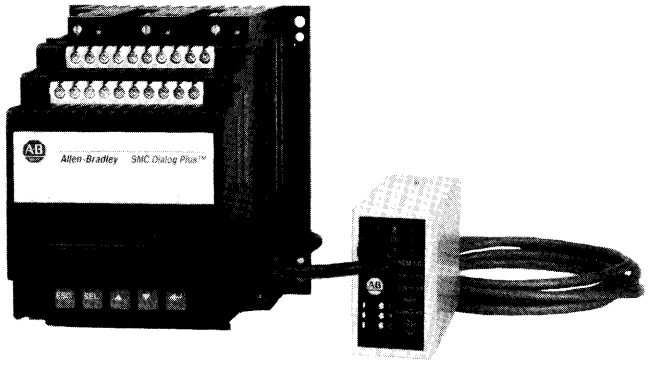
# SMC Dialog Plus™ Controller

Bulletin 150

## Feature Summary




## 1. General

1.1 This document describes the requirements for a solid-state reduced voltage starter (controller) used to provide ramp starting and stopping of three-phase AC induction motors or resistive loads.

1.2 Electrical Ratings

- 24 to 1000 Amps
- 200 to 600 Volts
- 50 to 60 Hz

1.3 The controller shall provide the following starting modes as standard:

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

## 1. General (continued)

1.4 The controller shall offer the following optional features:

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

## 2. Construction

2.1 The open-type device shall be modular, consisting of a logic component and a power structure.

2.2 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 without the use of wiring.

2.3 The power structure shall consist of three power modules mounted on a heatsink for ratings up to and including 135 Amps. For ratings 180 Amps to 1000 Amps, the power structure shall consist of three power poles with integral heatsinks.

## 3. Codes and Standards

3.1 The controller shall be designed to meet the applicable requirements of:

- EN
- IEC
- UL
- CSA
- NEMA
- IEEE
- VDE

3.2 These standards shall include:

- Creep distances and clearances 600V (UL/CSA) and 500V (IEC)
- Power terminal markings per EN 50005 and EN 60947
- Dielectric withstand per UL508 and IEC947
- Noise and radio frequency (RF) immunity per NEMA ICS 1-109
- Surge withstand per IEEE587 and IEC 801-5

## 4. Control Module Design Features

4.1 Mechanical

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

4.1.2 The control module shall be designed for integral mounting on the power structure and shall be compatible with the full range of current ratings — 24 Amps to 1000 Amps.

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

4.1.4 Control terminals shall be easily accessible, and located on the front top of the device. The terminals shall be UL rated for 300 Volts, 10 Amps maximum and accept a maximum of two wires, 0.75-2.5mm$^2$ (#18-#14 AWG).

4.1.5 Digital parameter adjustment shall be provided through a built-in keypad. Analog potentiometer adjustments are not acceptable.

4.1.6 A built-in alphanumeric, backlit LCD display shall be provided for controller set-up, diagnostics, status, and monitoring. The display shall be two-line, 16-characters minimum.

4.1.7 A serial communication port shall be provided as standard. Optional communication protocol interface modules shall be available for connection to Remote I/O, DH485, DeviceNet™, and RS 232/422/485.

4.1.8 A minimum of three auxiliary contacts shall be provided for customer use. These shall be programmable as follows:

- Two form C SPDT: normal (instantaneous) or up-to-speed
- One SPST: normal or fault; N.O. or N.C.

**Table A**
**Ratings**

| | Configuration | NEMA Rating | Continuous | Sealed | Inrush | Voltage |
|---|---|---|---|---|---|---|
| Form C | N.O. | B300 | 5A | 360VA | 3600VA | 240 V AC max. |
| | N.C. | C300 | 2.5A | 180VA | 1800VA | |
| SPST | N.O./N.C. | C300 | 2.5A | 180VA | 1800VA | |

## 4. Control Module Design Features (continued)

4.2 Electrical

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

4.2.2 The control module's power supply shall be self-tuning to accept control power input from 100 to 240 VAC, 50/60 Hz.

