

Motor Starters and Contactors—Low Voltage

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Specifications:

See Eaton's *Product Specification Guide*, available on CD or on the Web.

CSI Format:	1995	2010
	Sections 16481,	Sections 26 29 13.11,
	16484,	26 29 13.13,
	16485,	26 29 13.15,
	16902	26 29 05



Enclosed S801 Soft Start and Freedom NEMA Starter with C440 Electronic Overload Relay

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MS Starters with Hand /Auto

Maximum 1 hp, 120/277 Volts Single-Phase



General Purpose Type 1 Enclosed MS Starter with Hand/Auto and Pilot Light

General Description

The enclosed manual motor starter is a cost-effective solution offering local and remote control capability, overload protection, and running light indication on small single-phase motor applications for 10% less than competitive devices.

Features

- Hand/Auto switch allows starter control locally or from a remote source such as a building
- Keyed heater packs ensure proper positioning
- Ease of installation and wiring
- Trip-free handle can be locked in the OFF position with optional handle guard accessory (MSLG)
- Red RUN pilot light provides indication status

Applications

- HVAC
- Commercial construction
- Exhaust fans

Standards and Certifications

- UL® 60967-4-1

Specifications

- 1 hp at 120/240 V, single-phase
- 0.40–16 FLA
- NEMA® Type 1 enclosure

Resources

- Catalog number: MST02RN1PH
- Volume 5, Tab 3.1—NEMA Manual Starters
- www.eaton.mmshoa.com

Technical Data

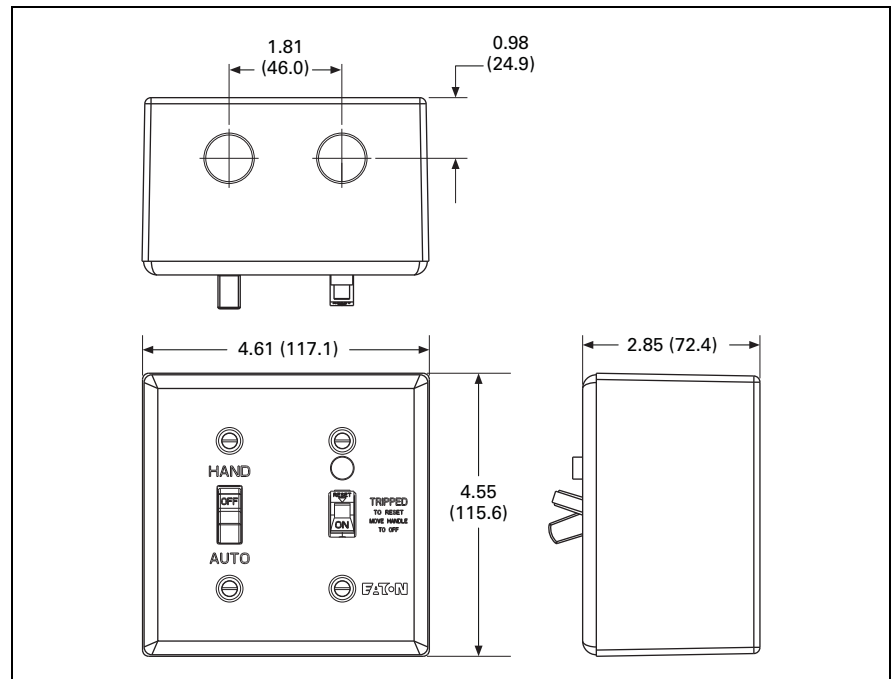


Figure 30.1-1. Dimensions in Inches (mm)

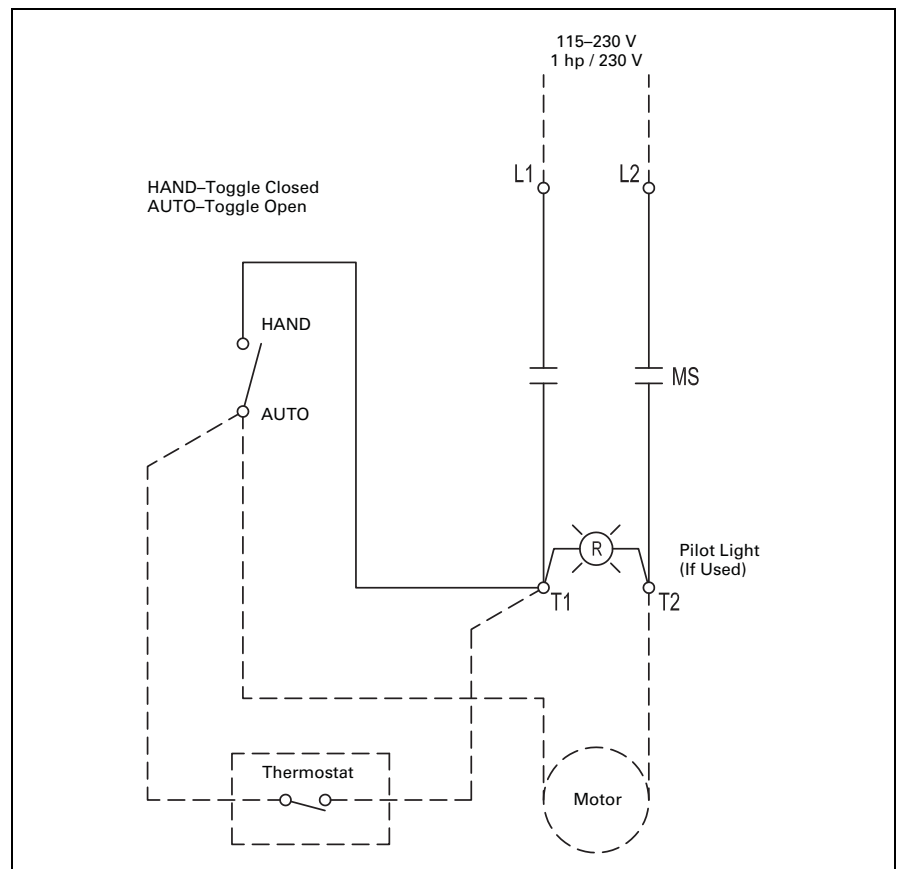


Figure 30.1-2. Wiring Diagram

Dimensions in inches. Not to be used for construction purposes unless approved.

Type B100

MS Manual Starters

**Maximum 1 hp, 120/277 Volts
Single-Phase**



*General Purpose Type 1 Enclosed
MS Starter*

Application Description

MS manual single-phase starters are designed to give positive, accurate, trouble-free overload protection to single-phase motors rated up to 1 hp. Typical applications are fans, machine tools, motors, HVAC, and so on.

Table 30.1-1. MS Ratings

Volts	hp	Poles
120/240 V, 277 Vac	1	1 or 2
120/240 Vdc	1	2
240 Vdc	1/4	1
32 Vdc	1/4	1 or 2

Enclosures

- Type 1: General Purpose
- Type 1: Flush Mounted, General Purpose
- Type 3, 4, 5: Watertight
- Type 7D: Class I, Group D Hazardous Locations
- Type 9E, F, G: Class II, Groups E, F, G Hazardous Locations
- Red pilot light available for NEMA® 1, factory-installed or field-installed kit

Typical Specifications

Manual single-phase starters shall be Eaton's Type MS or approved equal for motors rated not greater than 1 hp. They shall be built and tested in accordance with the applicable NEMA standards.

The starter shall have a "quick-make, quick-break" toggle mechanism. The overload shall have a field adjustment allowing up to $\pm 10\%$ variance in ratings of the nominal heater value.

