

[PROJECT NUMBER]
[DATE]

[PROJECT NAME]
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ROCKWELL AUTOMATION

PROCUREMENT SPECIFICATION

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SMC™ Flex Reduced Voltage Solid-State Smart Motor Controllers

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PART 1 GENERAL

1.01 QUALIFICATIONS

A. Manufacturer

1. The manufacturer shall have a minimum of 25 years of experience in the manufacture of solid-state reduced-voltage controllers.
2. The approved manufacturers are:
 - a) Rockwell Automation Allen-Bradley
 - b) Substitutions: None permitted

B. Support

1. The manufacturer shall maintain factory-trained and authorized service facilities within 100 miles of the project and shall have a demonstrated record of service for at least the previous ten years.
2. Support personnel are to be direct employees of the manufacturer and be available 24 hours per day through a toll-free number.
3. The manufacturer shall provide all required start-up and training services.
4. The approved manufacturers are:
 - a) Rockwell Automation Customer Support & Maintenance
 - b) Substitutions: None permitted

C. Certification

1. To ensure all quality and corrective action procedures are documented and implemented all manufacturing locations shall be certified to the ISO-9001 Series of Quality Standards.
2. Third party manufacturers and brand labeling shall not be allowed.

1.02 REFERENCES

A. The controller shall be designed to meet or exceed the applicable requirements of the following agencies.

1. EN
2. UL
3. VDE
4. IEC
5. CSA
6. NEMA
7. IEEE
8. CCC

B. The following standards shall be met.

1. Creep distances and clearances 600V (UL/CSA) and 690V (IEC)
2. Power terminal markings per EN 50005 and EN 60947
3. Dielectric withstand per UL 508 and IEC 947

4. Noise and radio frequency (RF) immunity per NEMA ICSA1-109
5. Surge withstand per IEEE C57 and IEC 801-5

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Confirm to specified service conditions during and after installation of products.
- B. Maintain area free of dirt and dust during and after installation of products.

1.04 PRE-MANUFACTURE SUBMITTALS

- A. Refer to Section _____ for submittal procedures.
- B. Manufacturer Drawings
 1. Elevation drawings showing dimensional information
 2. Structure descriptions showing
 - a) Enclosure ratings
 - b) Fault ratings
 - c) Other information as required for approval
 3. Conduit locations
 4. Unit descriptions including amperage ratings, frame sizes, trip settings, pilot devices, etc.
 5. Nameplate Information
 6. Schematic wiring diagrams
- C. Product Data
 1. Publications on solid state reduced voltage controller.
 2. Data sheets and publications on all major components including but not limited to the following
 - a) Contactors
 - b) Circuit breakers and fuse information including time current characteristics
 - c) Control power transformers
 - d) Pilot devices
 - e) Relays
- D. Specification Response
 1. Detailed response to this specification showing where in the literature each requirement is satisfied.
 2. All clarifications and exceptions must be clearly identified.
- E. Installation Instructions
 1. Provide a copy of the manufacturer's installation instructions which includes the following:
 - a) Receiving, handling, and storage instructions
- F. Testing and Test Reports
 1. Testing shall be per manufacturer's standard.

2. A copy of the test reports, if available, shall be provided as part of the final documentation.

1.05 FINAL SUBMITTALS

- A. Refer to Section _____ for procedure on submittal of final documentation.
- B. The contractor shall provide certification that the solid state reduced voltage controller has been installed in accordance with the manufacturer's instructions.
- C. The contractor shall provide certification that the Contractor has properly adjusted any timing devices required in the starting circuitry.
- D. Final Drawings
 1. The manufacturer shall provide final drawings reflecting the "As-Shipped" state of the installed equipment.
 2. Manufacturer drawings shall be provided in DWG format.
 3. Manufacturer drawings do not need to be stamped if a drawing schedule is provided that lists the drawing numbers, revision levels, and status of drawings (Preliminary, Approval, Final, etc.)
 4. The contractor shall be responsible for making any changes to the "As-Shipped" drawings from the manufacturer to reflect any field modifications.
- E. Test reports, if available, indicating manufacturer's standard testing was performed.
- F. Maintenance Data
 1. Solid state reduced voltage controller installation instructions and User Manual.
 2. Installation / Operation instructions for major components such as circuit
 3. Parameter listing
 4. Field service report from start-up service
 5. Solid state reduced voltage controller spare parts listing and pricing
 6. Include name and phone number for a local distributor for the spare parts.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The contractor shall coordinate the shipping of equipment with the manufacturer.
- B. The contractor shall store the equipment in a clean and dry space.
- C. The contractor shall protect the units from dirt, water, construction debris and traffic.
- D. During storage the contractor shall connect internal space heaters (if specified) with temporary power.

