



Bulletin 150 — Smart Motor Controllers — SMC-3™ Smart Motor Controller

The **SMC-3™** is a compact, simple to use, solid-state motor controller designed to operate 3-phase motors. It features a built-in overload relay and a built-in SCR bypass contactor on all three phases, allowing a smaller footprint than other soft starters on the market. This product is designed for many applications, including compressors, chillers, pumps, conveyors, and crushers. Modes of operation for the controller are as follows:

- Soft Start
- Current Limit Start
- Kick Start
- Soft Stop
- Coast-to-Rest

The controllers are available in 10 sizes: 3, 9, 16, 19, 25, 30, 37, 43, 60, and 85 A. They offer two voltage ranges: 200...480V AC and 200...600V AC. All voltage ranges will operate at either 50 or 60 Hz.

- 1...85 A Range
- Built-In Overload
- SCR Bypass

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Standards Compliance

- UL 508
- CSA C22.2 No. 14
- EN/IEC 60947-4-2
- cULus Listed (Open Type)
- (File No. E96956)

Approvals

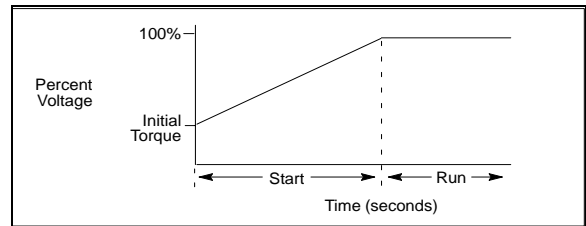
- CE Marked (Open Type) per EMC Directive and Low Voltage Directive

Your order must include 1) cat. no. of the controller selected, 2) if required, suffix code and description of any modifications, and 3) if required, cat. no. of any options or accessories.

Modes of Operation

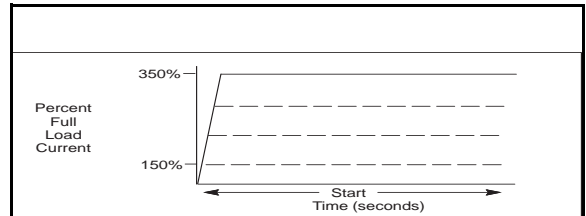
Soft Start

This method has the most general application. The motor is raised from an initial torque value to full voltage. This initial torque is adjustable to 15%, 25%, 35%, or 65% of locked rotor torque. The motor voltage is gradually increased during the acceleration ramp time, which can be adjusted from 2, 5, 10, 15, 20, 25, or 30 s.



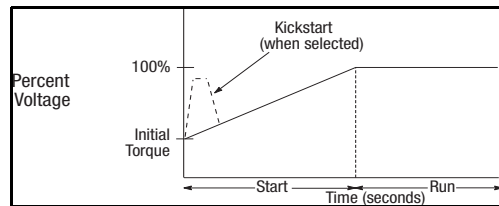
Current Limit Start

This starting mode is used when it is necessary to limit the maximum starting current. It can be adjusted for 150%, 250%, 350%, or 450% of full load amps. Start times are selectable from 2, 5, 10, 15, 20, 25, or 30 s.



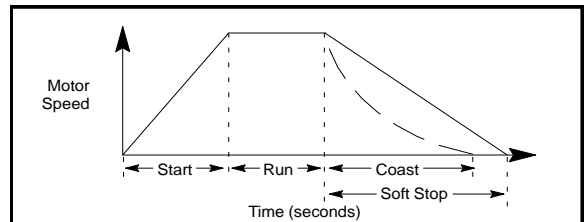
Selectable Kick Start

A kickstart, or boost, at the beginning of the start mode is intended to provide a current pulse of 450% of full load current. The kickstart time is adjustable from 0.5...1.5 seconds. This allows the motor to develop additional torque at start for loads which may need a boost to get you started.



Soft Stop

The Soft Stop function can be used with applications that require an extended coast to rest. When enabled, the voltage ramp down time can be selected to one, two, or three times the starting time. The motor will stop when the motor voltage drops to a point where the load torque is greater than the motor torque.



Description of Features

Electronic Motor Overload Protection

The SMC-3 controller incorporates, as standard, electronic motor overload protection. This motor overload protection is accomplished electronically with the use of current transformers on each of the three phases. The controller's overload protection is programmable, providing the user with flexibility. The overload trip class selection consists of either OFF, 10, 15, or 20. The trip current is easily selected by adjusting the rotary potentiometer to the motor full load current rating. Trip reset is selectable to either automatic or manual mode.

Note: Trip rating is 120% of dial setting.

Over-temperature

The SMC-3 monitors the SCR temperature by means of internal thermistors. When the power poles maximum rated temperature is reached, the microcomputer switches off the SMC and a TEMP fault is indicated via LED.

Phase Reversal Protection

When enabled via a DIP switch, 3-phase input power will be verified before starting. If input power phasing is detected to be incorrect, the start will be aborted and a fault indicated.

Phase Loss/Open Load

The unit will not attempt a start if there is a single-phase condition on the line. This protects from motor burnout during single-phase starting.

Phase Imbalance

The unit monitors for imbalance between phase currents. To prevent motor damage, the unit will trip if the phase imbalance exceeds specified limits and a fault will be indicated on the LED.

