Bulletin 7760, 7761, 7762, 7763

Allen-Bradley

OneGear™ MV SMC™ Flex
Solid-State Motor Controller
10-15 kV

Specification Guide

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Table of Contents

Section | Description | Page

1.0 Scope

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

The RVSS shall be ____ V, 3-phase, ____ hp or ____ kW rated, and used for the controlled starting and/or stopping of AC motors.

2.0 Codes and Standards

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

- IEC 60470: High-voltage Alternating Current Contactors and Contactor Based Motor-Starters.
- IEC 62271-100: High-voltage Switchgear and Control Gear, Circuit Breakers
- IEC 62271-1: High-voltage Switchgear and Control Gear, Common Specifications.
- IEC 62271-200: High-voltage Switchgear and Control Gear.
- IEC 62271-102: High-voltage Switchgear and Control Gear, Disconnectors and Earthing Switches.
- European Directives for Safety and EMC
- RoHS

Environmental Conditions

The RVSS shall be rated to operate in an ambient temperature range of 0°C to 50°C (32°F to 122°F) with a relative humidity of up to 95% (non-condensing). The controller shall be derated in ambients above 40ºC.

The RVSS is to be built using materials that comply with Class 1: Industrial Clean Air sulphur environments as defined in IEC Standard 60654-4 (Operating Conditions for Industrial-Process Measurement and Control Equipment), and G1 as defined in ISA-S71.04-1985 (Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants).

The equipment shall be capable of being stored in an enclosed clean environment with an ambient temperature range of -5°C to 75°C (23°F to 184°F).

The equipment shall operate at altitudes from 0 to 1000 m (3,300 ft) above sea level, without de-rating. For applications above 1000 m (3,300 ft), the maximum current and Basic Impulse Levels (B.I.L.) of the controllers shall be de-rated and vacuum contactors/breakers will be compensated for operation at the specified altitude.

3.0 Obligations of Seller

Deviations

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

4.0 Drawings and Manuals

Approval Drawings

Manufacturer's standard approval drawings shall be provided at no additional charge, if requested at the time of order. The approval submittal shall include the dimensional and electrical drawings supplied at quoted lead time after order receipt by the Seller. Approval drawings will be submitted electronically.

Note: Seller shall allow the user two (2) weeks to review the drawings. This period starts on the date that the drawings are shipped to the customer and ends on the date that the drawings must be back to the Seller.

Information Drawings

Orders shall include the submittal of the dimensional and electrical drawings at the time engineering is finalized. Drawings are to be submitted electronically.

Final Drawings and Manuals

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

5.0 Spare Parts

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

Critical Spares

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

Maintenance Spares

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

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

On-site Inventory Agreement (Optional)

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

6.0 Quality Assurance

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

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

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

Standard Testing

The following production tests shall be carried out in accordance with applicable requirements and/or specifications of International Electro-technical Commission (IEC).

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

The RVSS must be tested at rated voltage with a motor load.

A high potential AC (power frequency withstand voltage) dielectric withstand test shall be performed on all buswork and cables from phase to phase and phase to ground (except solid-state components, low voltage controls and instrument transformers). The voltage level used for this test depends on the product's nominal AC voltage. Auxiliary and control circuits shall be tested for 1 kV for 1 second.

6.0 Quality Assurance (cont.)

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

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

Medium voltage solid-state controllers shall be inspected for the following:

- Electrical interlocking
- Motor protection and ground fault
- Operation of the vacuum breaker.
- Operation at full voltage.

Physical Inspection

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

The physical inspection will consist of the following items:

- Ensure all power equipment 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 personal and equipment.
- Verify operation of door interlocks.

Factory Inspections (Optional)

Visual Inspection of Equipment

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

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

Witness Testing

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

The medium voltage solid-state, reduced-voltage testing consists of:

- Demonstrating an AC hipot (power frequency withstand voltage) test to the customer;
- Applying control power at the rated voltage to the equipment; then, a functional demonstration of customer-purchased options and control devices is completed with the starter in the TEST position.
- Operation of the vacuum breaker. (If included in scope)
- Soft Start operation to full voltage.

Custom Testing

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

7.0 Equipment Design and Selection

Product Overview

The medium voltage, RVSS controller shall consist of metal-clad, free-standing, dead front, vertical steel structures.

