @ 24V DC

DeviceNet

Adequate power supplies have been specified to conform to DeviceNet requirements. The power supply must provide 24V DC for the DeviceNet system and be rated no less than 8 A. It shall be provided 115V AC from either a separate control power transformer or remotely from a use supplied source.

Programming and Testing

EtherNet/IP

- The IP Address will be loaded into each unit.
- The IP Address shall be as indicated on the contract drawings or as provided by the contractor.
- The MCCs are tested to ensure each unit communicates properly prior to shipment.
- Each unit shall have a label showing the IP Address for the devices within it.
- A disk is supplied which contains applicable electronic data sheet (EDS) files for the EtherNet/IP devices.

DeviceNet

- The DeviceNet ID number (node address) is loaded into each unit.
- The DeviceNet ID number shall be as indicated on the contract drawings or as provided by the contractor.
- The DeviceNet network shall be designed and programmed for use at 250 kB or 500 kB.
- The MCCs will be tested to ensure each unit communicates properly prior to shipment.
- Each DeviceNet device shall have a label showing the unit location, node address, and communication rate.
- A disk is supplied which contains applicable electronic data sheet (EDS) files for the DeviceNet devices.

Unit Monitoring

EtherNet/IP

Each unit has IntelliVAC for vacuum contactor control. The IntellVAC will come with the 1734-AENT Point I/O Ethernet/IP Adapter.

DeviceNet

Each unit has IntelliVAC Plus for vacuum contactor control and unit monitoring. Eight digital inputs monitor the status of the isolation switch, as well as other non-intelligent devices. The two digital outputs are available for use in the control system (customer to program and additional control hardware).

Solid-State Reduced Voltage Controllers

Each solid-state reduced voltage controller (SMC Flex) unit has an EtherNet/IP or DeviceNet communication module to communicate the status over EtherNet/IP or DeviceNet.

Unit Protection

EtherNet/IP

Available options for protection include:

- Bulletin 857 Motor/Feeder protection relay
- Bulletin 865 Differential Protection System
- E3 Plus
- E1 Plus (equipped with Ethernet/IP module)
- PowerMonitor 5000
- E300 Motor Protection System

DeviceNet

Available options for protection include:

- 825P modular
- E3 Plus
- E1 Plus (equipped with optional DeviceNet module)
- Bulletin 857 Motor/Feeder protection relay

Programming of Parameters

EtherNet/IP

The MCC manufacturer shall test the MCC to ensure that each unit communicates properly prior to shipment. Each unit shall have a label showing the IP address for the devices within it. The MCC manufacturer shall provide a disk containing applicable electronic data sheet (EDS) files for the EtherNet/IP or DeviceNet devices.

The MCC manufacturer shall load the IP address into each unit. The IP address shall be as indicated on the contract drawings or as provided by the contractor.

DeviceNet

The DeviceNet MAC ID number (node address) must be loaded into each unit per the drawings. All other parameters must be left at the factory default setting.

The DeviceNet System components must be preconfigured to operate at the appropriate baud rate.

Preconfigured IntelliCENTER Software

The software shall be capable of viewing multiple MCC lineups.

The software communication driver shall allow the software to be installed and operated on the EtherNet/IP, ControlNet, or DeviceNet network.

The software shall be capable of functioning as a standalone software package or as an ActiveX control in a Human Machine Interface (HMI).

The software shall be capable of displaying the following:

Elevation View

- Dynamically displays status information based on reading data from devices in the MCC lineup
- Sizeable view to allow ease of viewing multiple MCC lineups
- Unit nameplate information
- Unit status indicators (ready, running, warning, fault, no communication)

Unit Monitor View

- Preconfigured for a specific unit
- Real time monitoring via analog dials and trending
- Data configurable for customized viewing
- Modifying device parameters

Spreadsheet View

- User configurable for customized monitoring
- Sorting and cascading functions
- Custom user fields

Event Log

- Track history of MCC unit
- Automatic logging of trips, warnings, and changes
- Manual entry of events

Documentation

- Front elevation drawings
- Unit wiring diagrams
- User manuals
- Spare parts lists

Testing

The interwired EtherNet/IP/DeviceNet MV MCC must be powered up, configured, and tested in an ISO 9001 facility to ensure each unit communicates properly prior to shipment.

Transportation and Equipment

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 depends on the site location.

Unless specified, transportation is determined by the seller based on shipment by the lowest cost carrier, and charged to buyer.

Loading Equipment

As standard, the seller utilizes tractors and trailers equipped with air-ride features, reducing the chance of damage and the need for extra packaging. All trailers must 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.

Notes:

Commissioning

Commissioning

Start-Up Commissioning Services (Optional)

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

The seller provides the following:

- A pre-installation meeting with the user to review:
  - The start-up plan
  - The start-up schedule
  - The controller's installation requirements
- Inspect the controller's mechanical and electrical devices
- Perform a tug test on all internal connections within the controller and verify wiring
- Verify critical electro-mechanical connections for proper torque requirements
- Verify and adjust mechanical interlocks for permanent location
- Confirm all sectional wiring is connected properly
- Verify control wiring from any external control devices
- Set up auxiliary equipment with customer supplied parameters
- Exercise the controller in Test Mode (combination controllers)
- Confirm cabling of controller to motor and line feed
- Apply medium voltage to the controller and perform operational checks
- Run the controller system throughout its operational range to verify proper performance
- User's personnel must 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 provides a qualified instructor to provide personnel with training that is specific to the medium voltage (MV) controller system installed at the user's facility. The training session will be one 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 covers the following topics:

- Controller hardware
- Contactor hardware
- Hardware replacement procedures
- Power device replacement procedures (as applicable)
- Fault analysis and troubleshooting
- Preventative maintenance procedures

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

Basic Data Sheets

Basic Data Sheets

Table 1 - Specifications

Description		Specifications
Controller		
Maximum Rated Voltage		5.0 kV or 7.2 kV
Nominal Voltage Ratings		2400V, 3300V, 4160V, 4800V, 6600V, 6900V
Removable Lifting Provisions Provided		Yes
Mounting Sill Channels	**Quantity**	2
	Removable	No
Weight of Motor Controller		Refer to Table 18.
Maximum Power Cell Door Swing		Refer to Table 18.
Dielectric Voltage Withstand Rating (Insulation Test) for 60 seconds	2400…5000 V	13.25 kV
	7200 V	18.2 kV
Basic Impulse Level (BIL) Rating		60 kV(1)
Enclosed Controller Current Rating		Refer to Table 15 - Controller Ratings and Table 16 - Controller Deratings
Fault Withstand Current Rating, Class E2 controller		50 kA RMS SYM (80 kA RMS ASYM)(2)
Minimum Insulation Creepage-to-Ground and Between Phases		89 mm (3.5 in.)
Ambient Temperature	℃	40

(1) The BIL rating must be derated for altitudes about 1000 m (3300 ft), refer to Table 16 - Controller Deratings.

(2) Some fuse sizes not included.

Table 1 - Specifications (continued)

Description	Specifications	
Main Horizontal Power Bus		
Standard 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)	
Short Circuit Withstand Current Rating (0.5 s)	50 kA RMS SYM (80 kA ASYM)	
Type of Bus Bracing	Molded glass polyester, Anti-hygroscopic	
Dimensions per Phase	1200 A	Quantity 1 – 6 x 100 mm (1/4 x 4 in.)
	2000 A	Quantity 2 – 6 x 100 mm (1/4 x 4 in.)
	3000 A	Quantity 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./55 mils)
	Anti-hygroscopic:	0.5…1%
	Dielectric Strength:	900 V/mil (49.5 kV total)
Vertical Power Bus		
Bus Bar Material	Tin-plated copper	
Continuous Current Rating at 40°C (104°F)	400, 600 and 800 A	
Short Circuit 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./45 mils)
	Anti-hygroscopic:	0.5…1%
	Dielectric Strength:	900 V/mil (40.5 kV total)
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	10 x 51 mm (3/8 x 2 in.)	
Cross Sectional Area	510 mm^2 (0.75 $in.^2$) total	

Table 1 - Specifications (continued)

Description	Specifications		
Power Fuses and Fuse Holders			
This section details the power fuse and fuse holder technical information to which each medium voltage product conforms. It includes information on E-rated and R-rated fuses, as well as mounting dimensions.			
Fuse Types (Supplier: Mersen)			
R Rated: 2…12R 2…38R, 48X, 57X 2…38R, 48X, 57X	A480R – 5.0 kV A051B – 5.0 kV A072 – 7.2 kV		
E Rated: 10…500E 10…200E	A055 – 5.5 kV A825X/A083B – 8.25 kV		
Mounting (Center) Dimensions			
Clip-On	304.8 mm (12.0 in.)		
Bolt-On	454.2 mm (17.88 in.) or 511.6 mm (20.14 in.)		
Power Losses			
Power Cell Losses (approximate)	**Current (A)**	**Fuse Size**	**Losses (kW) ± 10%**
	90	6R	0.125
	180	12R	0.35
	240	18R	0.51
	360	24R	1.0
	600	48X	1.5
	800	57X	2.0
Power Bus Losses (approximate)	**Bus Rating (A)**		**Fully Loaded Bus Losses per 915 mm (36 in.) Section (Watts) ±%**
	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.		

Table 2 - Bulletin 1502 Medium Voltage 400 Amp Contactor Ratings

Description			Specification
Voltage Ratings[1]			
Maximum Rated Voltage			7200
System Voltages			2400 3300 4160 4800 6600 6900
Dielectric Voltage Withstand Rating		For 60 seconds (kV)	18.2/20 (IEC)
Basic Impulse Level (BIL) Withstand		Phase-to-Ground, Phase-to-Phase (kV)	60
Frequency Ratings		Hz	50 / 60
Current Ratings(1)			
Rated Continuous Current (Amps)			400
Maximum Interrupting Current Rating (RMS Sym Amps)		2400V	6000
		5000V	6000
		7200V(2)	6000
Maximum Interrupting MVA Rating (Sym MVA)		2400V	25
		5000V	50
		7200V(2)	75
Short-Circuit Withstand at Rated Voltage		Current Peak ½ cycle (kA)	60
Short Time Current Rating Capability		For 1 second (kA)	6.0
		For 30 seconds (kA)	2.4
Chop Current (Average RMS Amps)			0.5
Make and Break Capability at Rated Voltage (kA)			4.0
Contactor Coil Data (Series E)			
Control Voltage (V_{CTL})	Coil Voltage (V_{CL})		
Electro-Mechanical (Relay) Control (Mechanical Latch Only)			
120 VAC	110 VDC	Close Current (A_{DC})	5.6
		Trip Current (A_{DC})	6.0
		Pick-up Voltage	102
		Trip Voltage	84
IntelliVAC Control (Electrically Held & Mechanical Latch)			
110…240 V AC or 110…250 V DC3	VAC: $V_{CL} = \sqrt{2}$ X V_{CTL}(Max.) VDC: $V_{CL} = V_{CTL}$	Close Current (A_{DC}, 200 milliseconds)	4.3
		Hold Current (A_{DC})	0.48
		Pick-up Voltage(3)	95
		Drop-out Voltage(3)	75
		Trip Current (A_{DC}, 200 milliseconds)	5.5
		Trip Voltage(3)	70

(1) The voltage and current ratings listed are valid up to 1000 m (3300 ft). Refer to Table 16 - Controller Derating.