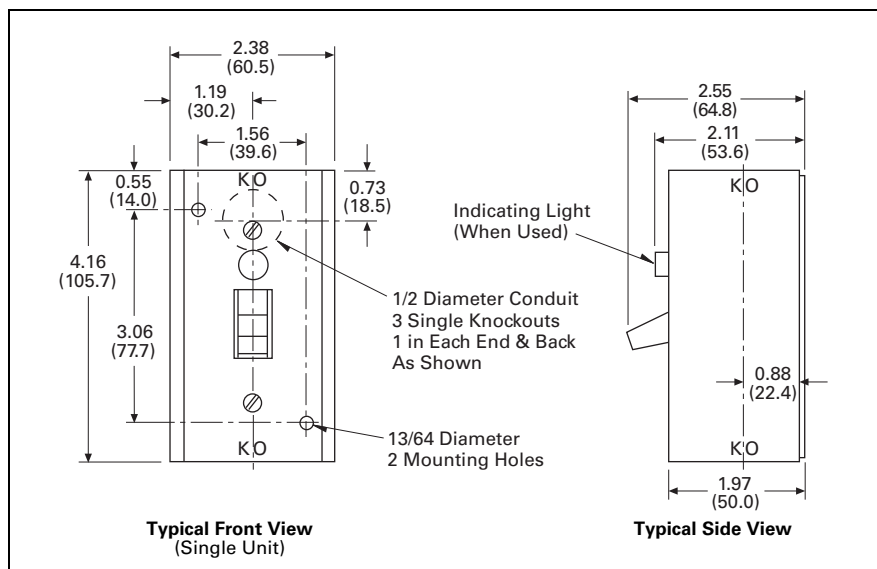


Figure 30.1-3. Type 1 Enclosures (Boxes and Covers)

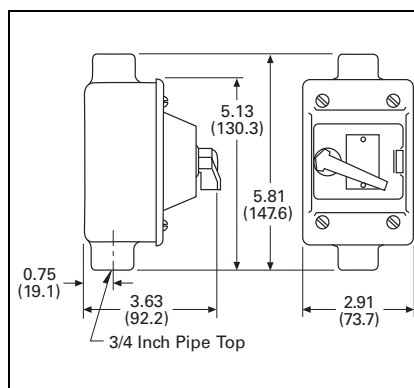


Figure 30.1-4. Watertight (Cast Aluminum)

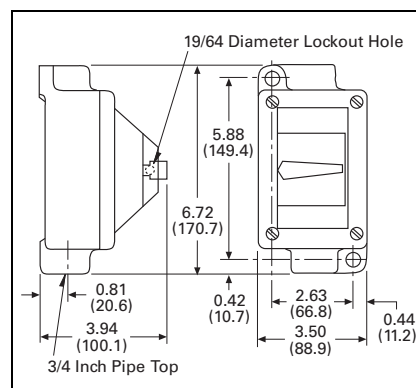


Figure 30.1-5. Hazardous Location (Cast Aluminum)

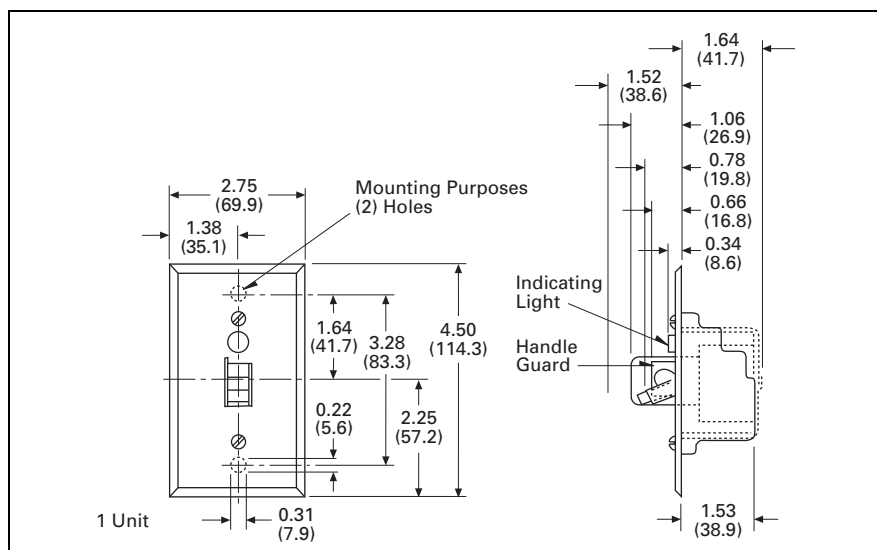


Figure 30.1-6. Flush Plates

Dimensions in inches. Not to be used for construction purposes unless approved.

Type B100

Type B100

Maximum 10 hp, 600 Volts



*General Purpose Type 1 Enclosed
B100 Starter*

General Description

MS manual single-phase starters are designed to give positive, accurate, trouble-free overload protection to single-phase motors rated up to 1 hp. Typical applications are fans, machine tools, motors, HVAC, and so on.

Table 30.1-2. MS Ratings

Volts	hp	Poles
120/240 V, 277 Vac	1	1 or 2
120/240 Vdc	1	2
240 Vdc	1/4	1
32 Vdc	1/4	1 or 2

Enclosures

- Type 1: General Purpose
- Type 1: Flush Mounted, General Purpose
- Type 3, 4, 5: Watertight
- Type 7D: Class I, Group D Hazardous Locations
- Type 9E, F, G: Class II, Groups E, F, G Hazardous Locations
- Red pilot light available for NEMA® 1, factory-installed or field-installed kit

Typical Specifications

Manual single-phase starters shall be Eaton's Type MS or approved equal for motors rated not greater than 1 hp. They shall be built and tested in accordance with the applicable NEMA standards.

The starter shall have a "quick-make, quick-break" toggle mechanism. The overload shall have a field adjustment allowing up to ±10% variance in ratings of the nominal heater value.

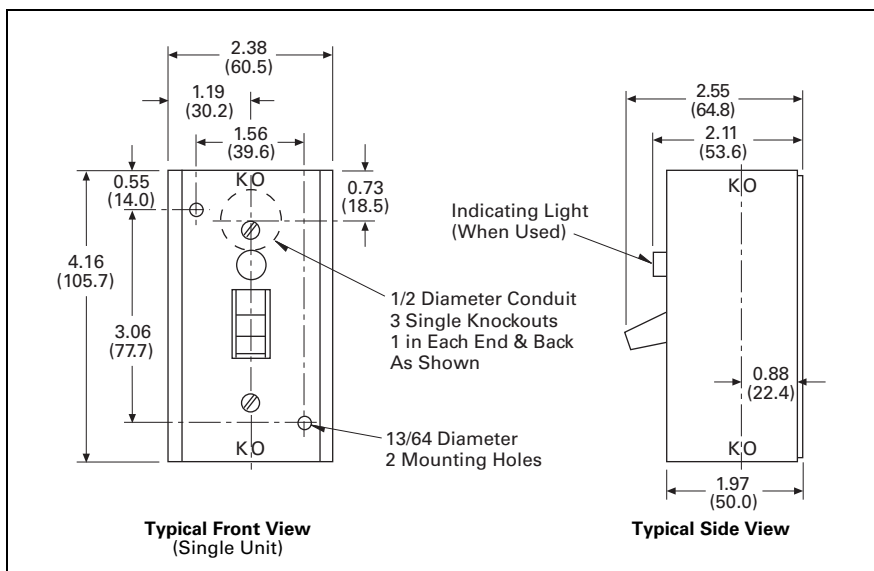


Figure 30.1-7. Type 1 Enclosures (Boxes and Covers)

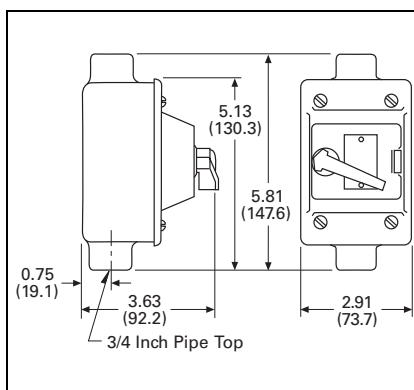


Figure 30.1-8. Watertight (Cast Aluminum)

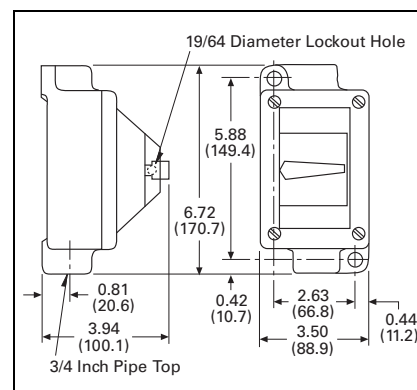


Figure 30.1-9. Hazardous Location (Cast Aluminum)

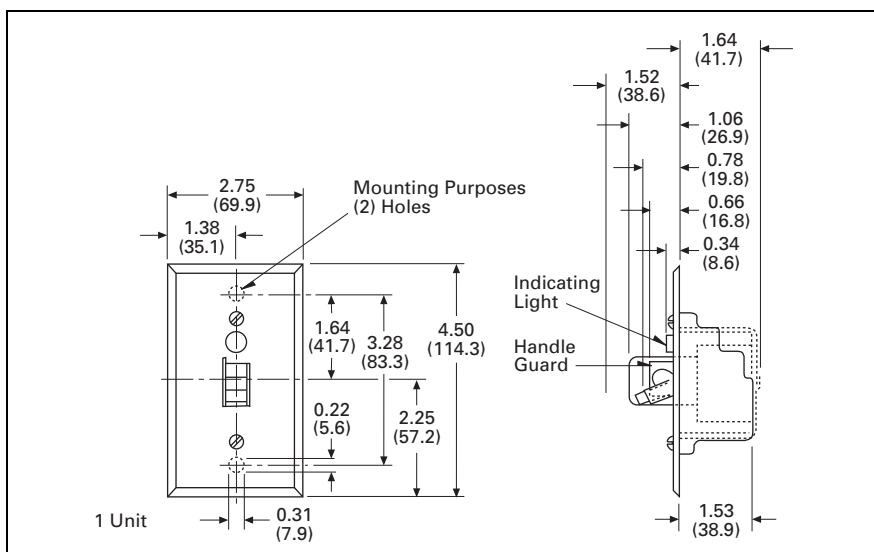


Figure 30.1-10. Flush Plates

Dimensions in inches. Not to be used for construction purposes unless approved.