Shorted SCR

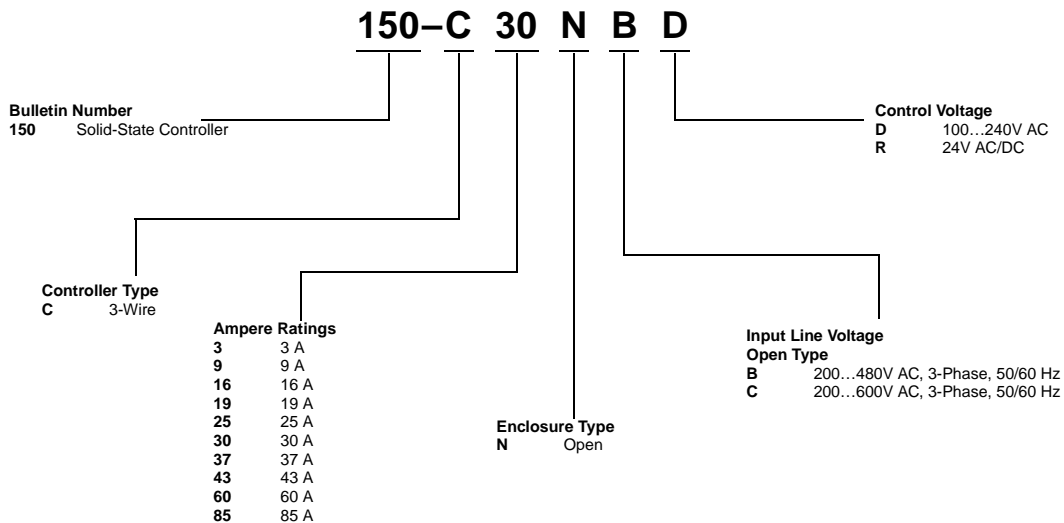
Prior to every start, the unit will check all SCRs for shorts and unit load connections to the motor. If there is a shorted SCR in the SMC-3 and/or open load, the start will be aborted and a shorted SCR/open load fault will be indicated. This prevents damage from phase imbalance.

LED Description (Number of Flashes)

1. Overload
2. Overtemperature
3. Phase Reversal
4. Phase Loss/Open Load
5. Phase Imbalance
6. Shorted SCR
7. Test

Cat. No. Explanation

Open and Non-Combination



Product Selection

Open Type Controllers

Up to 480V AC

Current Rating (A) ⓘ	kW				Hp						100...240V AC 50/60 Hz Control Cat. No.	24V AC/DC Control Cat. No.
	230V AC 50 Hz		380/400/ 415V AC 50 Hz		200V AC 60 Hz		230V AC 60 Hz		460V AC 60 Hz			
	Starting Duty											
	350%	450%	350%	450%	350%	450%	350%	450%	350%	450%		
1...3	0.55	0.37	1.1	0.75	0.5	0.5	0.5	0.5	0.5...1.5	0.5...1	150-C3NBD	150-C3NBR
3...9	2.2	1.5	4	3	0.75...2	0.75...1.5	0.75...2	0.75...2	1.5...5	1.5...3	150-C9NBD	150-C9NBR
5.3...16	4	3	7.5	5.5	1.5...3	1.5...3	1.5...5	1.5...3	5...10	5...7.5	150-C16NBD	150-C16NBR
6.3...19	4	4	7.5	5.5	1.5...5	1.5...3	2...5	2...3	5...10	5...10	150-C19NBD	150-C19NBR
8.3...25	5.5	4	11	9.5	3...7.5	3...5	3...7.5	3...5	7.5...15	7.5...10	150-C25NBD	150-C25NBR
10...30	7.5	5.5	15	11	3...7.5	3...5	5...10	5...7.5	7.5...20	7.5...15	150-C30NBD	150-C30NBR
12.3...37	7.5	7.5	18.5	15	5...10	5...7.5	5...10	5...10	10...25	10...20	150-C37NBD	150-C37NBR
14.3...43	11	7.5	22	15	5...10	5...7.5	5...15	5...10	10...30	10...20	150-C43NBD	150-C43NBR
20...60	15	11	30	22	7.5...15	7.5...10	7.5...20	7.5...15	15...40	15...30	150-C60NBD	150-C60NBR
28.3...85	22	18.5	45	37	10...25	10...20	15...30	15...20	25...60	25...50	150-C85NBD	150-C85NBR