Each structure shall also have removable lifting means for ease of handling and installation.

7.0 Equipment Design and Selection (cont.)

The medium voltage RVSS shall be of modular design to provide for ease and speed of maintenance. The modules are to be manufactured and designed to ensure ease of maintenance, including removal of medium voltage components and power electronic components.

The complete controller shall be divided into isolated compartments as follows:

- Main power bus compartment
- Power cell compartment
- Load termination compartment
- Low voltage compartment

Grounded metal barriers shall be provided between the low voltage compartment, power cell, main power bus compartment, and load termination compartment. Personnel shall have access to the low voltage compartment, with the controller energized, without being exposed to any medium voltage.

The controller shall be rated for either 12 or 15 kV, 3 phase, 50/60 Hz power systems. It shall be insulated for 28/36 kV frequency withstand voltage and 75/95 kV impulse voltage. The major components shall be type tested for partial discharge per IEC 62271-200 Procedure A.

Structure and Controller

Each structure shall contain the following items:

Retrofit Controller (No Main Isolation Contactor/Breaker: Bulletin 7760)

- Drawout bypass vacuum breaker
- Removable ‘PowerBrick’ SCR assemblies
- Voltage sensing board
- Fiber optic connection from SMC Flex control module to gate driver boards on ‘PowerBrick’
- Tin-plated insulated horizontal copper power bus
- A continuous bare copper ground bus
- LV control panel with SMC Flex control module and associated interface board and terminations.
- Provisions for bottom fed line and load connections. (Top available upon request.)
- Earthing switch (optional)

OEM Controller: Bulletin 7761

- Removable 'PowerBrick' SCR assemblies
- Voltage sensing board
- Fiber optic connection from SMC Flex control module to gate driver boards on 'PowerBrick'
- LV control panel with SMC Flex control module and associated interface board and terminations
- Provisions for bottom fed line and load connections. (Top available upon request.)
- Tin-plated insulated horizontal copper power bus (optional) ❶
- A continuous bare copper ground bus

❶ Power bus can only be supplied if suitable structures are present on both sides of the 7761 structure to provide termination and support for the bus.

Complete Controller (VC: Bulletin 7762) (12kV Max)

- Drawout main isolation (Start) vacuum contactor
- Drawout bypass (Run) vacuum contactor
- Removable 'PowerBrick' SCR assemblies
- Three current limiting main power fuses each for main and bypass contactors
- Six (6) current transformers
- Tin-plated insulated horizontal copper power bus
- A continuous bare copper ground bus
- Voltage sensing board
- Fiber optic connection from SMC Flex control module to gate driver boards on 'PowerBrick'
- LV control panel with SMC Flex control module and associated interface board and terminations
- Provisions for bottom load connections. (Top available upon request.)
- Earthing switch (optional)

Complete Controller (VB: Bulletin 7763)

- Drawout main isolation (Start) vacuum breaker
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- LV control panel with SMC Flex control module and associated interface board and terminations.
- Provisions for bottom fed load connections. (Top available upon request.)
- Earthing switch (optional)

7.0 Equipment Design and Selection (cont.)

Enclosure Types

The OneGear MV SMC Flex is available in an IP4X enclosure as standard. Optional enclosures are:
– IEC IP41
– IEC IP42

Each enclosure shall 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(s) shall be provided with an arc resistant enclosure design.

The arc resistant units will meet the requirements per IEC 62271-200 Annex A, and provide the following benefits:

- Reinforced structure, to contain arc flash material at faults up to 31.5 kA, 0.5 seconds
- Arc vent to exhaust arc flash material
- Plenum or chimney to redirect arc flash material
- Reinforced low voltage panel, sealed to prevent entry of arc flash material

Structure Finish

All exterior doors and lineup end plates shall be painted RAL 7035, textured finish. All metal back plates in the low voltage compartments shall be painted high gloss white for high visibility. The enclosure frame, internal structural metal and metallic barriers will be zinc coated galvanized steel or similar.

Description	Hybrid epoxy powder paint RAL 7035 textured finish
Standard Color	RAL 7035 textured finish
Procedure	Continuous paint line. All parts are painted before assembly.
Preparation	Alkaline wash/rinse/iron phosphate rinse/iron-chrome sealer rinse/recirculated de-ionized water rinse and virgin de-ionized water rinse.
Painting	Air-atomized electrostatic spray. Total paint thickness – 0.002” (0.051 mm) minimum.
Baking	Natural gas oven at 179°C (355°F) minimum.