Type XT

XT Manual Motor Protectors

Maximum 50 hp, 600 Volts



General Purpose Type 1 Enclosure
XTPBXENCF40

General Description

XTPB (pushbutton) and XTPR (toggle) are an economical and global solution to manual starting. They have a full spectrum of accessories and enclosures to meet various application needs. They can be utilized in single- and three-phase applications. They feature thermal protection with built-in overloads, bi-metallic and electronic.

Table 30.1-3. XTP Ratings

Frame Size	Maximum Horsepower				
	115 Vac	200 Vac	240 Vac	480 Vac	600 Vac

Single-Phase AC (see Wiring Diagram)

XTPB-B	2	3	5	—	—
XTPR-B	2	3	5	—	—
XTPR-D	3	5	10	—	—

Three-Pole, Three-Phase AC

XTPB-B	—	5	7.5	15	20
XTPR-B	—	7.5	10	20	25
XTPR-D	—	15	15	40	50

Enclosures

- OPEN, IP40, 55, 65, NEMA 1, 3R, 4X, 12, 13
- Red, green and white indicates available, field installable, without change in enclosure rating (light is not UL)

Typical Specifications

Manual starters shall be Eaton's **XT** or approved equal for motors rated not greater than 50 hp. They shall be built and tested in accordance with the applicable IEC and UL standards.

Features and Benefits

- ON/OFF rotary handle with lockout provision
- Visible trip indication
- Class 10 overload protection
- Phase loss sensitivity
- Ambient temperature compensation to IEC/EN 60947, VDE 0660
- Fixed short-circuit trip—14 times maximum setting of overload FLA dial
- Type 2 coordination per IEC 947
- Identification markers standard on starter faceplate
- Motor applications from 0.1 A to 65 A
- Built-in heater and magnetic trip elements to protect the motor
- Adjustment dial for setting motor FLA
- DIN rail mount
- Terminal types available:
 - Screw terminals
 - Screw (line) and spring cage (load) terminals
 - Spring cage terminals
- Accessories include:
 - Front and side auxiliary contacts
 - Trip indicating contacts
 - Tamperproof cover for OLR dial
 - Undervoltage release
 - Shunt trip
 - Through-the-door operators
 - Enclosures
 - Three-phase side connecting links

Standards and Certifications

- CE approved
- UL listed File No. E245398
- UL 508 group motor and Type E compliant
- IEC/EN 60947
- CSA File 229767, Class 3211-05
- DIN VDE 0660 Part 100, Part 101 and Part 102

Product Selection

When ordering, specify catalog numbers according to the following stipulations:

- **XT** manual motor protectors are selected based on the overload current range required for a given motor. This current range is determined from the motor full load ampere rating and motor service factor usually found on the motor nameplate.
- **For motors with service factors less than 1.15**, multiply the motor FLA by 0.90 to select appropriate MMP.

Example: For motor having FLA of 6.4 A and service factor of 1.0 (6.4 A x 0.90 = 5.76 A) select catalog number XTPB6P3B01.

See Application Note AP03402001E.

- **For motor with service factor of 1.15 or greater**, use motor nameplate full load amperes to select the appropriate MMP.

Example: For motor having FLA of 11 A and Service factor of 1.15, select catalog number XTPR012BC1.

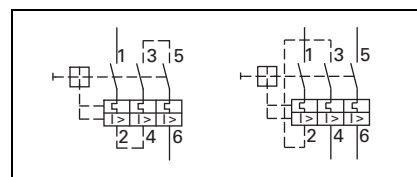


Figure 30.1-11. XTPB, XTPR Single- and Two-Pole Circuits with DC and AC Current

Type XT

Catalog Number Selection

Table 30.1-4. XT Manual Motor Protector Catalog Numbering System

Designation XT = XT IEC power control	Type PB = Manual motor protector—pushbutton PR = Manual motor protector—rotary	Current Ratings Frame B P16 = 0.16 A P25 = 0.25 A P40 = 0.40 A P63 = 0.63 A 001 = 1 A 1P6 = 1.6 A 2P5 = 2.5 A 004 = 4 A 6P3 = 6.3 A 010 = 10 A 012 = 12 A 016 = 16 A 020 = 20 A 025 = 25 A 032 = 32 A Frame D 016 = 16 A 025 = 25 A 032 = 32 A 040 = 40 A 050 = 50 A 058 = 58 A 063 = 63 A	Frame Size B = 45 mm D = 55 mm	Trip Class C1 = Class 10
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Dimensions

Approximate Dimensions in Inches (mm)

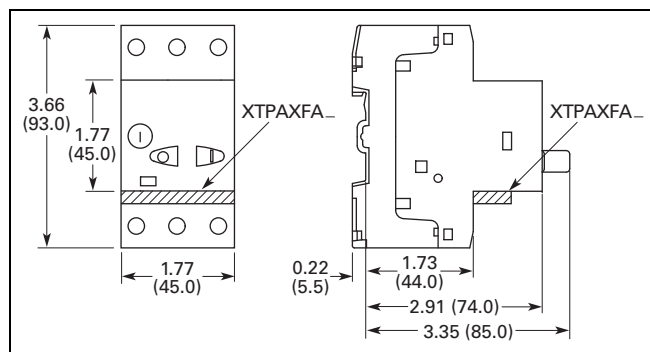


Figure 30.1-12. Manual Motor Protectors—XTPB

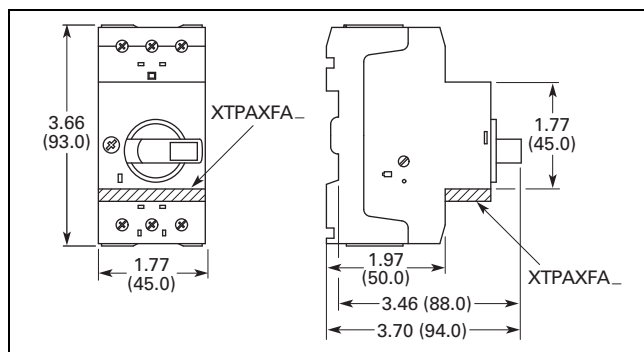


Figure 30.1-13. Manual Motor Protectors, Manual Transformer Protectors—XTPR...B

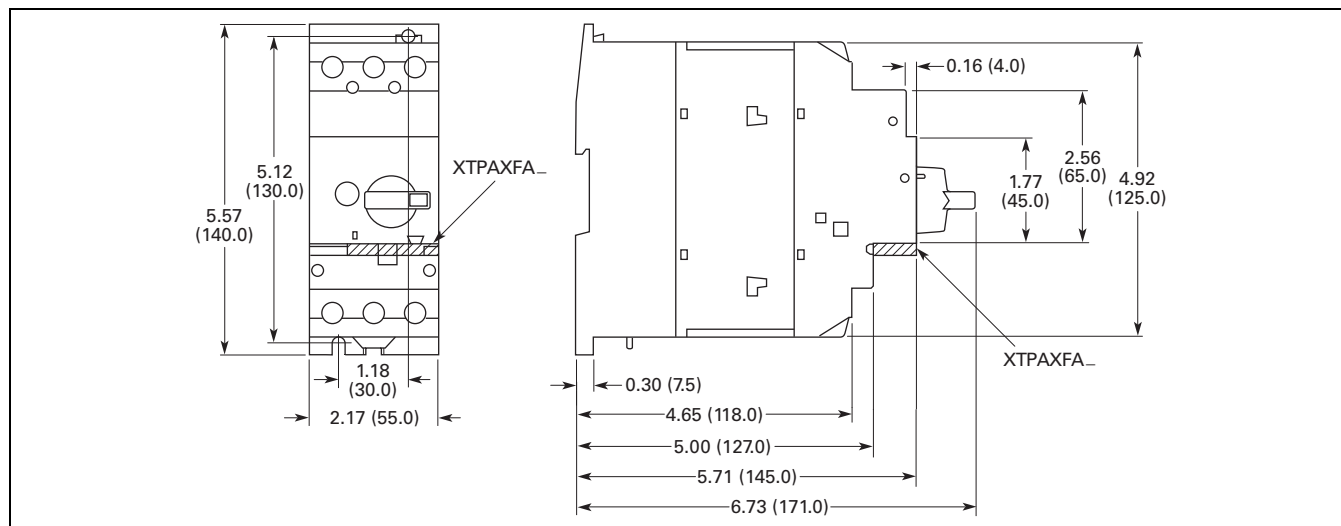


Figure 30.1-14. Manual Motor Protector—XTPR...DC1

Type XT

Dimensions

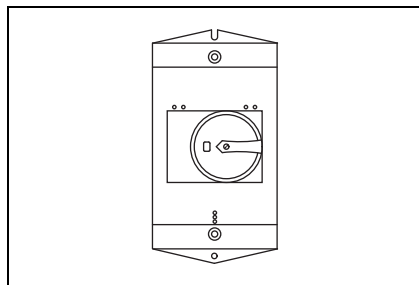


Figure 30.1-15. Frame B (0.1–32 A) XTPR Rotary Manual Motor Protectors

H x W x D
6.30 x 3.94 x 5.12
(160.0 x 100.0 x 130.0)