4.2.3 The SCR firing circuitry shall incorporate an RC snubber network to prevent false SCR firing.

4.2.4 The logic circuitry shall incorporate a latch circuit for three-wire control.

4.3 User Adjustments

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

4.3.2 The initial torque setting shall be adjustable from 0 to 90% of locked rotor torque.

4.3.3 Current limit starting shall be adjustable from 50 to 600% of the motor's full load current.

4.3.4 A selectable kickstart feature shall be available to provide a current pulse at 550% of the motor's full load current rating. The time period shall be adjustable from 0.0 to 2.0 seconds.

4.4 Monitoring

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

- Phase-to-phase supply voltage
- Three-phase line current
- Watts in kW
- kWH
- Elapsed time
- Power factor
- Motor thermal capacity usage

4.5 Protection and Diagnostics

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

- Power loss (with phase indication; pre-start)
- Line fault (with phase indication; pre-start) advising:
  - Shorted SCR
  - Missing load connection
- Line fault (running protection) advising:
  - Power loss
  - Shorted SCR
  - Missing load connection
- Voltage unbalance ❶
- Phase reversal ❶
- Undervoltage ❶
- Overvoltage ❶
- Stall ❶
- Jam ❶
- Overload ❶
- Underload ❶
- Excessive starts/hour ❶
- Open gate (with phase indication)
- Controller overtemperature

❶ *These protective features shall be defeatable.*

4.5.2 Overload protection shall be as follows:

- Meets applicable standards as a motor thermal 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.
- Overload protection shall be available through the controller, even in a bypass configuration.

4.5.3 When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.

## 4. Control Module Design Features (continued)

4.5.4 Fault diagnostics shall be indicated in descriptive text on the built-in LCD display. The exclusive use of fault codes shall be unacceptable.

4.5.5 An auxiliary contact that is programmable for fault indication shall be provided for customer use.

## 5. Control Options

5.1 Soft Stop

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

5.1.2 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.

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

5.2 Pump Control

5.2.1 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.

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

5.2.3 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.

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

5.3 Preset Slow Speed

5.3.1 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).

5.3.2 Two jog speeds shall also be available in the reverse direction: high (20% of base speed) and low (10% of base speed).

5.3.3 Reverse operation of the motor shall be achievable in the jog mode without the use of a reversing contactor.

5.3.4 The starting current for the slow speed operation shall be user adjustable from 0 to 450% of the motor's full load current rating.

5.3.5 The running current for the slow speed operation shall be user adjustable from 0 to 450% of the motor's full load current rating.

5.4 SMB Smart Motor Braking

5.4.1 The SMB Smart Motor Braking option shall provide braking torque to the motor to shorten the time period for the motor to come to rest.

5.4.2 Braking shall be achieved without using additional equipment such as resistors or contactors.

5.4.3 The controller shall bring the motor to rest and automatically shut it down when zero speed is sensed.

5.4.4 Additional equipment, such as tachometers, encoders, or speed switches, shall not be required for sensing a zero-speed condition.

5.4.5 Braking shall be initiated by a dedicated brake input. A coast-to-rest stop shall still be possible with a separate stop input.

5.4.6 The strength of the braking torque shall be user adjustable from 0 to 400% of the motor's full load current rating.

5.5 Accu-Stop/Slow Speed with Braking

5.5.1 The Accu-Stop/Slow Speed with Braking option shall provide general positioning control by providing jogging and braking control.

5.5.2 Two jog speeds in the forward direction shall be provided for both the starting and end-of-cycle periods: high (15% of base speed) and low (7% of base speed).

5.5.3 The starting current for the slow speed operation shall be user adjustable from 0 to 450% of the motor's full load current rating.

5.5.4 The running current for the slow speed operation shall be user adjustable from 0 to 450% of the motor's full load current rating.

5.5.5 Braking shall provide braking torque to the motor to shorten the time period for the motor to reach the preset slow speed or brake to zero speed.

## 5. Control Options (continued)

5.5.6 Braking shall be achieved without the use of additional equipment such as resistors or contactors.

5.5.7 The strength of the braking torque shall be user adjustable from 0 to 400% of the motor's full load current rating.

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

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

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

## 6. Power Structure Design Features

6.1 Mechanical: 24 Amps to 135 Amps

6.1.1 The power structure shall consist of three plug-in modules for controllers rated 24 Amps to 135 Amps.

6.1.2 The three power modules rated 24 Amps to 135 Amps shall be mounted on a single heatsink. The heatsink shall be isolated from the power modules and shall have a grounding provision.