Notes:

1. When optional custom paint color is specified, all doors and lineup end plates shall be painted to the custom color requirement, except for the external handle assemblies, lifting angles and lifting brackets .
2. All unpainted steel parts not listed above shall be protected from corrosion by plating or galvanizing.

Main Power Bus (Optional)

The power bus shall be made of solid copper conductor(s) and tin plated to resist corrosive elements. Heat shrink insulation is standard where applicable. The material used for the power bus is common from the main power bus through to the line side connection to the power cell. The same material should also be used from the load side terminal of the power cell to the load cable connections.

The main power bus will be located in a separate compartment located at the top and back of the controller.

Bus Ratings

The main bus is rated at 1250 or 2000 amps. The main bus is braced for 31.5 kA for 3 seconds. Higher ratings are available options.

Access is provided to the bus compartment from the top, rear or side of the structure to allow for installation and regular maintenance of the power bus splice connections. (Access is possible from the front of the switchgear sections, but requires some degree of disassembly.)

Ground Bus

A continuous copper ground bus will be provided along the entire length of the controller line-up. The ground bus is also available with optional tin plating to improve corrosion resistance in certain environmental conditions. A mechanical lug for 10 mm^2 to 50 mm^2 (#8 to #1/0 AWG) or 16 mm^2 to 120 mm^2 **(**#6 to 250 MCM) cable is supplied at the incoming end of the line-up. The ground bus will withstand a short time current level of 31.5 kA for 3 seconds.

Bus Linking

Bus linking system will be available to enable power and ground bus connection of adjacent units in the field by users or their agents.

7.0 Equipment Design and Selection (cont.)

Vacuum Contactor Specifications (Input and Bypass: 10 to 12 kV)

On the 10-12kV Bulletin 7760 and 7762 units, medium voltage magnetic drive contactors are used as the Main and/or Bypass current switching devices, up to 160 amp continuous rated current.

The main contactor connects the main power bus to the converter portion of the soft starter on a Bulletin 7762.

A bypass contactor is provided to connect the motor to the main bus voltage once the motor is up to full speed. When a stop option is selected, the bypass contactor will open, bringing the SCRs in the three phase power stack circuit (PowerBrick) back into the power circuit.

The bypass contactor is fully rated and is capable of providing a full voltage start in case of emergency bypass.

Each vacuum contactor will provide the following safety features:

- Prevent apparatus racking in or out with the apparatus closed.
- Prevent the closing of the apparatus when the truck is in an undefined position (neither service nor test position).
- Prevent apparatus racking in if the multi-contact plug is unplugged.
- Prevent unplugging the multi-contact plug if the truck is in the service or undefined position.
- Prevent the closing of the optional Earthing switch if the truck is in the service or undefined position.
- Prevent apparatus racking in if the optional Earthing switch is closed.

When the contactor is withdrawn, the automatic shutters provide isolation from the main power bus and load terminals. The electrical life of the contactor is to be up to 100,000 operations (AC3). The mechanical life of the contactor is to be up to 1 million operations. The contactor will come with an ‘Emergency Manual Operating Device’.

Interlocks

- Prevent the apparatus compartment door from opening if the truck is in the service or undefined position.
- Prevent the apparatus racking in if the apparatus compartment door is open.
- Prevent the feeder compartment door from opening if the optional Earthing switch is open.
- Prevent the optional Earthing switch from opening if the feeder compartment door is open.

Other Interlocks

Key Type

- Apparatus racking in
- Earthing switch closing
- Earthing switch opening
- Insertion of the apparatus racking lever
- Insertion of the Earthing switch operating lever

Padlock Type

- Compartment door opening
- Insertion of operating or racking levers
- Shutters opening or closing

Vacuum Circuit Breaker Specifications (Input and Bypass: 10 to 15 kV)

The medium voltage vacuum drawout circuit breaker used as the Main and Bypass switches, shall be vacuum type, rated 12 or 17.5 kV. The vacuum circuit breakers will be rated for 1250 A. The main breaker connects the main power bus to the converter portion of the soft starter, on a Bulletin 7763.