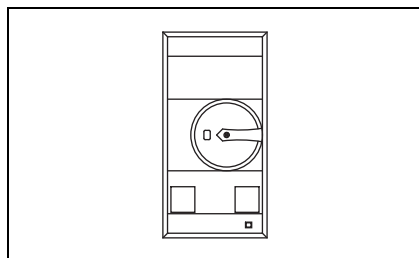


Figure 30.1-16. Frame B (0.1–32 A) XTPR Rotary Manual Motor Protectors with XTPAXFAEM20 Early-Make Front-Mount Auxiliary Contact

H x W x D
6.30 x 3.94 x 5.12
(160.0 x 100.0 x 130.0)

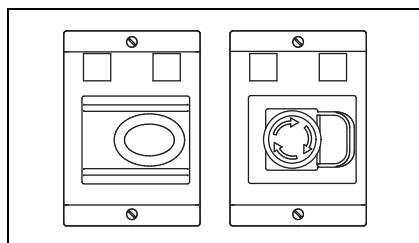


Figure 30.1-17. XTPB Pushbutton Manual Motor Protectors

H x W x D
5.08 x 3.55 x 4.54
(129.0 x 90.2 x 115.2)

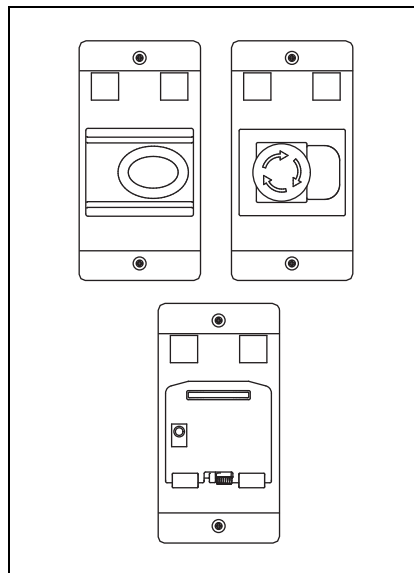


Figure 30.1-18. XTPB Pushbutton Manual Motor Protectors

H x W x D
6.22 x 3.15 x 4.59
(158.0 x 80.0 x 116.5)

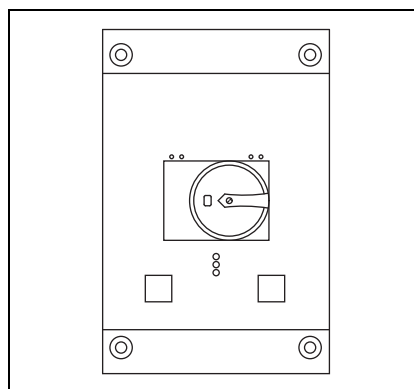


Figure 30.1-19. Frame D (10–65 A) Rotary Motor Protective Circuit Breakers

H x W x D
9.45 x 6.30 x 7.76
(240.0 x 160.0 x 197.0)

Wiring Diagrams

MMP Tripping Characteristics

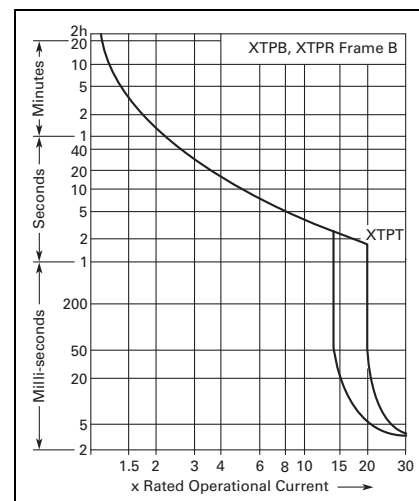


Figure 30.1-20. XTPB, XTPR Frame B

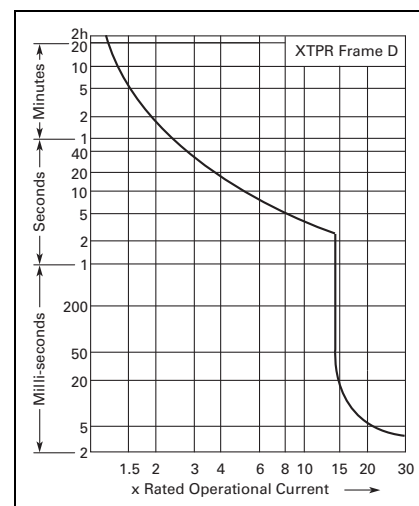
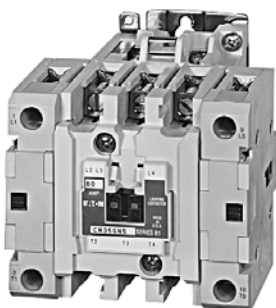


Figure 30.1-21. XTPR Frame D

Non-Combination Lighting Contactors

Non-Combination
Lighting Contactors

60 Ampere, Five-Pole Electrically Held



30 Ampere, 12-Pole Mechanically Held



30 Ampere, Four-Pole Magnetically Latched

General Description

Lighting contactors are designed to provide a safe, convenient means for local or remote switching of tungsten (incandescent filament) or ballast (fluorescent and mercury arc) lamp loads. They are also suitable for other loads such as low pressure and high pressure sodium lamp loads and other non-motor (resistive) loads. They are not recommended for most sign flashing loads.

These lighting contactors are designed to withstand the large initial inrush currents of tungsten lamp loads without contact welding. The full family of lighting contactors does not require derating.

Application Description

Loads:

Ballast Lamps—Fluorescent, mercury vapor, metal halide sodium vapor, quartz—600 V maximum.

Filament Lamps—Incandescent, infrared, heating—480 V maximum, line-to-line; 277 V maximum line-to-neutral.

Resistance Heating—Radiant and convection heating, furnaces and ovens.

Typical Specifications

Electrically Held Lighting Contactors—Eaton's CN35 or approved equal are rated for lighting loads of 10–300 A. They are built and tested in accordance with applicable NEMA standards.

Mechanically Held Lighting Contactors—Eaton's C30CNM or approved equal are rated for lighting loads of 30 A. They shall be capable of being supplied in a 2–12 pole single unit configuration.

These contactors are designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contacts welding. The contactor is capable of being operated such that it will not switch to "OFF" during the control power circuit power failures.

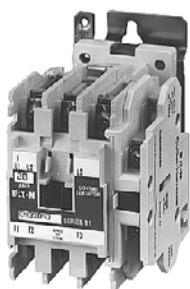
Magnetically Latched Lighting Contactors—A202 or approved equal are rated for lighting loads of 30–4000 A. Magnetically latched enclosed combination lighting contactors are Type ECL12 (breaker) or ECL13 (fusible) or approved equal for loads up to 30–200 A when integral short-circuit protection is required.

These contactors are designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contacts welding. The contactors are capable of being "mechanically held" via a magnetic latch design using a permanent magnet. The contactor is operated by a RUN signal and a STOP signal preventing the contactor from switching to "OFF" during control circuit power failure.

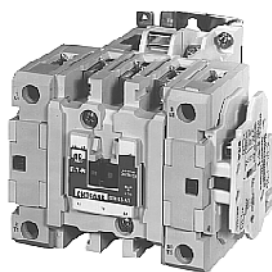
Table 30.2-1. Lighting Contactor Comparison

Ampere Rating	Number of Poles	Electrically Held	Mechanically Held	Magnetically Latched
10	2, 3, 4	CN35	—	—
20	2, 3, 4, 6, 9, 12	CN35	—	—
30	2, 3, 4, 5, 6, 9, 12	CN35	—	—
30	1–12	C30CNE	C30CNM	—
30	2, 3, 4, 5, 6, 8, 10, 12	—	—	A202
60	2, 3, 4, 5, 6, 8, 10, 12	—	—	A202
60	2, 3, 4, 5	CN35	—	—
100	2, 3, 4, 5	CN35	—	—
100	2, 3, 4, 5, 6, 8, 10, 12	—	—	A202
200	2, 3, 4, 5, 6, 8, 10, 12	—	—	A202
200	2, 3, 4, 5	CN35	—	—
300	2, 3, 4, 5	CN35	—	—
300	2, 3	—	—	A202
400	2, 3	—	—	A202

CN35-Open (ECL03-Enclosed)



20 Ampere



60 Ampere

General Description

Lighting contactors are designed to handle the switching of tungsten (incandescent filament) or ballast (fluorescent and mercury arc) lamp loads as well as other non-motor (resistive) loads. Ratings of 10–400 A, 1–12 poles, open or NEMA 1, 3R, 4/4X and 12 enclosed.