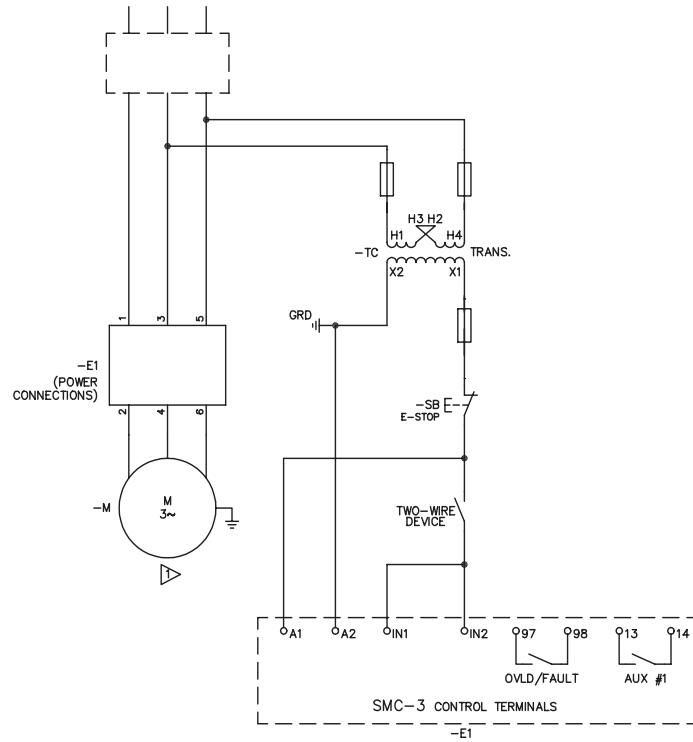
Up to 600V AC

Current Rating (A) ⓘ	kW						Hp								100...240V AC 50/60 Hz Control Cat. No.	24V AC/DC Control Cat. No.
	230V AC 50 Hz		380/400/415V AC 50 Hz		500V AC 50 Hz		200V AC 60 Hz		230V AC 60 Hz		460V AC 60 Hz		575V AC 60 Hz			
	Starting Duty															
	350%	450%	350%	450%	350%	450%	350%	450%	350%	450%	350%	450%	350%	450%		
1...3	0.55	0.37	1.1	0.75	1.5	1.1	0.5	0.5	0.5	0.5	0.5...1.5	0.5...1	0.75...2	0.75...1	150-C3NCD	150-C3NCR
3...9	2.2	1.5	4	3	5.5	4	0.75...2	0.75...1.5	0.75...2	0.75...2	1.5...5	1.5...3	3...7.5	3...5	150-C9NCD	150-C9NCR
5.3...16	4	3	7.5	5.5	7.5	7.5	1.5...3	1.5...3	1.5...5	1.5...3	5...10	5...7.5	5...10	5...10	150-C16NCD	150-C16NCR
6.3...19	4	4	7.5	5.5	11	7.5	1.5...5	1.5...3	2...5	2...3	5...10	5...10	7.5...15	7.5...10	150-C19NCD	150-C19NCR
8.3...25	5.5	4	11	9.5	15	11	3...7.5	3...5	3...7.5	3...5	7.5...15	7.5...10	7.5...20	7.5...15	150-C25NCD	150-C25NCR
10...30	7.5	5.5	15	11	18.5	15	3...7.5	3...5	5...10	5...7.5	7.5...20	7.5...15	10...25	10...20	150-C30NCD	150-C30NCR
12.3...37	7.5	7.5	18.5	15	22	18.5	5...10	5...7.5	5...10	5...10	10...25	10...20	15...30	15...25	150-C37NCD	150-C37NCR
14.3...43	11	7.5	22	15	22	22	5...10	5...7.5	5...15	5...10	10...30	10...20	15...40	15...30	150-C43NCD	150-C43NCR
20...60	15	11	30	22	37	37	7.5...15	7.5...10	7.5...20	7.5...15	15...40	15...30	20...50	20...40	150-C60NCD	150-C60NCR
28.3...85	22	18.5	45	37	55	45	10...25	10...20	15...30	15...20	25...60	25...50	30...75	30...60	150-C85NCD	150-C85NCR

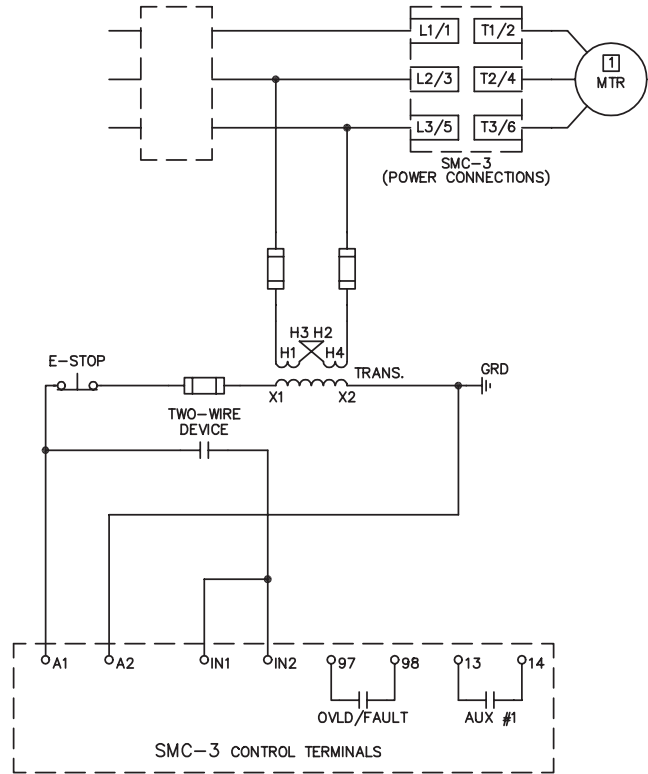
ⓘ Motor FLA must fall within the current range of the device.