The medium voltage circuit breakers shall be either spring actuated or magnetically actuated.

A bypass breaker is provided to connect the motor to the main bus voltage once the motor is up to full speed. When a stop option is selected, the bypass breaker will open, bringing the SCRs in the three phase power stack circuit back into the power circuit.

The bypass breaker is fully rated and is capable of providing a full voltage start in case of emergency bypass.

The vacuum circuit breaker provides the following safety features:

- Prevent apparatus (breaker) racking in our out with the apparatus closed.
- Prevent the closing of the apparatus when the truck is an undefined position (neither service nor test position).
- Prevent apparatus racking in if the multi-contact plug is unplugged.
- Prevent unplugging the multi-contact plug if the truck is in the service or undefined position.
- Prevent the closing of the optional Earthing switch if the truck is in the service or undefined position.
- Prevent apparatus racking in if the optional Earthing switch is closed.

7.0 Equipment Design and Selection (cont.)

Interlocks

- Prevent the apparatus compartment door from opening if the truck is in the service or undefined position.
- Prevent the apparatus racking in if the apparatus compartment door is open.
- Prevent the feeder compartment door from opening if the optional Earthing switch is open.
- Prevent the optional Earthing switch from opening if the feeder compartment door is open.

Other Interlocks

Key Type

- Apparatus racking in
- Earthing switch closing
- Earthing switch opening
- Insertion of the apparatus racking lever
- Insertion of the Earthing switch operating lever

Padlock Type

- Compartment door opening
- Insertion of operating or racking levers
- Shutters opening or closing

Three-Phase Power Stack Circuit (PowerBrick)

The power stacks shall be comprised of simple “building-block” components (i.e. a two-device power circuit using “PowerBrick” technology), to minimize the number of assemblies. The numbers of PowerBricks are a function of the system voltage and will increase to provide the required peak inverse voltage (PIV) withstand.

The PowerBrick assemblies shall be rated according to system and load requirements.

Each phase of the PowerBrick assemblies will be mounted on a rollout cart or ‘truck’ for ease of maintenance.

Control Wire Specification

The control wire shall be an insulated (with a flame retarding thermoplastic compound), flexible stranded, tinned copper wire supported and neatly bundled. Red wire shall indicate AC control, blue wire shall indicate DC control, and green wire with a yellow stripe shall indicate ground. Other colors or combinations may be used for specific applications. The control wire shall be isolated from medium voltage components in the power cell (whenever possible), and wire markers which are numbered according to the electrical diagram, shall be provided at each end of the wire. Dependent on application, either 2.5 mm^2 or 16 AWG control cable will be used.

Each control wire will be terminated by a copper ferrule, where possible. All of the control wire terminations shall be a spring-clamp type, copper-compression-type terminal block or connector which firmly grips the conductor, where possible.

Low Voltage Wireway

A standard low voltage wireway shall be available across the top of the structure.

- 153 mm x 100 mm (6 in. x 4 in.)

Low Voltage Control Panel

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

Optional meters, selector switches, operators, indicating lights, etc., shall be mounted on the front of the low voltage door in the contactor or breaker units arranged in a logical and symmetrical manner.

The low voltage panel shall have the following features:

- Space shall be provided for optional low voltage control devices.
- Necessary terminal blocks. Extra terminal blocks can be supplied as an option.
- Low voltage control panel access from the front, without turning the controller “OFF”.

7.0 Equipment Design and Selection (cont.)

- All remote low voltage cables are able to enter the low voltage control panel from the top or bottom of the structure. Access is by means of removable metal entry plates on the top and bottom of the structure.
- Pilot control systems used to operate vacuum contactor or breaker.
- The control panel supply voltage is rated at 110/120 V AC or 220/240 V AC, 50/60 Hz, from a separate source (by user).
- The low voltage control panel door has a viewing window, allowing the user to monitor the MV SMC Flex controller operation via the built-in display.

Power Fuses and Fuse Holders (Bulletin 7762 Only)

Current limiting backup power fuses will be provided. DIN style motor protective fuses will be used for the short circuit protection of medium voltage motors and motor controllers.

The medium voltage controller will have DIN power fuse holders located to allow easy inspection and replacement without any disassembly. The power fuses will be supplied with an open fuse indicator. The power fuse size will be selected when motor data and the protective device characteristics are known.