Application Description

Loads:

Ballast Lamps—Fluorescent, mercury vapor, sodium vapor, quartz—600 V maximum.

Filament Lamps—Incandescent, infrared, heating—480 V maximum.

Resistance Heating—Radiant and convection heating, furnaces and ovens.

Cover Control—See Enclosed Control Product Guide PG.3.02.TE start-stop and hand-off-auto only.

Enclosures

Open, NEMA Type 1, 3R, 4/4X and 12.

Auxiliary Contacts

Eaton's CN35 lighting contactors include a NO maintaining auxiliary contact mounted on right-hand side (on 10 A, two- and three-pole devices, auxiliary contact occupies 4th power pole position—no increase in width). Enclosed devices include a NO auxiliary contact only on the right-hand contactor. The 10–60 A devices will accept additional auxiliary contacts on the top and/or sides. The 100–400 A sizes will accept side-mounted auxiliaries only.

Typical Specifications

Electrically-held lighting contactors are Eaton Type CN35 or ELC03, or approved equal for lighting loads of 10–300 A. They are built and tested in accordance with applicable NEMA standards.

These contactors are designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding. Contactors are capable of accepting up to 8 auxiliary contacts—top and/or side up to 60 A and side only up to 400 A. Contactors are capable of being operated by AC or DC control.

Table 30.2-2. Ratings—CN35 AC Lighting Contactors—Electrically Held

Maximum Ampere Rating ①	Number of Poles
10	2, 3, 4
20	2, 3, 4, 6, 9, 12
30	2, 3, 4, 5, 6, 9, 12
60	2, 3, 4 ②, 5 ②
100, 200, 300	2, 3, 4, 5
400	2, 3

① Listed ampere ratings are based on a maximum load voltage of 480 V for tungsten lamp applications and 600 V for ballast or mercury vapor type applications.

② Additional power poles mounted on side(s) of contactor.

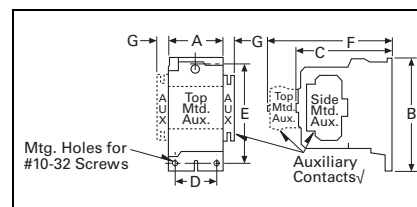


Figure 30.2-1. Open Type

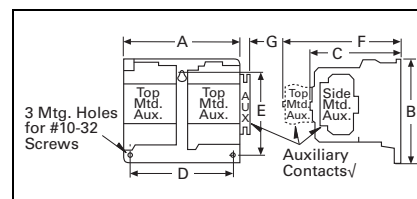


Figure 30.2-2. Open Type, 20–30 A Sizes, Four–Six Poles

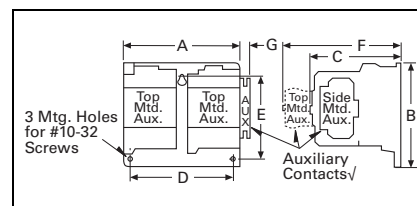


Figure 30.2-3. Open Type, 20–30 A Sizes, Four–Six Poles

③ See “Auxiliary Contacts” for type and location of auxiliary contacts supplied.

Table 30.2-3. Approximate Dimensions and Shipping Weights

Ampere Rating	Number of Poles	Dimensions in Inches (mm)							Shipping Weight Lb (kg)	
		Wide A	High B	Deep C	Mounting		F	G		
					D ④	E				
Open Type										
10	2-4	2.00 (50.8)	3.88 (98.5)	3.49 (88.6)	1.50 (38.1)	3.38 (85.9)	4.90 (124.5)	0.54 (13.7)	1.4 (0.63)	
20-30	2-3	2.00 (50.8)	3.88 (98.5)	3.49 (88.6)	1.50 (38.1)	3.38 (85.9)	4.90 (124.5)	0.54 (13.7)	1.45 (0.65)	
20-30	4-6	4.20 (106.7)	4.35 (110.5)	3.52 (89.4)	3.50 (88.9)	3.86 (98.0)	4.90 (124.5)	0.54 (13.7)	2.9 (1.3)	
20-30	9	10.50 (266.7)	5.75 (146.0)	4.52 (114.8)	4.50 (114.3)	5.00 (127.0)	—	—	4.35 (1.96)	
20-30	12	10.50 (266.7)	5.75 (146.0)	4.52 (114.8)	4.50 (114.3)	5.00 (127.0)	—	—	5.8 (2.6)	
60	2-3	2.56 (65.1)	5.05 (128.3)	4.44 (112.8)	2.00 (50.8)	4.50 (114.3)	5.80 (147.3)	0.54 (13.7)	3.4 (1.53)	
60	4	3.46 (87.8)	5.05 (128.3)	4.44 (112.8)	2.00 (50.8)	4.50 (114.3)	5.80 (147.3)	0.54 (13.7)	3.5 (1.57)	
60	5	4.36 (110.7)	5.05 (128.3)	4.44 (112.8)	2.00 (50.8)	4.50 (114.3)	5.80 (147.3)	0.54 (13.7)	3.55 (1.59)	
100	2-3	3.54 (89.9)	7.17 (182.1)	5.94 (150.9)	3.00 (76.2)	6.63 (168.4)	—	0.54 (13.7)	9 (4.1)	
200	2-3	7.05 (179.1)	9.11 (231.4)	7.25 (184.2)	6.00 (152.4)	8.50 (215.9)	—	—	20 (9.0)	
300	2-3	7.05 (179.1)	13.12 (333.2)	7.78 (184.2)	6.00 (152.4)	12.50 (317.5)	—	—	23 (10.35)	

④ Center mounting slot at bottom on 10–30 A sizes only.

Enclosed Box Selection

Table 30.2-4. Type 1 Non-combination Lighting Contactors—Electrically Held—CN35

Ampere Size (Poles)	Box No.	Shipping Weight Lb (kg)
---------------------	---------	-------------------------

Contactors—without Control Power Transformers

10 A (2P, 3P, 4P)	1	5 (2.3)
10 A (2P, 3P, 4P, 5P, 6P) w/top adders	2	7.3 (3.3)
10 A (9P, 10P, 12P, 20P)	3	9.5 (4.3)
20 A (2P, 3P)	1	5.2 (2.4)
20 A (2P, 3P, 4P, 5P, 6P) w/top adders & 6P w/o top adder	2	7.3 (3.3)
20 A (9P, 10P, 12P, 20P)	3	9 (4.1)
20 A (9P, 12P) w/top adders	3	9.3 (4.2)
30 A (2P, 3P)	1	5.3 (2.4)
30 A (2P, 3P, 4P) w/top adders	2	7.3 (3.3)
30 A (5P, 6P)	3	9.0 (4.1)
30 A (5P, 6P) w/top adders	3	9.2 (4.2)
30 A (9P, 10P, 12P, 20P)	3	9.5 (4.3)
30 A (9P, 12P) w/top adders	3	9.7 (4.4)
60 A (2P, 3P)	1	7 (3.2)
60 A (2P, 3P) w/top adders	3	9.8 (4.4)
60 A (4P, 5P, 6P, 9P, 10P, 12P)	3	9.5 (4.3)
60 A (4P, 5P) w/top adders	3	10 (4.5)
100 A (2P, 3P)	4	35 (16)
100 A (4P, 5P, 6P, 9P)	4	60 (27)
200 A (2P, 3P)	4	70 (32)
200 A (4P, 5P, 6P)	10	133 (60)
300 A (2P, 3P)	10	113 (51)
300 A (4P, 5P, 6P)	10	136 (62)
400 A (2P, 3P)	10	125 (57)

Contactors—with Control Power Transformers

10 A (2P, 3P, 4P)	2	11 (5.0)
10 A (2P, 3P, 4P, 5P, 6P, 9P, 10P, 12P, 20P) w/top adders	3	13.1 (5.9)
20 A (2P, 3P, 4P, 6P)	2	11 (5.0)
20 A (2P, 3P, 4P, 5P, 6P) w/top adders	3	13.1 (5.9)
20 A (9P, 10P, 12P, 20P)	3	13.5 (6.1)
20 A (9P, 12P) w/top adders	3	13.5 (6.1)
30 A (2P, 3P, 4P)	2	12 (5.4)
30 A (2P, 3P, 4P) w/top adders	3	13.1 (5.9)
30 A (5P, 6P)	2	12.5 (5.7)
30 A (5P, 6P) w/top adders	3	13.5 (6.1)
30 A (9P, 10P, 12P, 20P)	3	13.9 (6.3)
30 A (9P, 12P) w/top adders	3	14.1 (6.4)
60 A (2P, 3P)	2	12.8 (5.8)
60 A (2P, 3P) w/top adders	3	14 (6.4)
60 A (4P, 5P, 6P, 9P, 10P, 12P)	3	14 (6.4)
60 A (4P, 5P) w/top adders	3	14.2 (6.4)
100 A (2P, 3P)	4	39 (18)
100 A (4P, 5P, 6P, 9P)	4	67 (30)
200 A (2P, 3P)	10	117 (53)
200 A (4P, 5P, 6P)	10	140 (64)
300 A (2P, 3P)	10	120 (54)
300 A (4P, 5P, 6P)	10	143 (65)
400 A (2P, 3P)	10	132 (60)