(2) The IEC rating at 7200 V (RMS Sym.) is 5300 A / 66 MVA.

(3) Control voltage, as measured at the input of the IntelliVAC control module.

Table 2 - Bulletin 1502 Medium Voltage 400 Amp Contactor Ratings (continued)

Description			Specifications
Contactor Coil Data (Series D)			
Control and Coil Voltage	120V AC 110V DC	Coil Inrush Current (A) – Electrically Held	7.3
		Coil Inrush Current (A) – Mechanical Latch	11.5
		Coil Inrush Current (A) – Mechanical Latch Trip	5.1
		Coil Continuous Current (A)	0.13
		Coil Pick-up Voltage (VAC)	102
		Coil Drop-out Voltage (VAC)	75
	230V AC 210V DC	Coil Inrush Current (A) – Electrically Held	8.3
		Coil Inrush Current (A) – Mechanical Latch	NA
		Coil Inrush Current (A) – Mechanical Latch Trip	NA
		Coil Continuous Current (A)	0.11
		Coil Pick-up Voltage (VAC)	190
		Coil Drop-out Voltage (VAC)	140
Operational Characteristics			
Mechanical Life (Operations) x 1000[1]		Electrically Held	2500
		Mechanical Latch	100
Electrical Life (Operations) x 1000[1]			1000
Switching Frequency (Operations per hour)		Electrically Held	600
		Mechanical Latch	150
Opening and Closing Times (Series E)			
Electro-Mechanical (Relay) Control (Mechanical Latch Only)			
Maximum Closing Time (120 VAC)		50 or 60 Hz (ms)	160
Maximum Opening Time (120 VAC)		50 or 60 Hz (ms)	50
IntelliVAC Control (Electrically Held & Mechanical Latch)			
Maximum Closing Time		120 / 240 VAC (ms)	100/70
Maximum Opening Time (without delay)[2]		120 to 240 VAC (ms)	60
Opening and Closing Times (Series D)			
Maximum Closing Time		50 or 60 Hz (ms)	160
Maximum Opening Time (Normal Drop Out)		50 or 60 Hz (ms)	130
Maximum Opening Time (Fast Drop Out and Mechanical Latch)		50 or 60 Hz (ms)	50
Capacitor Switching Capability (max KVAR)			
System Voltage		2400 V	800
		4160 V	1400
		6900 V	2000
General			
Standard Altitude Capability (m/ft)[3] [4]			-1000…5000 -3300…16500
Contactor Weight (kg/lb)			21.8 / 48
Auxiliary Contact Rating			A600
Auxiliary Contacts on the Vacuum Contactor (max)[5]			3 N.O./3 N.C.

(1) Provided that regular maintenance is performed.

(2) A contactor drop-out delay may be configured with the IntelliVAC control module (refer to publication 1503-UM051).

(3) The full altitude range is available with the IntelliVAC control module only, and the IntelliVAC is to be configured accordingly (refer to publication 1503-UM051). If used with electro-mechanical control, contactors are designed for -1000…1000 m (-3300…3300 ft). Higher altitudes are possible by changing the contactor return springs.

(4) The voltage and current ratings listed are valid up to 1000 m (3300 ft). Refer to Table 16 - Controller Deratings.

(5) The number of contactor auxiliary contacts depends on the contactor type. Some of the contacts are used in the typical control schemes used.

Table 3 - Bulletin 1502 Medium Voltage 800 Amp Contactor Ratings

Description			Specification
Voltage Ratings(1)			
Maximum Rated Voltage			7200
System Voltages			2400 3300 4160 4800 6600 6900
Dielectric Voltage Withstand Rating		For 60 seconds (kV)	18.2/20 (IEC)
Basic Impulse Level (BIL) Withstand		Phase to Ground, Phase to Phase (kV)	60
Frequency Ratings		Hertz	50/60
Current Ratings(1)			
Rated Continuous Current (Amps)			800
Maximum Interrupting Current Rating (RMS Sym Amps)		2400V	12,500
		5000V	12,500
		7200V	12,500
Maximum Interrupting MVA Rating (Sym MVA)		2400V	50
		5000V	100
		7200V	150
Short-Circuit Withstand at Rated Voltage		Current Peak ½ cycle (kA)	85
Short Time Current Rating Capability		For 1 second (kA)	12.0
		For 30 seconds (kA)	4.8
Chop Current (Average RMS Amps)			0.5
Make and Break Capability at Rated Voltage (kA)			8.0
Ambient Temperature		°C	40
Contactor Coil Data (Series E)			
Control Voltage (V_{CTL})	Coil Voltage (V_{CL})		
110…240 VAC or 110…250 VDC[2]	VAC: $V_{CL} = \sqrt{2} \times V_{CTL}$ (Max.) VDC: $V_{CL} = V_{CTL}$	Close Current (A_{DC}, 200 ms)	12
		Hold Current (A_{DC})	0.7
		Pick-up Voltage(2)	95
		Drop-out Voltage(2)	75
		Trip Current (A_{DC}, 200 ms)	5.2
		Trip Voltage(2)	70
Contactor Coil Data (Series D)			
Control Voltage (V_{CTL})	Coil Voltage (V_{CL})		
120V AC	110V DC	Coil Inrush Current (A) – Electrically Held	13.1
		Coil Inrush Current (A) – Mechanical Latch	13.1
		Coil Inrush Current (A) – Mechanical Latch Trip	5.6
		Coil Continuous Current (A)	0.24
		Coil Pick-up Voltage (VAC)	102
		Coil Drop-out Voltage (VAC)	75