Control Circuit Power Supply

User supplied control power will be provided for operation of the rollout contactor or circuit breaker, and other control and protection devices within the controller.

The minimum requirements are: 110/120 or 220/240 VAC, 250 VA.

Current Transformer

When supplied the medium voltage load termination compartment shall include three (3) current transformers of sufficient VA capacity to meet the requirements of all the devices connected to them.

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

Load Terminations

An appropriate load termination location shall be provided to accommodate lugs with single or two-hole mounting, for connection of the load cables.

It will be possible to connect up to three single-pole cables per phase, with stress cones (maximum cross-sectional area of 300 mm^2), or two cables per phase, with stress cones (maximum cross-sectional area of 185 mm^2). The connection height of the cables in relation to the floor is a minimum of 530 mm.

There shall be provisions to locate a toroid (donut) style, ground fault sensing current transformer, when the zero sequence ground fault protection feature is required (7760, 7762 or 7763 controllers only).

For Bulletin 7761, provision is provided for up to 12 cables (6 in, 6 out) with 2 per phase with a maximum size of 240 mm2 (500 MCM). The connection height of the cables relative to the floor plate is approximate.

Earthing Switch (optional)

The OneGear MV SMC Flex can be equipped with a snap action manually operated earthing switch for high speed positive closing. The unit is also sized to conduct the short circuit rated current. The switch comes with an earthing blade that connects all three phases by earthing pins. The earthing switch is rated per IEC 62271-102. Short circuit rating of the earthing switch will match the rating of the bypass and/or input section.

7.0 Equipment Design and Selection (cont.)

RVSS Control Module

Electrical

The SMC Flex control module shall provide closed-loop digital microprocessor control and supervision of all controller operations, including SCR pulse firing control.

The SMC Flex control module shall have the following functions:

- Soft Start – with Selectable Kickstart
- Soft Stop
- Current Limit Start – with Selectable Kickstart
- Linear Speed Acceleration ⊇ – with Selectable Kickstart
- Linear Speed Deceleration ⊇
- Dual Ramp – with Selectable Kickstart
- Full Voltage
- Preset Slow Speed
- Pump Control (Optional module)

⊇ Requires motor tachometer

The start ramp time shall be programmable from 0 to 120 seconds.

The stop time shall be programmable from 0 to 120 seconds. Motor and controller thermal start and stop analysis to be provided with quotation by respective suppliers.

Kick-start, selectable with soft start, current limit and linear acceleration, shall provide an adjustable time pulse of current prior to the normal start mode. The current shall be controlled to provide 0-90 % of locked rotor torque for a time between 0.0 and 2.0 seconds. This feature shall be field selectable.

Pump Control (per Data Sheet)

- The Pump Control option shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping.
- Closed loop control shall be achieved without using external sensors or feedback devices.
- Pump Stop shall be initiated by a dedicated Pump Stop input. A coast-to-rest stop shall still be possible with a separate stop input.
- The Pump Stop time shall be user adjustable from 0 to 120 seconds.

Monitoring

The SMC Flex shall provide the following monitoring functions indicated though the built-in LCD display; or remotely via the communication port:

- Phase-to-phase supply voltage
- Three-phase line current
- Three-phase power (MW, MWh, power factor)
- Elapsed time
- Motor thermal capacity usage
- Motor speed (with optional use of tachometer input and Linear ramp function)

Protection and Diagnostics

The following protection and diagnostics shall be provided as standard with the controller:

- Power loss (with phase indication; pre-start)
- Line fault (with phase indication; pre-start) advising:
  – Shorted SCR
  – Missing load connection
- Line fault (running protection) advising:
  – Power loss
  – Shorted SCR
  – Missing load connection
- Voltage unbalance ❶
- Phase reversal ❶
- Undervoltage ❶
- Overvoltage ❶
- Stall ❶
- Jam ❶
- Overload ❶
- Underload ❶
- Excessive starts/hour ❶
- Open gate (with phase indication)
- Overtemperature (power stack, with phase indication)
- Communication loss
- Motor temperature (via PTC input)
- Ground fault (with GFCT option)

❶ These protective features shall be defeatable.

7.0 Equipment Design and Selection (cont.)

Overload Protection

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

Note: The SMC-Flex control module does not include definite time trip elements for use with circuit breakers.