Two-Wire Configuration

IEC

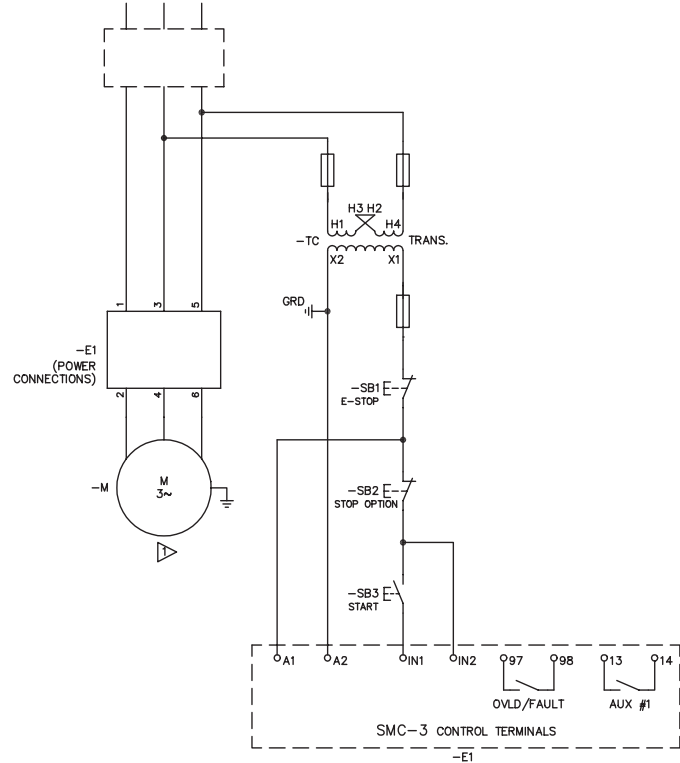


NEMA

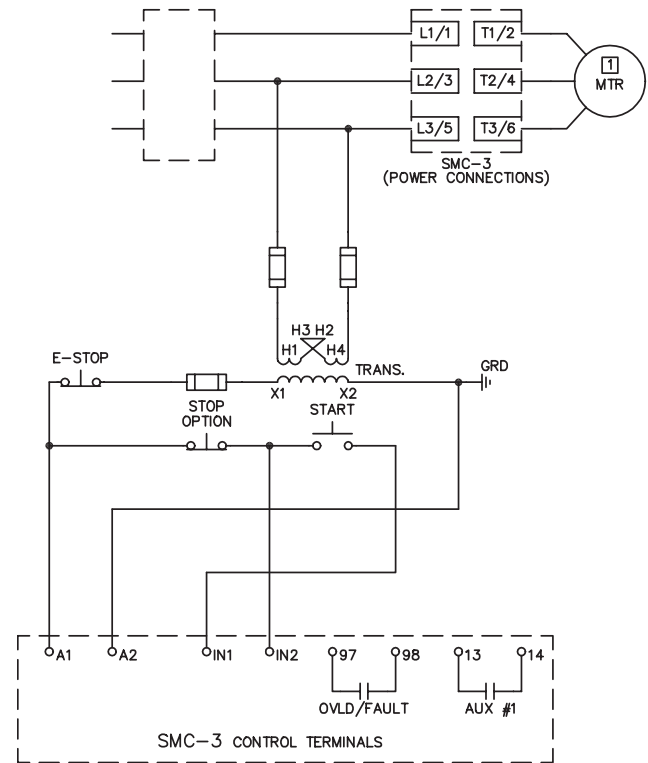


Three-Wire Configuration

IEC



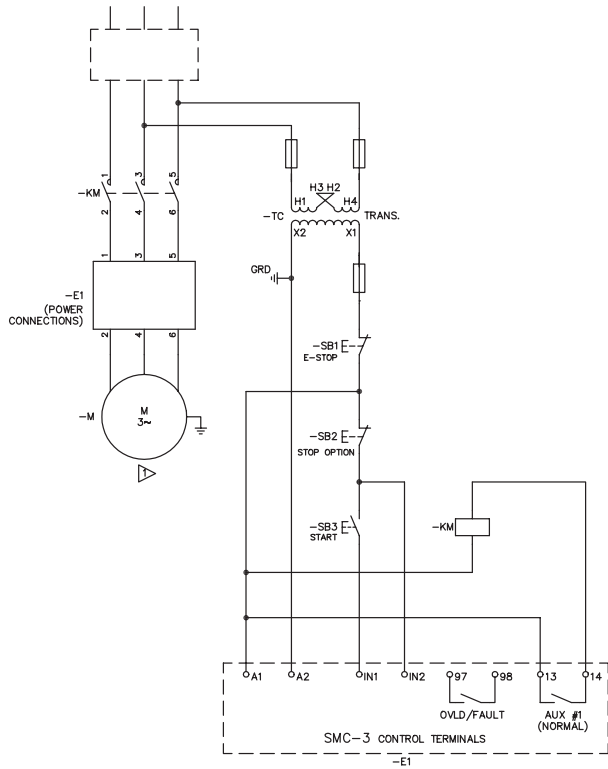
NEMA



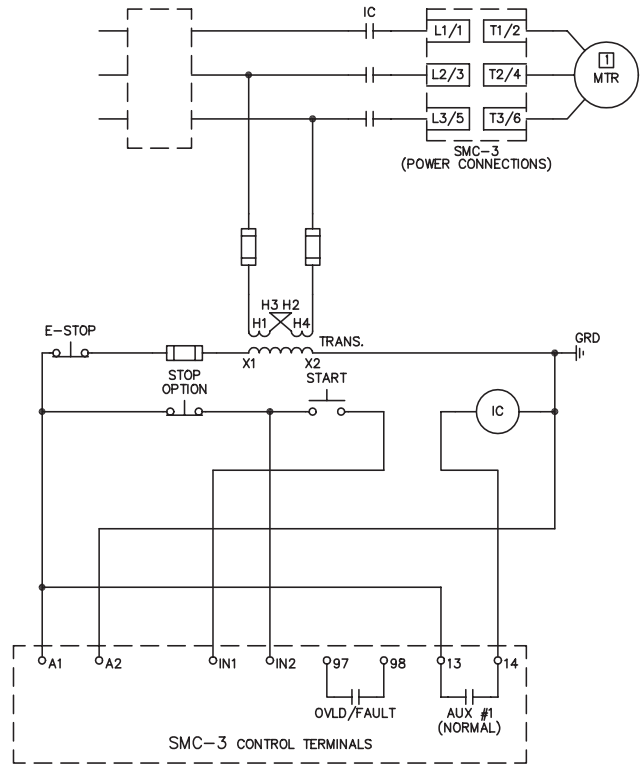
Typical Wiring Diagrams, Continued

Isolation Contactor Configuration

IEC



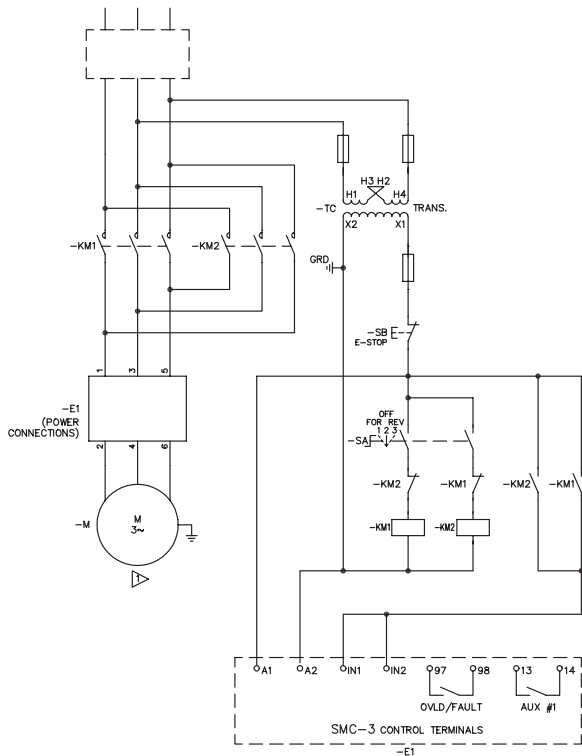
NEMA



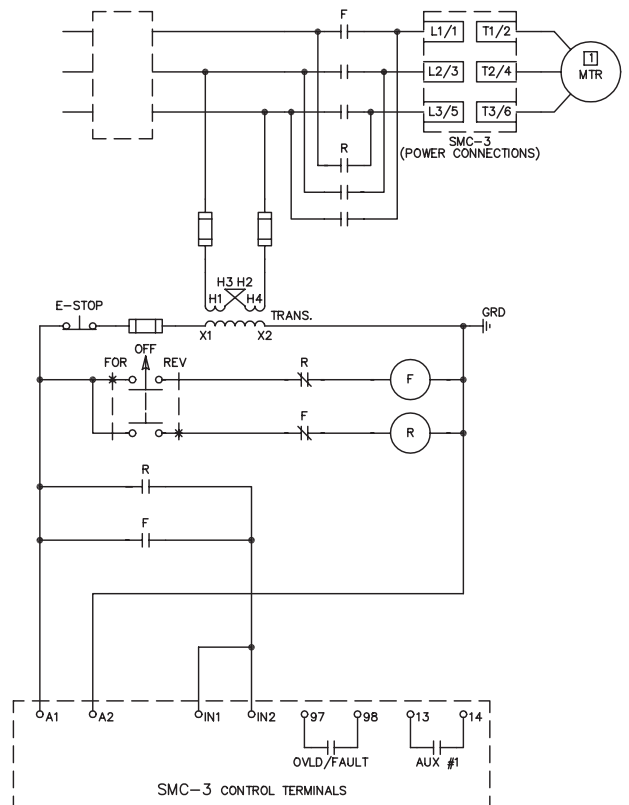
Reversing Configuration

Note: Minimum Off time equals 1.0 s.

IEC



NEMA



Electrical Ratings Cat. Nos. 150-...											
Cat. No.	C3	C9	C16	C19	C25	C30	C37	C43	C60	C85	
Rated operating current I_e (A)	3	9	16	19	25	30	37	43	60	85	
Heat dissipation (W)	Continuous										
Rated operating voltage	200...480, 200...600V AC 50/60 Hz, 3-phase (+10%, -15%)										
Line Power terminals	Cable size: Tightening torque:							2.5...95 mm ² (14...3/0 AWG) 11.3...12.4 N•m (100...110 in-lbs)			
Load Power terminals	Cable size: Tightening torque:							2.5...16 mm ² (14...6 AWG) 2.3...3.4 N•m (20...30 in-lbs)			
Control terminals	Cable size: Tightening torque:							0.2...2.5 mm ² (24...14 AWG) 0.5...0.9 N•m (4.4...8.0 in-lbs)			
Maximum continuous current	3 A	9 A	16 A	19 A	25 A	30 A	37 A	43 A	60 A	85 A	
Overload current range (A)	1...3	3...9	5.3...16	6.3...19	8.3...25	10...30	12.3...37	14.3...43	20...60	28.3...85	
Control Voltage Requirements	100...240V AC or 24V AC/DC 50/60 Hz										