(1) The voltage and current ratings listed are valid up to 1000 m (3300 ft). Refer to Table 16 - Controller Deratings.

(2) Control voltage, as measured at the input of the IntelliVAC control module.

Table 3 - Bulletin 1502 Medium Voltage 800 Amp Contactor Ratings (continued)

Description		Specifications
Operational Characteristics		
Mechanical Life (Operations) x 1000(1)	Electrically Held	250
	Mechanical Latch	100
Electrical Life (Operations) x 1000(1)		250
Switching Frequency (Operations per hour)	Electrically Held	600
	Mechanical Latch	150
Opening and Closing Times (Series E)		
Maximum Closing Time	120/240V AC (ms)	150
Maximum Opening Time (without delay)(2)	120…240V AC (ms)	60
Opening and Closing Times (Series D)		
Maximum Closing Time	50 or 60 Hz (ms)	200
Maximum Opening Time (Normal Drop Out)(3)	50 or 60 Hz (ms)	240
Maximum Opening Time (Fast Drop Out and Mechanical Latch)	50 or 60 Hz (ms)	60
Capacitor Switching (max. KVAR)		
System Voltage	2400V	2000
	4160V	3000
	6900V	4000
General		
Standard Altitude Capability (m/ft)(4) (5)		-1000…5000 -3300…16,500
Contactor Weight (kg/lb)		45/100
Auxiliary Contact Rating		A600
Auxiliary Contacts on the Vacuum Contactor (Max.)(6)		3 N.O. / 3 N.C.

(1) Provided that regular maintenance is performed.

(2) A contactor drop-out delay may be configured with the IntelliVAC control module (refer to publication 1503-UM051).

(3) FDO = Fast Drop-Out. NDO = Normal Drop-Out.

(4) The voltage and current ratings listed are valid up to 1000 m (3300 ft). Refer to Table 16 - Controller Deratings.

(5) Altitude adjustment required.

(6) The number of contactor auxiliary contacts depends on the contactor type. Some of the contacts are used in the typical control schemes used.

Table 4 - Control Wire and Control Relays

Description		Specifications
Control Wire		
All Medium Voltage structures shall be equipped with control wire which meets the following specifications.		
Type		TEW, Stranded Copper Wire (tinned)
AWG Size (Control Circuit)		14 AWG
AWG Size (Current Transformer Secondary Circuit)		12 AWG
Number of Strands		19
Maximum Voltage Rating		600 V
Maximum Rated Temperature		105°C (221°F)
Electro-Mechanical Relays		
Control Relays used in the medium voltage produce line shall conform to the following design standards.		
Pick-up Time	CR1	20 ms
	CR2	30 ms
Drop-Out Time	CR1	20 ms
	CR2	75 ms
Pick-Up Current	CR1	0.60 AC amps
	CR2	0.10 DC amps
Sealed Current	CR1	0.07 AC amps
	CR2	0.10 DC amps

Table 5 - Power Wire

Description	Specifications
Power wire used to feed the primary of the control power transformer or potential transformers is as follows.	
AWG Size	PT – 8 AWG / CPT – 12 AWG
Insulation Rating	8.0 kV
Maximum Temperature Rating	150°C (302°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	8.0 kV	90 °C (194 °F)
400	4/0	EP-CSPE MV90	8.0 kV	90 °C (194 °F)
450	350 MCM	EP-CSPE MV90	8.0 kV	90 °C (194 °F)
600	(2) x 4/0	EP-CSPE MV90	8.0 kV	90 °C (194 °F)
800	(2) x 350 kcmil	EP-CSPE MV90	8.0 kV	90 °C (194 °F)

Table 6 - IntelliVAC Control Module Specifications(1) (2) (3)