Table 30.2-5. Type 3R, 4/4X, 12 Non-combination Lighting Contactors—Electrically Held—CN35

Ampere Size (Poles)	Box No.	Shipping Weight Lb (kg)
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Contactors—without Control Power Transformers

10 A (2P, 3P, 4P, 5P, 6P)	5	12 (5.4)
10 A (9P, 10P, 12P, 20P)	7	20 (9.1)
20 A (2P, 3P, 4P, 5P)	5	12 (5.4)
20 A (6P)	5	14 (6.4)
20 A (9P, 10P, 12P, 20P)	7	20 (9.1)
30 A (2P, 3P, 4P)	5	13 (5.9)
30 A (5P, 6P)	6	14 (6.4)
30 A (9P, 10P, 12P, 20P)	7	20 (9.1)
60 A (2P, 3P, 4P)	5	13 (5.9)
60 A (5P, 6P)	6	16 (7.3)
60 A (9P, 10P, 12P)	7	22 (10)
100 A (2P, 3P)	8	49 (22)
100 A (4P, 5P, 6P, 9P)	8	57 (26)
200 A (2P, 3P)	8	110 (50)
300 A (2P, 3P)	10	113 (51)
400 A (2P, 3P)	10	125 (57)

Contactors—with Control Power Transformers

10 A (2P, 3P, 4P, 5P, 6P)	5	16 (7.3)
10 A (9P, 10P, 12P, 20P)	7	20 (9)
20 A (2P, 3P, 4P, 5P)	5	16 (7.3)
20 A (6P, 9P, 10P, 12P, 20P)	7	24 (11)
30 A (2P, 3P, 4P)	6	18 (8.2)
30 A (5P, 6P)	6	18 (8.2)
30 A (9P, 10P, 12P, 20P)	7	24 (11)
60 A (2P, 3P)	6	21 (10)
60 A (4P, 5P, 6P)	6	23 (10)
60 A (9P, 10P, 12P)	7	22 (10)
100 A (2P, 3P)	8	56 (25)
100 A (4P, 5P, 6P, 9P)	8	64 (29)
200 A (2P, 3P)	8	117 (53)
300 A (2P, 3P)	10	120 (54)
400 A (2P, 3P)	10	132 (60)

Table 30.2-6. Type 1 Combination Lighting Contactors

Ampere Size	Box No.	Shipping Weight Lb (kg)
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Electrically Held—3P Only—with or without Control Power Transformers

30 A	A	35 (16)
60 A	A	36 (16)
100 A	C	65 (30)
200 A with disconnect switch	D	110 (50)
200 A with thermal-magnetic breaker	E	150 (68)
300 A	E	160 (73)
400 A	E	170 (77)

Table 30.2-7. Type 3R, 4/4X, 12 Combination Lighting Contactors

Ampere Size (Device)	Box No.	Shipping Weight Lb (kg)
----------------------	---------	-------------------------

Electrically Held—3P Only—with or without Control Power Transformers

30 A	A	35 (16)
60 A	A	36 (16)
100 A	C	65 (30)
200 A with disconnect switch	D	110 (50)
200 A with thermal-magnetic breaker	E	150 (68)
300 A	E	160 (73)
400 A	E	170 (77)

For enclosure box dimensions, refer to Page 30.6-3.

Electrically Held—Technical Data—CN35

Table 30.2-8. AC Magnet Coil Data

Description	Contactor Catalog Number/Size							
	CN35AN 10 A	CN35BN 20 A	CN35DN 30 A	CN35GN 60 A	CN35KN 100 A	CN35NN 200 A	CN35SN 300 A	CN35TN 400 A
Frame size	45 mm	45 mm	45 mm	65 mm	90 mm	180 mm	180 mm	180 mm
AC Magnet Coil Data								
Pickup volts—cold	74%	74%	74%	74%	72%	75%	75%	75%
Pickup volts—hot	78%	78%	78%	78%	76%	77%	77%	77%
Pickup voltamperes	100	100	100	230	390	1158	1158	1158
Pickup watts	65	65	65	95	112	240	240	240
Sealed voltamperes	10	10	10	28	49.8	100	100	100
Sealed watts	3.1	3.1	3.1	7.8	13	27.2	27.2	27.2
Dropout volts—cold	45%	45%	45%	49%	50%	63%	63%	63%
Dropout volts—hot	46%	46%	46%	50%	52%	64%	64%	64%
Pickup time (ms)	12	12	12	20	14	23	23	23
Dropout time (ms)	12	12	12	14	11	15	15	15
Coil operating range	–15% to +10%							
Magnet coil data UL listed rating	Class 130 (B)—105 °C Temperature Rate							
Operating temperature	–20 °C to +65 °C							
Maximum operating altitude	6000							
Mechanical life	20,000,000			10,000,000	6,000,000	5,000,000	5,000,000	5,000,000
Wire Range								
Power terminals	12–16 stranded, 12–14 solid Cu	12–16 stranded, 12–14 solid Cu	8–16 stranded 10–14 solid Cu	3–14 (upper) &/or 6–14 (lower) Stranded or solid Cu	1/0–14 Cu	350 kcmil–6 Cu	350 kcmil–8 Cu	600 kcmil–2/0 Cu
Control Terminals	12–16 Stranded 12–14 Solid Cu							
Contact Kit Part No.								
Two-pole	N/A	N/A	N/A	6-65-7	6-43-5	6-44	6-45	6-45
Three-Pole	N/A	N/A	N/A	6-65-8	6-43-6	6-44-2	6-45-2	6-45-2
Auxiliary contact rating	A600, P300 See Page 30.2-5							

Table 30.2-9. DC Magnet Coil Data

Description	Contactor Catalog Number/Size							
	CN35AN 10 A	CN35BN 20 A	CN35DN 30 A	CN35GN 60 A	CN35KN 100 A	CN35NN 200 A	CN35SN 300 A	CN35TN 400 A
Frame size	45 mm	45 mm	45 mm	65 mm	90 mm	180 mm	180 mm	180 mm
Volts	24 V							
DC Magnet Coil Data								
Pickup volts—hot	80%	80%	80%	60%	61%	61%	61%	67%
Pickup voltamperes	3.2	3.2	3.2	6.2	12.0	12.0	12.0	18
Pickup watts	76.8	76.8	76.8	88.4	288.0	288.0	288.0	400.0
Sealed voltamperes	0.14	0.14	0.14	0.21	0.20	0.20	0.20	0.22
Sealed watts	3.36	3.36	3.36	4.96	4.75	4.75	4.75	5.3
Dropout volts—hot	60%	60%	60%	29%	22%	22%	22%	25%
Pickup time (ms)	22	22	22	20	38	38	38	53
Dropout time (ms)	17	17	17	13	14	14	14	14
Maximum operating altitude	3600							2400

■ **UL Insulation Rating**—Class 130 (B), 105°C temperature rise

■ **Operational Limits**—85–110% of rated voltage for AC coils and 80%–110% of rated voltage for DC coils

Coil Data Notes

P.U. = Pickup time is the average time taken from closing of the coil circuit to main contact touch.

D.O. = Dropout time is the average time taken from opening of the coil circuit to main contact separation.

Cold = Coil data with a cold coil.

Hot = Coil data with a hot coil.

All data is based on a standard contactor with no auxiliary devices and a 120 Vac or 24 Vdc magnet coil. Coil data has a ±5% range depending on the application, therefore specific data may vary.

**Type C30CNM—Open
(ECC—Enclosed)**

C30CNM

General Description

Eaton's C30CNM 30 A mechanically held lighting contactors are designed for industrial, commercial and outdoor lighting applications where efficient control is required. The mechanically held operation ensures that the contactor will not switch to OFF during control power failure. It also ensures the removal of coil from the circuit for noise-free operation and the elimination of all coil losses after the contactor is latched. The control module microprocessor validates the control signal before operation, so it will not respond to momentary voltage spikes of noise. The operation command has a built-in 0.4 second delay to avoid multiple short-term commands that can cause contact fatigue or failure. Also, the feedback loop prevents the contactor from getting out of sequence with switches, even after power failures.

Typical Specifications

Mechanically held lighting contactors are Eaton Type C30CNM or approved equal and are rated for lighting loads of 30 A. They are capable of being supplied in a 2–12 pole single unit configuration.