1.07 FIELD MEASUREMENTS

- A. The contractor shall verify all field measurements prior to the fabrication of the solid state reduced voltage controller.

1.08 SPARE MATERIALS

- A. Provide one (1) set of three (3) of each size power fuse utilized.
- B. Provide spares equal to 10 percent of the installed quantity for primary and secondary control power fuses.
- C. Provide one (1) spare control relay for each unique relay utilized on the project.

1.09 WARRANTY

- A. The manufacturer shall provide their standard parts warranty for eighteen (18) months from the date of shipment or twelve (12) months from the date of being energized, whichever occurs first.
- B. The manufacturer shall confirm this warranty as part of the submittal.
- C. This warranty applies only to stand alone solid-state reduced-voltage controllers.

PART 2 PRODUCTS

2.01 RATINGS

- A. The solid state reduced voltage controller shall accept an input voltage from 200...480V AC, 200...600V AC, or 230...690V AC three-phase plus 10 percent or minus 15 percent.
- B. The solid-state reduced-voltage controller shall have a minimum short-circuit current rating of 65 kA when protected with a type CC/J/L fuses (up to 600V).
- C. Environmental Ratings
 - 1. Storage ambient temperature range: -25...+75°C.
 - 2. Operating ambient temperature range: 0...50°C.
 - 3. The relative humidity range: 5% ...95% non-condensing.
 - 4. Operating elevation: up to 2000 meters.
- D. Definitions
 - 1. The Solid-State Reduced-Voltage Controller Unit shall refer to the actual controller unit that will be mounted within the specified enclosure.
 - 2. The Solid-State Reduced-Voltage Controller System shall refer to the controller unit and all items specified under Controller System Options.

2.02 SOLID-STATE REDUCED-VOLTAGE CONTROLLER UNIT DESIGN

- A. The open-type controller device shall be modular, consisting of a power structure and a logic component.
- B. Power Structure
 - 1. The family of devices must be available from 1...1250 A in a line connection
 - 2. The family of devices must be available from 1...1600 A when connected inside the delta
 - a) The inside the delta mode must be enabled with a parameter setting on the device
 - 3. The power structure shall include an electro-mechanical SCR bypass device.
 - 4. The power structure shall include built-in 3-phase current monitoring and overload protection.
 - 5. The power structure shall consist of three power poles with integral heatsinks.
 - 6. The power poles are to be modular in design that each is easily replaceable
 - 7. Back-to-back SCR pairs shall be the only power switching semiconductor means acceptable. Diode-SCR (Silicon Controlled Rectifier) combinations shall not be acceptable.
 - 8. SCRs shall have the following minimum repetitive peak inverse voltage ratings.

- a) 1400V for units rated 200...480V
- b) 1600V for units rated 200...600V
- c) 1800V for units rated 230...690V

- 9. SCRs shall have built in temperature monitoring sensors.
- 10. Use of an External bypass must be an option
- 11. The manufacture must supply guidance on obtaining SCR protection

C. Logic Component

- 1. The logic component shall be a self-contained control module, compatible with the full range of power structures. The control module shall mount directly to the power structure.
- 2. The control module shall provide digital microprocessor control and supervision of all controller operation, including pulse firing of the SCRs.
- 3. The control module shall consist of the following.
 - a) Self-tuning power supply accepting control power input from 100...240V AC or 24V AC/DC, 50/60 Hz.
 - b) Logic control circuitry incorporating a latch circuit for three-wire control.
 - c) SCR firing circuitry that incorporates an RC snubber network to prevent false firing.
 - d) Input / output circuitry
 - e) Digital programming keypad
 - f) Backlit LCD display with multi-lingual capabilities
 - g) DPI communication port
- 4. The control terminals shall have the following characteristics
 - a) The control terminal wiring connector shall be easily accessible and located on the front top of the device.
 - b) The terminals shall be UL rated for 300V, 10 A maximum.
 - c) The terminals are UL Recognized to accept a maximum of two (2) wires rated #8...#14 AWG.
- 5. The control module shall be easily removed from the power structure, without the need to disassemble associated printed circuit board assemblies.

2.03 SOLID-STATE REDUCED-VOLTAGE CONTROLLER UNIT MODES

A. Starting Modes

- 1. Soft start with Selectable Kickstart
 - a) Programmable initial torque value of 0...90% of locked rotor torque.
 - b) Programmable acceleration ramp time from 0...30 seconds.
 - c) A selectable kickstart, or boost, shall be provided at the beginning of the voltage ramp. The kickstart shall provide a current pulse of 550 percent of the full load current. The kickstart time shall be adjustable from 0...2 seconds.