IntelliVAC Catalog Numbers		Vacuum Contactor Type	
1503VC-BMC5	IntelliVAC	Electrically Held or Mechanical Latch	
1503VC-BMC5-EM1(4)	IntelliVAC Plus		
1503VC-BMC5-MC1(5)	IntelliVAC MC	Electrically Held	
Ratings and Approvals			
Input Voltage		AC – 110…240V, 47 to 63 Hz(1)	
		DC – 110…250V	
Input Current(6)	**AC(1)**	Inrush (max.)	– 25 A peak (½ cycle)
		Idle (max.)	– 125 mA
		Close (max.)	– 11.3 A
		Hold (max.)	– 300 mA
		Latch Trip (max.)	– 7.0 A
	DC(1)	Inrush (max.)	– 25 A
		Idle (max.)	– 355 mA
		Close (max.)	– 4.8 A
		Hold (max.)	– 100 mA
		Latch Trip (max.)	– 3.7 A
Command Inputs		AC – 100…240V, 9 mA max.(1)	
		DC – 50…250V, 9 mA max.	
IntelliVAC Plus Inputs(7)		AC – 100…240V, 9 mA max.(1)	
		DC – 50…250 V, 9 mA max.	
Status Output Contacts		AC – 250V, 5.A, R load(1)	
		DC – 30 V, 5 A, R load	
IntelliVAC Plus Output Contacts(7)		AC – 250V, 5 A, R load(1)	
		DC – 30V, 5 A, R load	
Standards and Approval		cULus, IEC, CE	

(1) All AC values are rms, except where noted.

(2) Common ratings for all versions of IntelliVAC, except where noted.

(3) A wire harness is required for Bulletin 1502 vacuum contactors when IntelliVAC is used.

(4) This kit includes a Plus control board, half of the enclosure to house both control boards as well as product labels and documentation to aid in the field upgrade.

(5) This kit includes an MC control board, half of the enclosure to house both control boards as well as product labels and documentation to aid in the field upgrade.

(6) The maximum currents shown are for either the 400 or 800 A Bulletin 1502 vacuum contactors. Close current duration is 200 ms.

(7) Available with IntelliVAC Plus (1503VC-EMC1) only.

Table 7 - Control Power Transformer

Description	Specifications
Type	Dry
Voltage Class	5.0 and 7.2 kV
Frequency	50/60 Hz
Standard Capacity VA Rating	500 VA
Optional VA Ratings	1000V 2000V 3000V
Primary Voltage, Single Phase(1)	2400 V AC 4800 V AC 3300 V AC 6600 V AC 4160 V AC 7200 V AC
Rated Secondary Voltage	110/120V AC or 220/240 V AC
Basic Impulse Level (BIL) Rating	25 kV
Primary Fuses	
Type (Current Limiting)	A480T – 4.8 kV A720T – 7.2 kV
Maximum Continuous Current	Sized According to Requirements
Interrupting Rating	50 kA RMS SYM (80 kA RMS ASYM)
Secondary Fuses	
Type	ATM
Maximum Continuous Current	Sized According to Requirements

(1) Primary voltages above 5000V are supplied according to the application.

Table 8 - Potential Transformer

Description	Specifications	
Voltage Class	**5.0 kV**	**7.2 kV**
Frequency	50/60 Hz	
Thermal Capacity at VA Rating (55 °C)	425 VA	300 VA
Optional VA Ratings	None	
Primary Voltage Single Phase	2400V AC 3300V AC 4160V AC 4800V AC	7200 V AC
Rated Secondary Voltage	120V AC (60 Hz), 110V AC (50 Hz)	
Basic Impulse Level (BIL) Rating	60 kV	60 kV
Metering Accuracy	0.3 WX, 0.6 MY, 1.2 Z	0.3 WXMY, 1.2 Z

Table 9 - Potential Transformer Ratings

PT Burden Designation	VA	Burden PF
W	12.5	0.1
X	25	0.7
M	35	0.2
Y	75	0.85
YY	150	0.85
Z	200	0.85

Table 10 - Controller Current Transformer

Description		Specifications	
Type	Bar	Wound Primary	
	Donut	Toroid	
Voltage Class	Bar	7.2 kV	
	Donut	600V	
Basic Impulse Level (BIL) Rating	Bar	60 kV	
	Donut	10 kV(1)	
Momentary (Short-Circuit) Current Rating		Withstands the Let-Through of the fuse	
Secondary Current Rating		5.0 A(2)	
Maximum Continuous Secondary Current		7.5 A (Bar and Donut) at 30°C (86°F) ambient (Most ratios)	
Accuracy	Type	Metering	Relaying
	Bar	0.3 – B0.1 0.6 – B0.5 0.6 – B0.9 1.2 – B1.8	10T20
	Donut	(3)	10C20 (most ratios)
Bar Current Transformer			
Rated Short-Circuit Time Thermal Current		18 kA RMS for 1 second(4)	
Rated Short Time Mechanical Current		40 kA RMS for 1 second(4)	

(1) BIL rating of 60 kV when used with 8.0 kV power cable.

(2) Some donut CTs used for ground fault protection may have secondaries of different current ratings.

(3) Accuracy depends on the C.T. ratio, but most meet bar-type specification.

(4) The maximum rating depends on the C.T. ratio.

Table 11 - Incomer Current Transformers

Description		Specifications
Type	Bar	Wound Primary
Voltage Class		7.2 kV
Basic Impulse Level (BIL) Rating		60 kV
Continuous Thermal Rating		60 °C
Momentary (Short-Circuit) Current Rating 1 second rating	200 & 300:5	50 kA
	400 & 500:5	55 kA
	600 & 1200:5	70 kA
	1500:5	90 kA
	2000...3000:5	100 kA
Peak (Short-Circuit) Current Rating	200 & 300:5	126 kA
	400...3000:5	144 kA
Secondary Current Rating		5.0 A
Maximum Continuous Secondary Current		7.5 A at 60 °C ambient (Most ratios)