These contactors are designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding. The contactor is capable of being operated such that it will not switch to OFF during control circuit power failures.

Operation

Three-wire control is the choice for use with momentary devices allowing operation from multiple locations. A momentary pulse of energy operates the contactor while a second pulse on an alternate leg returns the contactor to its original state.

Two-wire control is the choice for single output automatic operation or for operation from single-pole devices. When voltage is applied to the input terminals the contactor is latched into position (coil is removed from the circuit while control voltage is continuously supplied). When control voltage is removed, the latch is disengaged and the contactor is returned to its original state.

Technical Data and Specifications**Main Power Poles****Table 30.2-10. Maximum AC Voltage and Ampere Ratings**

Load Type	Amps Continuous	Poles	
		Single-Phase	Three-Phase
Ballast	30	347 Vac	600 Vac
General use	30	600 Vac	600 Vac
Tungsten	20	277 Vac	480 Vac
AC resistive	30	600 Vac	600 Vac

Table 30.2-11. Maximum Horsepower Rating

Normal Starting Duty	
Volts	Horsepower
Single-Pole, Single-Phase	
110–120	1
220–240	2
Three-Pole, Three-Phase	
200–208	3
220–240	5
440–480	10
550–600	15

Table 30.2-12. Control Module

Input Voltage	Steady-State Current at Rated Voltage (mA)	Maximum VA
12–24 Vdc	42	2
24 Vac	80	5
115–120 Vac	83	12
200–277 Vac	91	30

Table 30.2-13. Other Control Module Characteristics

Description	Specification
Minimum pulse duration (Three-wire control module)	250 ms
Maximum allowable Leakage current	1.8 mA
EMI	35 V/m
Surge transient peak	6 kV
Frequency range	40–70 Hz

Auxiliary Contacts Rating:

- 600 A, 24 Vdc, 24 VA

Ambient Temperature:

- –13 °F to +104 °F (–25 °C to +40 °C)

Mounting Position:

- Vertical three-point mounting only

Coil:

- Inrush 248 VA
- Sealed 28 VA

Electrically Held, 30 A, 2–12 Pole—C30CNE

Wire Size

Table 30.2-14. Wire Specifications

Component	Number of Cables	Wire Range (Solid or Stranded)	Wire Temp.
Power Poles	1	14–8 AWG	75 °C Cu
	2	14–8 AWG ①	75 °C Cu
Coil	1 or 2	18–14 AWG	60 /75 °C Cu
Control Module	1	22–12 AWG	60°/75 °C Cu
Auxiliary Contacts	1 or 2	22–12 AWG	60/75 °C Cu

① 8 AWG stranded only.

Enclosed Box Selection

Table 30.2-15. Type 1 Non-combination Lighting Contactors—C30CN ②

Ampere Size (Poles)	Box No.	Shipping Weight Lb (kg)
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Lighting Contactors—
without Control Power Transformers

30 A (2–12)	2	9 (4.1)
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Lighting Contactors—
with Control Power Transformers

30 A (2–12)	3	13.5 (5.9)
-------------	---	------------

② Consult factory for combination enclosures.

Table 30.2-16. Type 3R, 4X and 12 Non-combination Lighting Contactors—C30CN ③

Ampere Size (Poles)	Box No.	Shipping Weight Lb (kg)
---------------------	---------	-------------------------

Lighting Contactors—
without Control Power Transformers

30 A (2–12)	6	14 (6.4)
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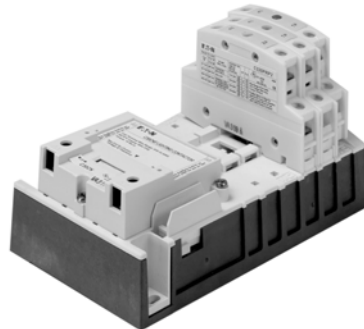
Lighting Contactors—
with Control Power Transformers

30 A (2–12)	7	20 (9.1)
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③ Consult factory for combination enclosures.

Components

Electrically Held Base Contactor



Electrically Held Base Contactor

The C30CNE20_0 electrically held base contactor contains a 2NO power pole as standard and will allow the addition of power poles to build an electrically held contactor up to 12 poles maximum. A mechanically held module kit can also be added to convert the electrically held contactor into a mechanically held contactor in the field.

Table 30.2-17. Electrically Held Base Contactor

Power Poles	Catalog Number ①
2NO	C30CNE20_0

① When ordering, select required contactor by Catalog Number and replace the magnet coil alpha designation in the Catalog Number (...) with the proper Code Suffix from Table 30.2-18.

Table 30.2-18. Coil Base Voltage (Digit 8)

Voltage (Digit 8)	Code Suffix
115–120 V 60 Hz/110 V 50 Hz	A
230–240 V 60 Hz/220 V 50 Hz	B
460–480 V 60 Hz/440 V 50 Hz	C
575–600 V 60 Hz/550 V 50 Hz	D
200–208 V 60 Hz	E
265–277 V 60 Hz/240 V 50 Hz	H
24 V 60 Hz/20 V 50 Hz	T
28 V 60Hz/24 V 50 Hz	V
347 V 60 Hz	X

Power Poles



Power Poles

The C30CN contactor accepts up to a maximum six single- or double-pole (or combinations) power poles. These can be used to form up to:

- 12NO poles maximum when six double-poles are used in NO positions (1–6) or 8NC poles maximum with four double-poles in the NC position (1–4) and 4NO poles with two double-poles in the 2NO positions (5–6)

Table 30.2-19. Power Poles

Power Poles	Catalog Number
Single-pole	C320PRP1
Double-pole	C320PRP2

For enclosure box dimensions, refer to Page 30.6-3.

Mechanically Held Module Kits



Conversion Kits

These kits are for converting electrically held contactors to mechanically held units. Kits include control module, latch, latch cover and auxiliary contacts plus installation instructions. Conversion kits are suitable for coil voltages of 277 V and below.

Table 30.2-20. Mechanically Held Module Kits

Coil Volts	Control Volts	Catalog Number
Two-Wire		
24–277 Vac	110–120 Vac	C320MH2WA0
	200–277 Vac	C320MH2WH0
	24 Vac	C320MH2WT0
	12–24 Vdc	C320MH2WT1
Three-Wire		
24–277 Vac	110–120 Vac	C320MH3WA0
	200–277 Vac	C320MH3WH0
	24 Vac	C320MH3WT0
	12–24 Vdc	C320MH3WT1

Auxiliary Contacts



Auxiliary Contacts

A mechanically held contactor with a two-wire control module uses 1NC auxiliary contact as standard for the control wiring circuit. The mechanically held contactor with a three-wire control module uses 1NO–1NC auxiliary contacts as standard for the control wiring circuit. See **Table 30.2-21** for possible additional auxiliary contact configurations.

Table 30.2-21. Auxiliary Contact Configurations

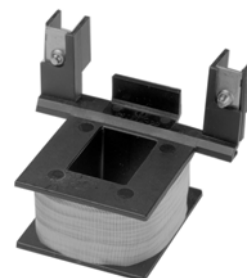
Two-Wire	Three-Wire
None	None
1NO (single-pole)	1NC (double-pole)
2NO (double-pole)	1NO (double-pole)
1NC (double-pole)	1NO–1NC (double-pole)
1NO–1NC (NO single-pole NC double-pole)	—
2NO–1NC (double pole)	—

Table 30.2-22. Auxiliary Contact Blocks

Auxiliary Block	Catalog Number
Single-pole	C320AMH1
Double-pole	C320AMH2

Replacement Parts

Magnetic Coils for the Base Contactor



Magnetic Coils

Table 30.2-23. Magnetic Coils

Coil Voltage	Catalog Number
115–120 V 60 Hz/110 V 50 Hz	9-3242-1
230–240 V 60 Hz/220 V 50 Hz	9-3242-2
460–480 V 60 Hz/440 V 50 Hz	9-3242-3
575–600 V 60 Hz/550 V 50 Hz	9-3242-4
200–208 V 60 Hz	9-3242-5
265–277 V 60 Hz/240 V 50 Hz	9-3242-6
24 V 60 Hz/20 V 50 Hz	9-3242-7
28 V 60 Hz/24 V 50 Hz	9-3242-8
347 V 60 Hz	9-3242-9