Short Circuit Coordination (Max Fuse or Circuit Breaker Size) Type 1											
UL Class K5 and RK5 Fuses UL Listed Combination (600V)	5 kA Available Fault Current										
	10 A	35 A	60 A	70 A	100 A	110 A	125 A	150 A	—	—	
UL Class K5 and RK5 Fuses UL Listed Combination (600V)	10 kA Available Fault Current										
	—	—	—	—	—	—	—	—	225 A	300 A	
UL Listed Thermal Magnetic Circuit Breaker UL Listed Combination (600V)	5 kA Available Fault Current										
	15 A	35 A	60 A	70 A	100 A	110 A	125 A	150 A	—	—	
UL Listed Thermal Magnetic Circuit Breaker UL Listed Combination (600V)	10 kA Available Fault Current										
	—	—	—	—	—	—	—	—	225 A	300 A	
UL Listed Bulletin 140M Motor Protection C.B. UL Listed Combination (600V)	5 kA Available Fault Current										
	C25	C25	F45	F45	F45	F45	F45	—	—	—	
Power Circuit											
	UL/cUL					IEC					
Rated operational voltage	200...480V AC 200...600V AC					200...480V~ — 400V~ 500V~ — 500V~					
Rated insulation voltage	600V AC					500V~					
Dielectric withstand	2200V AC					2500V~					
Repetitive peak	200...480V AC — 1400V 200...600V AC — 1600V					200...480V~ — 1400V 500V~ — 1600V					
Operating frequency	50/60 Hz					50/60 Hz					
Utilization category	Intermittent duty					AC-53b					
Number of poles	Equipment designed for 3-phase only										
Rated impulse voltage	6 kV										
DV/DT protection	1000V/μs										
Overvoltage category	III					III					