Tachometer Signal Conditioner (per Data Sheet)

- A panel-mounted tachometer signal conditioner (TSC) shall be made available for use with linear acceleration/deceleration applications.
- A suitable power supply will be provided with the TSC.
- The TSC shall be used to convert the motor speed feedback signal (in pulse format) to a 0 to 4.5 VDC level.

Mechanical

The control module shall be designed for mounting within the low voltage panel (for safety reasons) and shall be compatible with the full range of current and voltage ratings.

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

Programming and Display

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

The display shall be capable of depicting alphanumeric characters in any of the following languages, by adjustment of a single parameter:

- English
- French
- Spanish
- German
- Portuguese
- Mandarin

Communications

A serial communications port DPI (Drive Programming Interface), shall be provided as standard. Optional communications protocol interface modules shall be available for connection to Remote I/O, DeviceNet™, ControlNet™, Ethernet, RS-485, Modbus RTU, Modbus/HCP and Profibus-DP.

Current Loop Gate Driver (GLCD) Board

The board will provide the turn-on capability for SCR devices. The board will provide optical fiber isolation between itself and the gating source logic. It will be powered by recovering energy from the snubber circuit, so it is fully isolated from the control and logic circuits. The board will also receive short-term power from the current loop power supply.

The RVSS will have three heatsinks fitted with a thermistor to monitor temperature rise. The circuitry on the gate driver board accepts the thermistor, and drives a fiber-optic cable if the temperature is below the setpoint (85ºC). If the temperature rises above the setpoint, the driver is turned off, and the RVSS will be signaled to stop gating and initiate a temperature fault.

Control Module Interface Boards

The interface board shall provide for all the necessary feedback and control signals to operate the RVSS up to 14.4 kV. The following shall be incorporated

- Gate drive signals, sufficient for up to 12 devices per phase in conjunction with the Fiber Optic expansion board
- Current feedback
- Voltage feedback
- Power stack heatsink temperature feedback
- Power supply input requirements
  - 110-240 VAC (-15/+10%), 50/60 Hz
  - 15 VA
  - Auto-sensing (no jumpers required)

7.0 Equipment Design and Selection (cont.)

The interface board will provide for set-up and troubleshooting aids, as follows:

- Diagnostic LEDs
- Manual gate firing pulse enable/disable (only for use without MV applied to the unit)
- Heatsink temperature feedback enable/disable

Fiber Optic Expansion Board

The fiber optic expansion board accepts fiber gate drive signals from the Control Module Interface Board and splits them into the required fiber optic gate drive signals for 10-15 kV PowerBrick assemblies. The expansion board can control up to 36 SCRs.

Power supply input requirements:

- 110-240 VAC (-15/+10%), 50/60 Hz
- 25 VA maximum
- Universal input

Voltage Sensing Module

The voltage sensing board has six independent channels, with different sized resistors based on pre-defined voltage ranges, which convert voltages ranging between 10 and 14.4 kV down to save voltage levels that are used by the SMC Flex control module logic.

8.0 Transportation and Equipment

Delivery Times

Estimated drawing and shipment delivery times are based on receipt of all information at time of final quote and factory material lead times.

Actual on-site delivery will depend 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 will utilize tractors and trailers equipped with air-ride features, reducing the chance of damage and the need for extra packaging. All trailers shall have logistic posts allowing the most secure loading.

Special Packaging Requirements (per Data Sheet)

The Seller may 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.

9.0 Commissioning

Start-Up Commissioning Services (per Data Sheet)

Start-up services will be performed at the User's site, if purchased.

The Seller will provide 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 starter's mechanical and electrical devices enclosed.
- Perform a tug test on all internal connections within the controller and verify wiring.
- Verify critical mechanical connections for proper torque requirements.
- Verify and adjust mechanical interlocks for permanent location.
- Confirm all sectional wiring is connected properly.
- Re-verify control wiring from any external control devices.
- Set up auxiliary equipment with customer supplied parameters.

9.0 Commissioning (cont.)

- 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 motor system throughout the operational range to verify proper performance.
- User's personnel shall be required on-site to participate in the start-up of the system.

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

On-Site Training (per Data Sheet)

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

The training will cover the following topics:

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

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

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