- d) Current limit start
 - e) Provides means of limiting the maximum starting current
 - f) Adjustable from 50...600% of motor full load current.
- 2. Full-voltage start
 - a) Provides across the line starting.
 - b) Ramp time shall be less than 0.25 seconds.
 - 3. Dual ramp start
 - a) Provides two (2) separate start profiles with separately adjustable ramp times and initial torque, settings.
 - b) Programmable acceleration times from 0... 30 seconds.
 - c) Current limit level programmable from 50...600% full load current.
 - d) Programmable initial torque values from 0...90% of locked rotor torque.
- B. Stopping Modes
- 1. Soft stop
 - a) The soft stop option shall provide a voltage ramp-down for an extended motor stopping time.
 - b) Soft stop shall be initiated by a dedicated Soft Stop input. A coast-to-rest stop shall still be possible with a separate stop input.
 - c) Programmable voltage ramp down time from 0...60 seconds.
 - d) The load shall stop when the motor voltage drops to a point where the load torque is greater than the motor torque
 - 2. Preset Slow Speed
 - a) Provides a slow speed for applications requiring a slow speed.
 - b) The Preset Slow Speed option shall provide two jog speeds in the forward direction: high (15% of base speed) and low (7% of base speed).
 - c) The Preset Slow Speed option shall provide two jog speeds in the reverse direction: high (20% of base speed) and low (10% of base speed). Reverse operation of the motor shall be available in the jog mode without the use of a reversing contactor
 - d) The starting current for the slow speed operation shall be user adjustable from 0...450% of the motor's full load current rating.
 - e) The running current for the slow speed operation shall be user adjustable from 0... 450% of the motor's full load current rating.
- C. Mutually exclusive starting and stopping modes. Refer to the system specifications for the option (if any) required
- 1. Pump Control
 - a) The Pump Control option shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping. This shall aid in eliminating the phenomena commonly referred to as "water hammer." Methods utilizing Soft Start with Soft Stop shall not be acceptable.

- b) Closed loop control shall be achieved without using external sensors or feedback devices.
- c) 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.
- d) Programmable starting time from 0...30 seconds.
- e) Programmable stopping time from 0...120 seconds.

2.04 SOLID-STATE REDUCED-VOLTAGE CONTROLLER UNIT FEATURES

A. LCD Display

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

B. Overload Protection

- 1. Shall meet applicable standards as a motor thermal protective device.
- 2. Shall utilize three-phase current sensing. The use of two current transformers shall be unacceptable.
- 3. Selectable trip classes of 10, 15, 20, and 30 shall be provided as standard.
- 4. Electronic thermal memory shall provide enhanced motor protection.

C. Digital I/O

- 1. A minimum of four (4) auxiliary contacts shall be provided for customer use
- 2. The contacts shall be rated for 240V AC maximum.
- 3. Contact configuration shall be programmable and contain the following configurations:
 - a) Normal Operation (N.O. or N.C.)
 - b) Up-to-Speed indication (N.O. or N.C.)
 - c) External bypass
 - d) Fault indication (N.O. or N.C.)
 - e) Alarm indication (N.O. or N.C.)
 - f) Network controlled output (N.O. or N.C.)

D. DPI Serial Communication Port

- 1. A DPI serial communication ports shall be provided as standard.
- 2. Optional communication protocol interface modules that shall be available for connection to EtherNet/IP, Remote I/O, DH485, ControlNet, DeviceNet and RS232/422/485.
- 3. Refer to the system specification for the options (if any) required.

E. Monitoring – the controller shall provide the following motor and/or power system monitoring functions indicated through the optional LCD display.

- 1. Three-phase current
- 2. Three-phase voltage
- 3. Power in kW

4. Power usage in kWh or MWh
5. Power factor
6. Motor thermal capacity usage
7. Elapsed time

F. Protection and Diagnostics

1. Pre-start line fault advising of shorted SCR or missing load connection with phase indication.
2. Running line fault advising power loss, shorted SCR, or missing load connection.
3. Pre-start power loss with phase indication.
4. Over temperature
5. Open gate with phase indication.
6. The following programmable protection shall be provided as standard with the controller.
 - a) Overload
 - b) Underload
 - c) Undervoltage
 - d) Overvoltage
 - e) Voltage unbalance
 - f) Phase reversal
 - g) Stall
 - h) Jam
 - i) Excessive starts per hour
7. When fault conditions are detected, the controller shall inhibit starting or shutting down SCR pulse firing.
8. Fault diagnostics shall be indicated in descriptive text on the LCD display. The exclusive use of fault codes is unacceptable.
9. An auxiliary contact that is user programmable for fault indication shall be provided for customer use.