Specifications, Continued

Control Circuit		
	UL/cUL	IEC
Rated operational voltage (+10%, -15%)	100...240V AC, 24V AC/DC	100...240V~, 24V AC/DC
Rated insulation voltage	250V	250V~
Rated impulse voltage	—	4 kV
Dielectric withstand	1500V AC	2000V~
Overvoltage category	—	III ❶
Operating frequency	50/60 Hz	50/60 Hz
Input onstate voltage minimum (IN1, IN2)	85V AC, 19.2V DC / 13.5V AC	
Input onstate current (IN1, IN2)	9.8 mA @ 120V AC / 19.6mA @ 240V AC, 7.3 mA @ 24V AC/DC	
Input offstate voltage maximum (IN1, IN2)	40V AC, 17V DC / 12V AC	
Input offstate current @ input offstate voltage (IN1, IN2)	<10 mA, <12 mA	
Control power with fan, during start	3...37 A	215 mA @ 120V AC / 180 mA @ 240V AC, 800 mA @ 24V DC / 660 mA @ 24V AC
	43...85 A	200 mA @ 120V AC / 100 mA @ 240V AC, 700 mA @ 24V AC/DC
Control power without fan, during start	3...37 A	205 mA @ 120V AC / 145 mA @ 240V AC, 705 mA @ 24V DC / 580 mA @ 24V AC
Auxiliary Contacts		
	UL/cUL	IEC
Rated operational voltage	250V AC / 30V DC	250V~ / 30V DC
Rated insulation voltage	250V	250V~
Rated impulse voltage	—	4 kV
Dielectric withstand	1500V AC	2000V~
Overvoltage category	—	III ❶
Operating frequency	50/60 Hz	50/60 Hz
Utilization category	D300	AC15
TB-97, -98 (OVL/D/Fault)	Type of control circuit	Electromagnetic relay
	Number of contacts	1
	Type of contacts	Normally Open (N.O.)
	Kind of current	AC/DC
	Rated operational current (max.)	0.6 A @ 120V~ and 0.3 A @ 240V~
	Conventional thermal current I_{th}	1 A
	Make VA/break VA	432/72
TB-13, -14 (Normal/Up-to-Speed)	Type of control circuit	Electromagnetic relay
	Number of contacts	1
	Type of contacts	Normally Open (N.O.)
	Kind of current	AC/DC
	Rated operational current (max.)	0.6 A @ 120V~ and 0.3 A @ 240V~
	Conventional thermal current I_{th}	1 A
	Make VA/break VA	432/72
Standard Features		
Start times	2, 5, 10, or 15 s	
Selectable soft start	15%, 25%, 35%, and 65% of locked rotor torque	
Selectable current limit	150%, 250%, 350%, and 450% of full load current	
Selectable soft stop	100%, 200%, or 300% of the start time setting when wired	
Weight — kg (lbs)	1...37 A	0.86 (1.9)
	43...85 A	2.25 (5)
Mechanical Design Specifications/Test Requirements		
Resistance to vibration	Operational	1.0 G peak, 0.152 mm (0.006 in.) displacement
	Non-operational	2.5 G peak, 0.381 mm (0.015 in.) displacement
Resistance to shock	Operational	15 G
	Non-operational	30 G

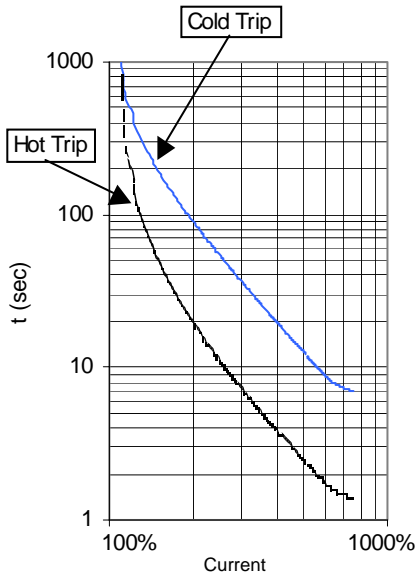
❶ Overvoltage category II, when either control or auxiliary circuit is wired to a SELV or PELV circuit.