Table 12 - Incomer Current Transformers Metering Accuracy

Metering	200:5	300:5	400, 500:5	600-3000:5
B0.1	0.3	0.3	0.3	0.3
B0.5	0.6	0.3	0.3	0.3
B0.9	1.2	0.6	0.3	0.3
B01.8	2.4	1.2	0.6	0.3

Table 13 - Incomer Current Transformers Relaying Class Accuracy

Relaying Class Ratios	50 Hz	60 Hz
200:5	10…35 °C	10…40 °C
300:5	10…50 °C	10…65 °C
400:5	10…60 °C	
400…600:5		10…80 °C
500, 600:5	10…65 °C	
800:5	10…75 °C	10…100 °C
1000:5	10…95 °C	10…125 °C
1200:5	10…115 °C	
1200, 1500:5		10…150 °C
1500, 2000:5	10…125 °C	
2000…3000:5	10…200 °C	
2500:5	10…120 °C	
3000:5	10…100 °C	

Table 14 - Environmental Ratings

Environmental Ratings	UL/CSA/NEMA	IEC
Operating Temperature Range	0…40°C (32…104°F)	
Storage and Transportation Temperature Range	-20…75°C (-4…149°F)	
Altitude(1)	1000 m (3300 ft)	
Humidity	5…95% (non condensing)	
Pollution Degree	2	
Seismic (UBC Rating)(2)	1, 2, 3, 4	

(1) De-ratings apply for higher altitudes.

(2) Some units may require special bracing. Contact factory for more information.

Table 15 - Controller Ratings

Starter Size and Type	NEMA Type 1 Enclosure				NEMA Type 1A, 12, 3R Enclosure, Arc Resistant			
	Max. Continuous Current (amps) (2)	Horsepower(3)			Max. Continuous Current (amps)(2)	Horsepower(3)		
		2400 V	4160 V	6900 V		2400V	4160V	6900V
1-unit	360	1500	2500	4000	360	1500	2500	4000
2-unit structure with standard blank doors	260 Top Cell	1000	1750	3000	260 Top Cell	1000	1750	3000
	300 Bottom Cell	1250	2250	3500	300 Bottom Cell	1250	2250	3500
	560 Total/ Structure	2250	4000	6500	560 Total/ Structure	2250	4000	6500
2-unit structure with vented door Option(1)	300 Top Cell	1250	2250	3500	N/A	—	—	—
	360 Bottom Cell	1500	2500	4500	N/A	—	—	—
	660 Total/ Structure	2750	4750	8000	N/A	—	—	—
600 A	600	2500	4500	7000	540	2250	4000	7000
800 A	720	3000	5500	9000	720	3000	5500	9000
800 A with vented door Option(1)	800	3500	6000	9000	N/A	—	—	—

(1) The power cell doors are vented. Specify unit modification "-100T" to configure. Not available with arc resistant option.

(2) The standard current and basic impulse level (BIL) ratings are valid up to an altitude of 1000 m (3300 ft). For applications above 1000 m (3300 ft), the maximum continuous current and BIL withstand ratings shall be reduced per Table 16.

(3) The horsepower values are based on assumed Full Load Current and a Service Factor of 1.0 motor data. The actual Full Load Current and Service Factor ratings determine the limits.

Table 16 - Controller Deratings

Altitude Range	Power Cell Rating				Reduce BIL Withstand Rating By:
	180 A	360 A	600 A	800 A	
	Reduce Max. Continuous Current Rating By(1)				
1000…2000 m (3300…6600 ft)	5 A	10 A	15 A	20 A	6.0 kV
2001…3000 m (6601…9900 ft)	10 A	20 A	30 A	40 A	12.0 kV
3001…4000 m (9901…13,200 ft)	15 A	30 A	45 A	60 A	18.0 kV
4001…5000 m (13,201…16,500 ft)	20 A	40 A	60 A	80 A	24.0 kV

(1) Current deratings shown are the minimum levels. Additional derating may be required due to power fuse limitations. Please consult factory for additional details.

Table 17 - Static Exciter Sizes and Specifications

Style	Size	Output Voltage
A	13 kW - 1 PH	125V DC
	21 kW - 3 PH	125V DC
B	13 kW - 1 PH	250V DC
	21 kW - 3 PH	250V DC