2.05 SOLID-STATE REDUCED-VOLTAGE CONTROLLER SYSTEM OPTIONS

A. Enclosure

1. NEMA 12 enclosure for indoor use to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids. They shall be designed to meet drip, dust and rust resistance tests. No ventilation openings shall be allowed.
2. Paint: ANSI 49 Gray
3. Unless indicated differently, provide top entry and bottom exit for power cables.
4. Provide a 6.25 in. x 2 in. door-mounted white lamacoid nameplate with black letters (message to be defined during submittal).
5. UL label

B. Transient Protection Modules

1. Transient protection with separately mounted protective modules.
2. Protective modules shall consist of metal oxide varistors (MOVs) in combination with capacitors to protect the power components from electrical transients and / or electrical noise. The capacitors shall be provided to shunt noise energy away from the controllers electronics.

3. The MOVs and capacitors shall be encapsulated in a clear material for easy inspection.
4. The protective modules shall be mounted so that they will not cause damage to the power components upon absorbing an electrical transient.
5. The MOVs shall be rated for a minimum of 220 joules.

C. Input Circuit Breaker

1. Provide a door interlocked thermal magnetic circuit breaker disconnect
2. Operator Handles
 - a) Provide flange mounted operator handles for free standing units
 - b) Through the door operating handles are acceptable for wall mounted units
 - c) Handles shall be padlockable
3. The system shall be rated for 30,000 A. The rating shall be shown on the system label.

D. Input Isolation

1. An input contactor between the AC line and the controller can be provided.
2. The contactor shall have two N.O. and two N.C. auxiliary contacts.

E. Control Power Transformer

1. Provide a control power transformer mounted and wired inside of the system enclosure.
2. The transformer shall be rated for an additional 100 VA for customer use.
3. The transformer shall be provided with fused primary and secondary protection.

F. Hand-Off-Auto Selector Switch

1. Provide a "Hand/Off/Auto" selector switch for start-stop control
2. Provide pilot lights for indication of the "Hand" and "Auto" modes
3. The devices shall be Allen-Bradley Bulletin 800E pilot devices (22.5 mm, NEMA Type 4/4X/13) mounted on the enclosure door.

G. Start-Stop Push buttons

1. Provide Start-Stop and Pump Stop (if required) push buttons. Stop push buttons shall always be active.
2. The devices shall be Allen-Bradley Bulletin 800E (22.5 mm, NEMA Type 4/4X/13) pilot devices mounted on the enclosure door.

H. Pilot Lights

1. Provide pilot lights, mounted on the enclosure door, for indication of On, Off and Fault.
2. Pilot lights shall be transformer type
3. The devices shall be Allen-Bradley Bulletin 800E (22.5 mm, NEMA Type 4/4X/13) pilot devices mounted on the enclosure door.

I. Pump Control Option

1. For pumping applications provide the Pump Control option.
- J. Human Interface Module (HIM)
1. Provide a door mounted Human Interface Module with integral display and programming keys.
 2. The display shall show operating conditions, adjustments and fault indications.
 3. The display shall be backlit LCD and shall consist of four lines of 16 characters alphanumeric.

PART 3 EXECUTION

3.01 MANUFACTURER'S SERVICES

- A. The service division of the manufacturer shall perform all start-up services.
- B. Start-up personnel shall be direct employees of the manufacturer and shall be degreed engineers.
- C. At a minimum, the start-up service shall include:
 1. Pre-power check
 - a) Megger motor resistance: phase-to-phase and phase-to-ground
 - b) Verify system grounding per manufacturer's specifications
 - c) Verify power and signal grounds
 - d) Check connections
 - e) Check environment
 2. Power-up and commissioning
 - a) Measure incoming power phase-to-phase and phase-to-ground
 - b) Measure DC bus voltage
 - c) Measure AC current unloaded and loaded
 - d) Measure output voltage phase-to-phase and phase-to-ground
 3. Recording of all measurements
 4. Tuning for system operation
 5. Providing a parameter list

3.02 TRAINING

- A. Manufacturer to provide a quantity of one (1) session of on-site instruction.
- B. The service engineer shall perform training.
- C. The instruction shall include the operational and maintenance requirements of the controller
- D. The basis of the training shall be the installed controller, the engineered drawings and the user manual. At a minimum, the training shall do the following:
 - 1. Review of the engineered drawings identifying the components shown on the drawings.
 - 2. Review starting / stopping options for the controller.
 - 3. Review operation of the Human Interface for programming and monitoring of the controller.
 - 4. Review the maintenance requirements of the controller.
 - 5. Review safety concerns with operating the controller.

End of section.

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