EnviroN•mental			
Operating temperature		0...50°C (32...122°F) (open) 0...40°C (32...104°F) (enclosed)	
Storage temperature		-25...85°C (-13...185°F)	
Altitude		2000 m (6560 ft)	
Humidity		5...95% (non-condensing)	
Pollution degree		2	
Type of Protection		IP2X	
Other			
		UL/cUL	IEC
EMC emission levels	Conducted radio frequency emissions	—	Class A
	Radiated emissions	—	Class A
EMC immunity levels	Electrostatic discharge	4 kV contact and 8kV air discharge	
	Radio frequency electromagnetic field	—	Per IEC 60947-4-2
	Fast transient	—	Per IEC 60947-4-2
	Surge transient	—	Per IEC 60947-4-2

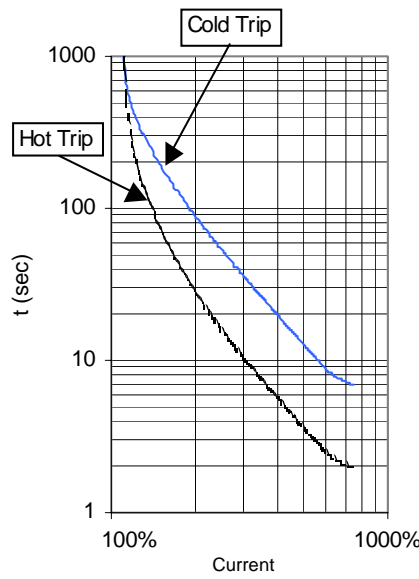
Trip Curves

SMC-3 Overload Relays

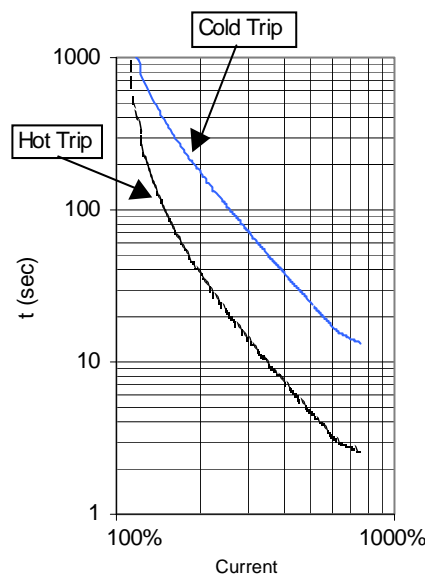
Trip Class 10



Trip Class 15

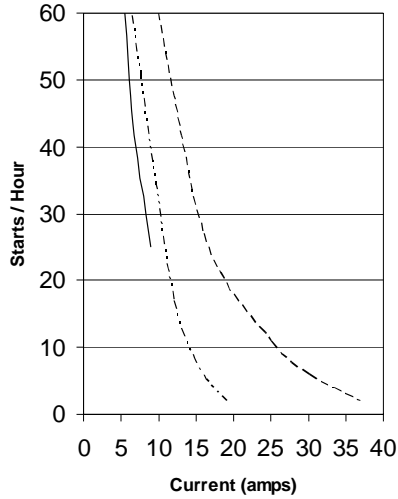


Trip Class 20



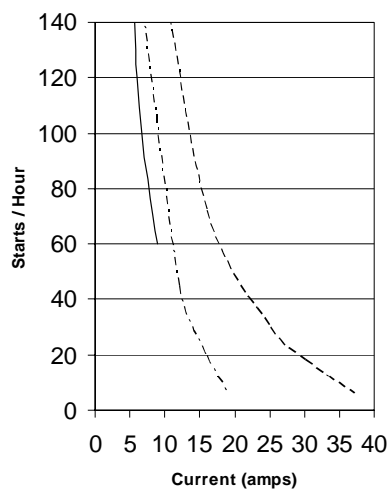
Starts per Hour Curves

SMC-3 Starts per hour
 40C, 100% duty cycle 10sec, 350%, No Fan



- 150-C3,C9
- - - 150-C16,C19
- · - · 150-C25,C30,C37

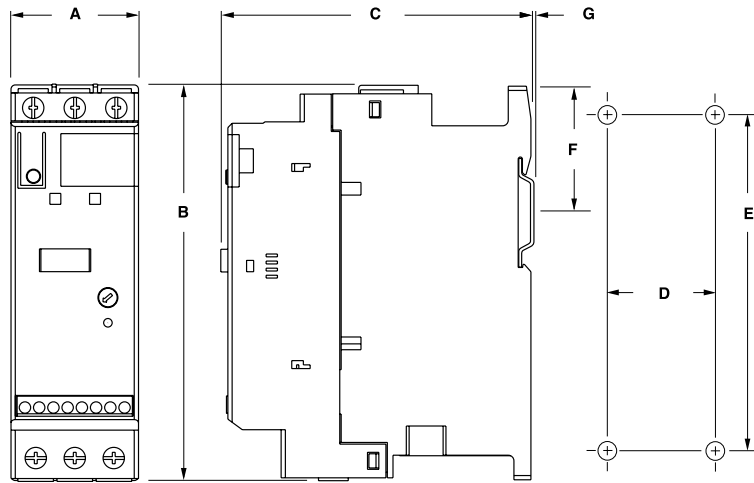
SMC-3 Starts per hour
 40C, 100% Duty Cycle, 10sec, 350% with Fan



- 150-C3,C9
- - - 150-C16,C19
- · - · 150-C25,C30,C37

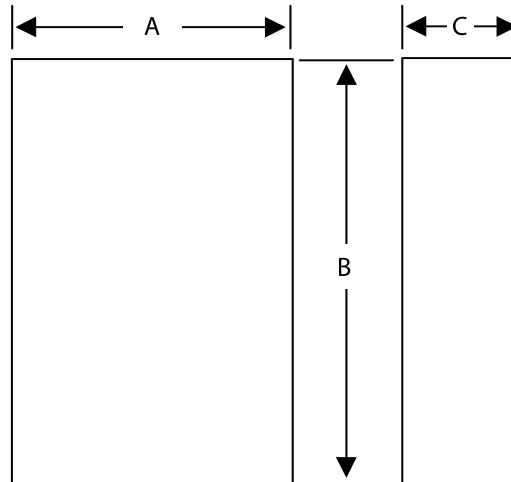
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Open Type