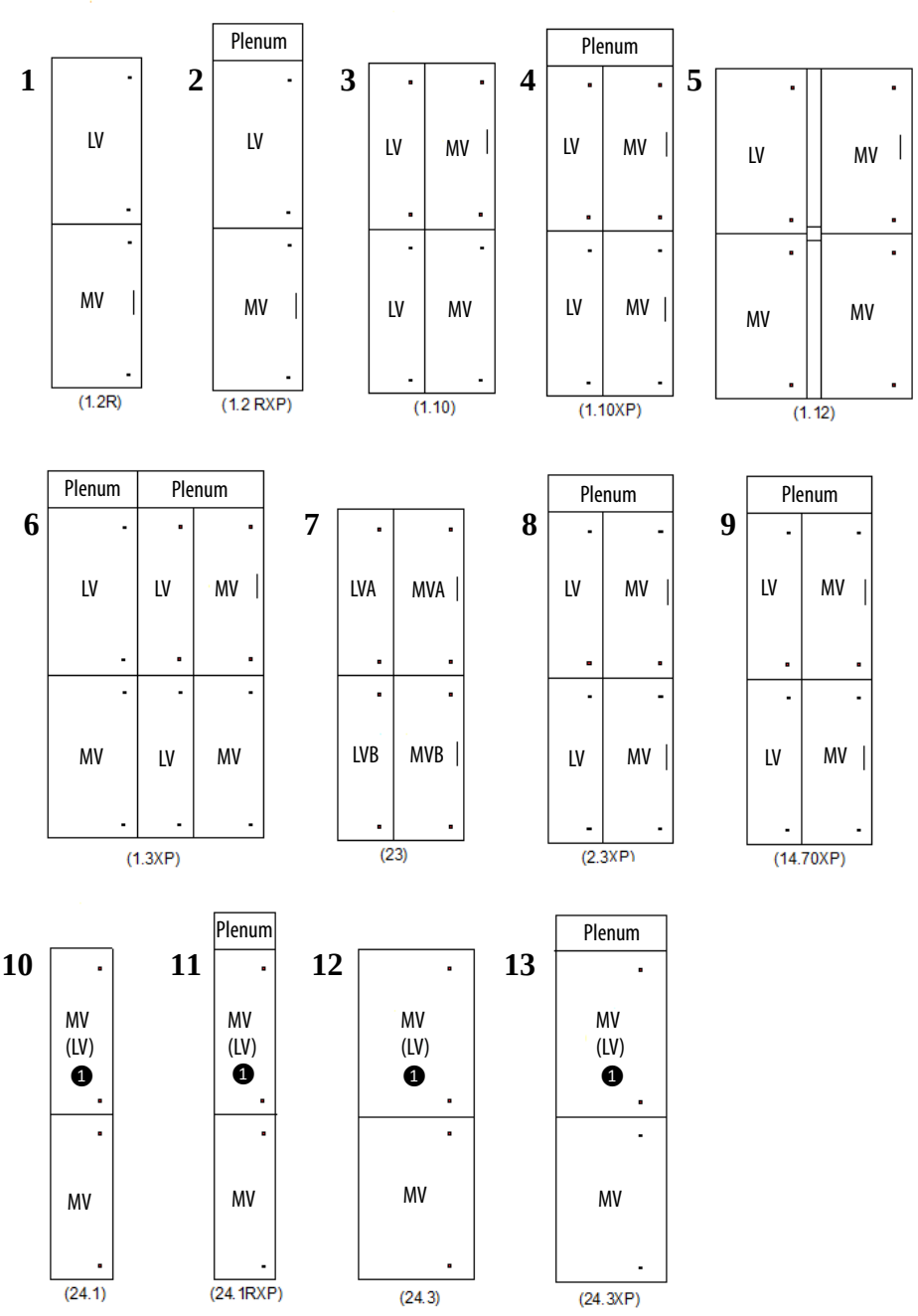
Structure Styles, Dimensions and Weights

The structures shown below are the standard configurations. For other structure types and complete dimension details, consult the factory for assistance.

Structure Styles

LV - Low Voltage Compartment

MV - Medium Voltage Compartment/Power Cell



❶ Optional

Table 18 - Structure, Dimensions, and Weights(1)

Item No.	Bulletin No.	Description	Dimensions (W x H x D)	Weight	Power Cell Door Swing
1	1512A	1-High, 400 A FVNR Controller	661 x 2315 x 915 mm (26 x 91 x 36 in.)	490 kg (1078 lb)	597 mm (23.5 in.)
2	1512A	1-High, 400 A FVNR Controller (Arc Resistant)(1)	661 x 3264 x 915 mm(3) (26 x 128.5 x 36 in.)	600 kg (1320 lb)	597 mm (23.5 in.)
3	1512A	1-High, 600 A FVNR Controller	915 x 2315 x 915 mm (36 x 91 x 36 in.)	614 kg (1350 lb)	508 mm (20.0 in.)
4	1512A	1-High, 600A FVNR Controller (Arc Resistant)(1)	915 x 3264 x 915 mm(3) (36 x 128.5 x 36 in.)	773 kg (1700 lb)	857 mm (33.75 in.)
5	1512A	1-High, 800 A FVNR Controller	1422 x 2315 x 915 mm (56 x 91 x 36 in.)	816 kg (1800 lb)	597 mm (23.5 in.)
6	1512A	1-High, 800 A Controller (Arc Resistant)(1)	1575 x 3264 x 915 mm (62 x 128.5 x 36 in.)	1400 kg (3080 lb)	857 mm (33.75 in.)
7	1512B	2-High, 400 A FVNR Controller	915 x 2315 x 915 mm (36 x 91 x 36 in.)	802 kg (1770 lb)	508 mm (20.0 in.)
8	1512B	2-High, 400 A FVNR Controller (Arc Resistant)(1)	915 x 3264 x 915 mm(3) (36 x 128.5 x 36 in.)	1050 kg (2310 lb)	857 mm (33.75 in.)
9	1562E	200 to 400A RVSS Controller (Arc Resistant)(1)(2)	915 x 3264 x 915 mm(3) (36 x 128.5 x 36 in.)	886 kg (1950 lb)	857 mm (33.75 in.)
10	1591A	Incoming Line Unit	457 x 2315 x 915 mm (18 x 91 x 36 in.)	272 kg (600 lb)	394 mm (15.5 in.)
11	1591A	Incoming Line Unit (Arc Resistant)(1)	457 x 3264 x 915 mm(3) (18 x 128.5 X 36 in.)	464 kg (1020 lb)	394 mm (15.5 in.)
12	1591A	Incoming Line Unit	915 x 2315 x 915 mm (36 x 91 x 36 in.)	363 kg (800 lb)	857 mm (33.75 in.)
13	1591A	Incoming Line Unit (Arc Resistant)(1)	915 x 3264 x 915 mm(3)3 (36 x 128.5 x 36 in.)	663 kg (1459 lb)	857 mm (33.75 in.)