6.1.3 Power modules rated 24 Amps to 135 Amps shall be encapsulated and shall include two power-switching semiconductors and control module interface pins. Integral lugs for power wiring terminations shall be provided for controllers rated 24 Amps to 54 Amps.

Mechanical: 180 Amps to 1000 Amps

6.1.4 The power structure for controllers rated 180 Amps to 1000 Amps shall consist of three power poles with a clamped pair of hockey puck style power switching semiconductors.

6.1.5 The individual power poles for controllers rated 180 Amps to 1000 Amps shall have integral, power-conducting heatsinks that mount to the controller-mounting flange. The controller-mounting flange shall have a grounding provision.

6.1.6 For controllers rated 180 Amps to 1000 Amps, a printed circuit board shall be provided to interface the control module with the power structure. Interface pins shall be located on the printed circuit board for direct mounting of the control module.

6.2 Electrical

6.2.1 Back-to-back SCR pairs shall be the only power-switching semiconductor means acceptable. Diode-SCR combinations shall not be acceptable.

6.2.2 There shall be separate power sections to operate from 200V to 480V and 200V to 600V, 50/60 Hz.

6.2.3 SCRs shall have the following minimum repetitive peak inverse voltage ratings:

- 200 to 480V: 1400V
- 200 to 600V: 1600V

6.2.4 The power section shall have a minimum thermal capacity rating of 600% of the controller's current rating for 10 seconds.

6.3 Transient Protection: 24 Amps to 360 Amps

6.3.1 For controllers rated 24 Amps to 360 Amps, transient protection with separately mounted protective modules shall be available as an option.

6.3.2 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 controller's electronics.

6.3.3 The MOVs and capacitors shall be encapsulated in a clear material for easy inspection.

6.3.4 The protective modules shall be mounted so that they will not cause damage to the power components upon absorbing an electrical transient.

6.3.5 The MOVs shall be rated for a minimum of 220 joules.

Transient Protection: 500 Amps to 1000 Amps

6.3.6 For controllers rated 500 Amps to 1000 Amps, transient protection shall be provided as standard.

6.3.7 The MOVs shall be rated for a minimum of 220 joules for 200-480V rated controllers and 300 joules for 200-600V rated controllers.

6.3.8 Integral fusing shall be provided for additional protection.

## 7. Energy Saver

7.1 The Energy Saver feature shall operate to automatically cause the output voltage from the controller to be reduced when a motor is unloaded or lightly loaded.

7.2 Customer adjustments shall not be required.

7.3 The Energy Saver feature shall be defeatable.

7.4 Additional mounting space or wiring shall not be required.

## 8. Phase Rebalance

8.1 When the Phase Rebalance feature is enabled, the controller shall regulate the individual phase output voltages from the controller to maintain equal three-phase currents to the motor.

8.2 Customer adjustments shall not be required.

8.3 The Phase Rebalance feature shall be defeatable.

8.4 Additional mounting space or wiring shall not be required.

## 9. Environmental Ratings

9.1 Temperature Ratings

9.1.1 The open-type device shall deliver its rated current in ambient temperatures ranging from 0°C to +50°C.

9.1.2 The ambient storage temperature shall range from –20°C to +75°C.

9.2 Humidity Range

9.2.1 The controller shall be operable in relative humidity of 5 to 95%, non-condensing.

9.3 Shock and Vibration

9.3.1 The controller shall withstand a 30G shock for 11 ms in any plane without malfunction.

9.3.2 The controller shall withstand 2.5G vibration for one hour in any plane without malfunction.

9.4 Altitude Rating

9.4.1 The controller shall be suitable for operation up to altitudes of 2,000 meters without derating.

9.5 Noise and RF Immunity

9.5.1 The controller shall perform without malfunction from showering arc tests of 500V to 1500V (NEMA ICS 2-230).

9.5.2 The controller shall perform without malfunction when subjected to 3000V surges at a rate of 100 bursts per second for 10 seconds (IEEE STD 472).

9.6 Dielectric Withstand

9.6.1 The controller shall be tested to withstand 1000V + 2x (voltage rating) at a rate of 200V per second (held for 60 seconds, then gradually reduced) between live parts and ground.

9.6.2 The controller shall be subjected to an additional test at the previous voltage level plus 20% for one second (UL 508) (CSA Std. C22.2).

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