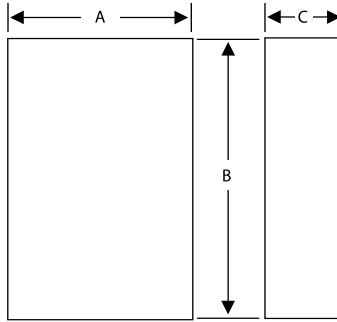
Rating (A)	A	B	C	D	E	F	G	Mounting Hole Size	Weight kg (lbs)
1...37	44.8 (1-49/64)	139.7 (5-1/2)	100 (4-21/64)	35 (1-3/8)	132 (5-13/64)	46.4 (1.81)	2 (1/16)	4.6 (0.18)	0.86 (1.9)
43...85	72 (2.83)	206 (8.11)	130 (5.12)	55 (2.17)	198 (7.8)	102 (4.02)	2 (1/16)	5.3 (0.21)	2.25 (5.0)
108...135	196.4 (7.74)	443.7 (17.47)	205.2 (8.08)	166.6 (6.56)	367 (14.45)	—	—	7.5 (0.295)	15 (33)
201...251	225 (8.86)	560 (22.05)	265.3 (10.45)	150 (5.91)	504.1 (19.85)	—	—	11.5 (0.45)	30.4 (67)
317...480	290 (11.42)	600 (23.62)	298 (11.73)	200 (7.87)	539.2 (21.23)	—	—	11.5 (0.45)	45.8 (101)

Minimum Enclosure Size



Controller	A Width	B Height	C Depth	Fan Requirements
1...37 A	224 (9)	305 (12)	152 (6)	none
43...85 A	406 (16)	305 (12)	203 (8)	none
108...135 A	762 (30)	610 (24)	305 (12)	none
201...251 A	965 (38)	762 (30)	356 (14)	none
317...480 A	1295 (51)	914 (36)	356 (14)	none

Enclosed Type Line-Connected Controllers



Controller Rating (A)	Disconnect Rating (A)	IP65 (Type 4/12)		
		B Height	A Width	C Depth
Non-Combination Controller				
3	—	305 (12)	305 (12)	152 (6)
9	—	305 (12)	305 (12)	152 (6)
16	—	305 (12)	305 (12)	152 (6)
25	—	305 (12)	305 (12)	152 (6)
30	—	305 (12)	305 (12)	152 (6)
37	—	305 (12)	305 (12)	152 (6)
43	—	356 (14)	406 (16)	203 (8)
60	—	356 (14)	406 (16)	203 (8)
85	—	356 (14)	406 (16)	203 (8)
108	—	762 (30)	610 (24)	305 (12)
135	—	762 (30)	610 (24)	305 (12)
201	—	965 (38)	762 (30)	356 (14)
251	—	965 (38)	762 (30)	356 (14)
317	—	1295 (51)	914 (36)	356 (14)
361	—	1295 (51)	914 (36)	356 (14)
480	—	1295 (51)	914 (36)	356 (14)
Combination Controllers with Fusible Disconnect				
3	30 A/J	356 (14)	406 (16)	203 (8)
9	30 A/J	356 (14)	406 (16)	203 (8)
16	30 A/J	356 (14)	406 (16)	203 (8)
25	30 A/J	356 (14)	406 (16)	203 (8)
30	60 A/J	356 (14)	406 (16)	203 (8)
37	60 A/J	356 (14)	406 (16)	203 (8)
43	60 A/J	356 (14)	406 (16)	203 (8)
60	100 A/J	610 (24)	406 (16)	254 (10)
85*	100 A/J	610 (24)	406 (16)	254 (10)
85*	100 A/J	762 (30)	610 (24)	305 (12)
108	200 A/J	965 (38)	762 (30)	356 (14)
135	200 A/J	965 (38)	762 (30)	356 (14)
201	400 A/J	965 (38)	762 (30)	356 (14)
251	400 A/J	965 (38)	762 (30)	356 (14)
317	600 A/J	1524 (60)	965 (38)	356 (14)
361	600 A/J	1524 (60)	965 (38)	356 (14)
480	600 A/J	1524 (60)	965 (38)	356 (14)
Combination Controllers with Circuit Breaker				
3	15 A	356 (14)	406 (16)	203 (8)
9	15 A	356 (14)	406 (16)	203 (8)
16	20 A	356 (14)	406 (16)	203 (8)
25	30 A	356 (14)	406 (16)	203 (8)
30	40 A	356 (14)	406 (16)	203 (8)
37	50 A	356 (14)	406 (16)	203 (8)
43	80 A	610 (24)	406 (16)	254 (10)
60	100 A	610 (24)	406 (16)	254 (10)
85	125 A	610 (24)	406 (16)	254 (10)
108	175 A/175 A Plug	965 (38)	762 (30)	356 (14)
135	225 A/225 A Plug	965 (38)	762 (30)	356 (14)
201	300 A/300 A Plug	965 (38)	762 (30)	356 (14)
251	400 A/400 A Plug	965 (38)	762 (30)	356 (14)
317	600 A/600 A Plug	1295 (51)	914 (36)	356 (14)
361	600 A/600 A Plug	1295 (51)	914 (36)	356 (14)
480	800 A/800 A Plug	1295 (51)	914 (36)	356 (14)

* Dimensions for FHD-43, FAD-44, FBD-47, and FCD-48.

* Dimensions for FHD-44, FAD-45, FBD-48, and FCD-49