(1) Height dimension includes plenum (953 mm [37.5 in.]) which is removed for shipping, and installed by customer.

(2) Available up to 5 kV. Refer to Publication 1560E-SR022 for additional details.

(3) Depth dimension includes plenum which extends 254 mm (10 in.) in front of structure.

(1) For other controller types, contact factory for complete structure and dimension details.

CENTERLINE® Medium Voltage
Motor Control Center Specification Checklist

for Bulletin 1500 and Bulletin 1900

Check boxes and fill in blanks as required.

Customer: **User:**

Prepared by: **Office:**

Project Reference:

Standards

☐ UL Labeled ☐ NEMA ☐ ICS Specification No. _____

☐ CSA Certified ☐ Service Entrance ☐ Other: _____

Incoming Power

Line Voltage: ☐ 2400 ☐ 3300 ☐ 4160 ☐ 4800 ☐ 6000

☐ 6600 ☐ 7200 ☐ Other _____

Power: ☐ 3-phase 3-wire ☐ 3-phase 4 wire

Frequency: ☐ 50 Hz ☐ 60 Hz

Available Fault Current: ____ kA

Environmental

Elevation: ____ meters ☐Above sea level ☐Below sea level

Motor

Motor Full Load Amps: _____

Motor Service Factor: ☐1.0 ☐1.15 ☐Other (specify) _____

RTDs: ☐None ☐100 ohm Platinum ☐10 ohm Copper

☐100 ohm Nickel ☐120 ohm Nickel

Structure

NEMA Type: ☐Type 1 ☐Type 1 w/ gasket ☐ Arc Resistant w/ Plenum

☐Type 12 ☐Type 3R non-walk-in ☐ Arc Resistant w/ Chimney

Paint Color: ☐ANSI 49 medium light gray ☐ANSI 61 light gray

☐Special paint - describe: _____

Options: ☐2” x 4” wireway ☐6” x 6” wireway ☐Export crating

☐Arc Resistant (Type 2B Accessibility per IEEE C37.20.7)

☐Other:_____

Bus

Horizontal power bus:	☐1200 A copper	☐2000 A copper	☐3000 A copper
(60 kA RMS symmetrical)	☐Tin plated	☐Silver plated	☐Insulated

Horizontal ground bus: ☐Unplated copper, 3/8 x 2 in. ☐Tin plated copper, 3/8 x 2 in.

Incoming Line Termination

To main power bus: Located in Section No. ____ ☐Top ☐Bottom
No. of cables per phase ____ Cable Size _____
☐Lugs by others ☐Crimp compression lugs

Incoming line unit: Located in Section No. ____ ☐Top ☐Bottom
No. of cables per phase ____ Cable Size _____
☐Lugs by others ☐Crimp compression lugs

Main load break switch: Ampere size _____
☐Fused ☐Non-Fused
Located in Section No. _____ ☐Top ☐Bottom
No. of cables per phase ____ Cable Size _____
☐Lugs by others ☐Crimp compression lugs

Incoming metering options: No. of current transformers required _____
No. of potential transformers required _____

Ammeter	☐Ammeter Switch	☐Power Monitor
Voltmeter	☐Voltmeter Switch	☐Digital meter – Describe: _____
☐Other: _____		

Transition: ☐Existing structure: Describe or series number – _____

Load Termination

Outgoing Load Cable Connection: ☐Top ☐Bottom
Load Cables per phase: ☐1 ☐2
Load Cable Size (specify): _____

Combination Starter Units

Starter Types: ☐FVNR (1-high) ☐FVNR (2-high) ☐BTSYN
☐FVR ☐RVAT ☐RVR
☐BLSYN ☐Prepared space – for FVNR only
☐Other: _____

Motor Protection Relays: ☐Allen-Bradley Bulletin 857
☐Allen-Bradley Bulletin 592 (Eutectic Alloy Type)
☐Allen-Bradley Bulletin 825P
☐Other (specify): _____

Unit Nameplates: ☐3 line ☐6 line
☐Black letters on white ☐White letters on black

Control Power: ☐Separate Control 120 volts
☐Control Power Transformer ☐120V Sec. ☐120/240V Sec.
☐Standard 500 VA ☐1000 VA ☐2000 VA ☐3000 VA

Starter Options: ☐Pilot devices ☐Push buttons _____
☐Selector switches
☐Pilot lights – Qty ____ Color(s) _____
☐Transformer type ☐Push-to-test ☐Other _____
☐Auxiliary relays, timers – describe: _____
☐Other – describe: _____

Other Unit

☐Feeder Load Break Switches Description: _____

☐Solid State Starters Description: _____

☐Drives: Description: _____

Comments / Additional Notes:

C

D

E

F

V

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

Medium Voltage Products, 135 Dundas Street, Cambridge, ON, N1R 5X1 Canada, Tel: (1) 519.740.4100, Fax: (1) 519.623.8930
Online: www.ab.com/mvb

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1500-SR020I-EN-P - October 2014
Supersedes Publication 1500-SR020H-EN-P - September 2009