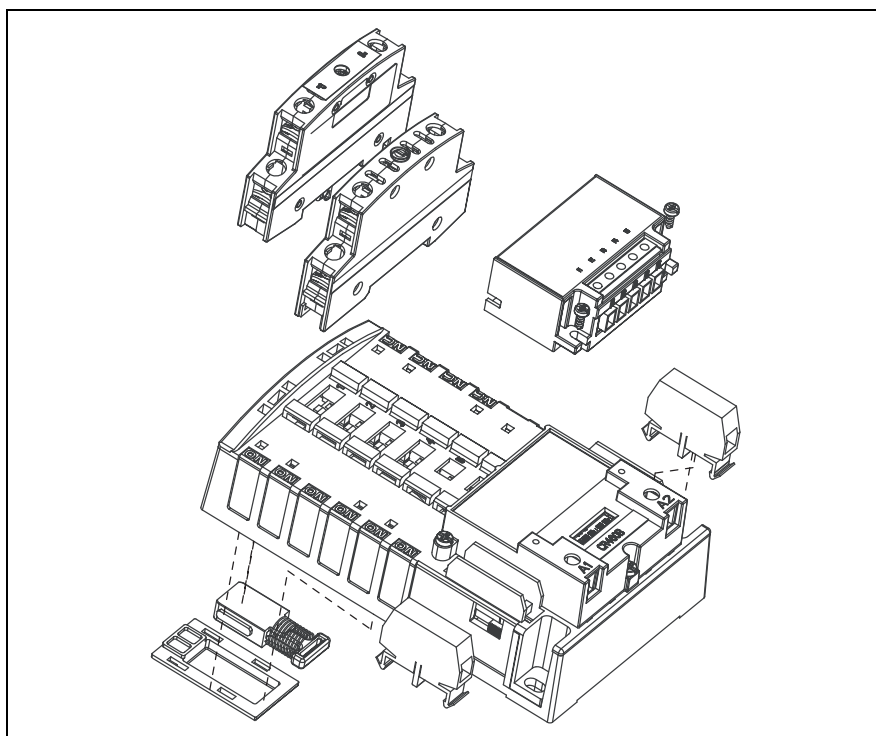


Figure 30.2-4. C30CNM Components—Exploded View

Technical Data and Specifications

Non-Combination C30 Lighting Contactors SCCR Charts

Table 30.2-24. Circuit Breakers—Standard Size Enclosure

Circuit Breakers			Enclosure Type (Standard Size Enclosure)		Enclosure Type (Standard Size Enclosure)		Enclosure Type (Standard Size Enclosure)	
AC Service Voltage	Breaker Size	Circuit Breaker Design	Type 1	SCCR Value	Type 12	SCCR Value	Type 3R	SCCR Value
240 V	30 A	Eaton T-mag ①	Eaton Box 2 or UL Listed equivalent ②	14 kA	Eaton Box 5 or UL Listed equivalent ②	14 kA	Eaton Box 5A or UL Listed equivalent ②	14 kA
	40 A	Eaton T-mag ①		10 kA		10 kA		
277 V	30 A	Eaton T-mag ①		10 kA		10 kA		
480 V	40 A	Eaton T-mag ①		5 kA		5 kA		
600 V	40 A	Eaton T-mag ①		5 kA		5 kA		5 kA

① Any Eaton UL Listed thermal-magnetic circuit breaker may be used provided the breaker interrupting rating meets or exceeds the SCCR values shown above.

② Any UL Listed enclosure may be used that meets or exceeds the size of the specified Eaton enclosure.

Table 30.2-25. Circuit Breakers—Oversized Enclosure

Circuit Breakers			Enclosure Type (Oversized Enclosure)		Enclosure Type (Oversized Enclosure)		Enclosure Type (Oversized Enclosure)	
AC Service Voltage	Breaker Size	Circuit Breaker Design	Type 1	SCCR Value	Type 12	SCCR Value	Type 3R	SCCR Value
240 V	40 A	Eaton T-mag ③	Eaton Box F or UL Listed equivalent ④	22 kA	Eaton Box I or UL Listed equivalent ④	22 kA	Eaton Box L or UL Listed equivalent ④f	22 kA
277 V	40 A	Eaton T-mag ③		14 kA		14 kA		14 kA
480 V	40 A	Eaton T-mag ③		10 kA		10 kA		10 kA

③ Any Eaton UL Listed thermal-magnetic circuit breaker may be used provided the breaker interrupting rating meets or exceeds the SCCR values shown above.

④ Any UL Listed enclosure may be used that meets or exceeds the size of the specified Eaton enclosure.

Table 30.2-26. Fuses—Standard Size Enclosure

Fuses			Enclosure Type (Standard Size Enclosure)		Enclosure Type (Standard Size Enclosure)		Enclosure Type (Standard Size Enclosure)	
AC Service Voltage ⑤	Fuse Size and Class	Fuse Vendor	Type 1	SCCR Value	Type 12	SCCR Value	Type 3R	SCCR Value
600 V	30 A—Class J	Eaton (Bussmann)	Eaton Box 2 or UL Listed equivalent ⑥	100 kA	Eaton Box 5 or UL Listed equivalent ⑥	100 kA	Eaton Box 5A or UL Listed equivalent ⑥	100 kA
600 V	30 A—Class RK1 or K	Eaton (Bussmann)		50 kA		50 kA		50 kA
600 V	30 A—Class H	Eaton (Bussmann)		10 kA		10 kA		10 kA

⑤ 600 volts covers all lower voltage values (200 to 600 Vac). Fuse interrupt rating must meet or exceed SCCR value shown above.

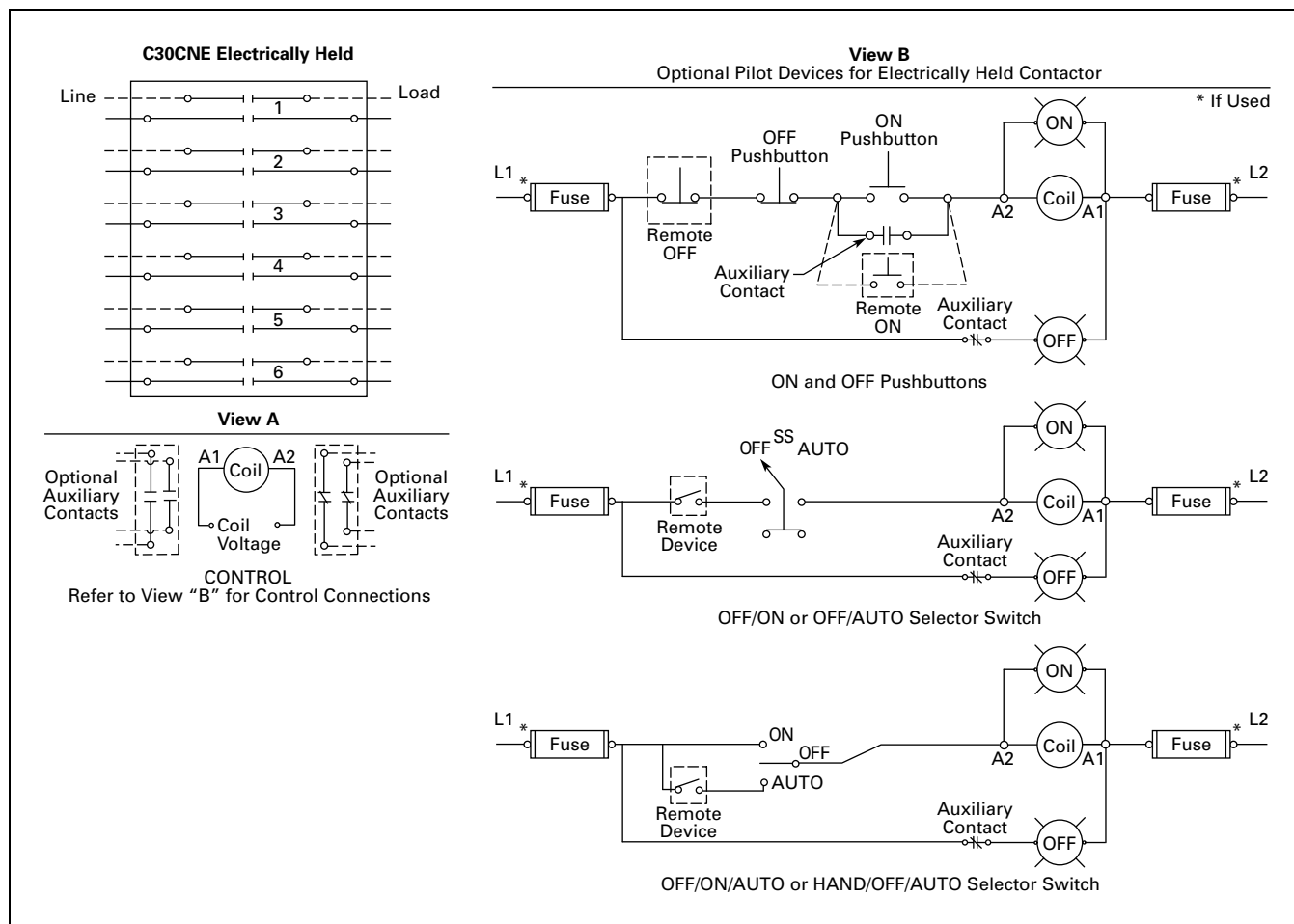
⑥ Any UL Listed enclosure may be used that meets or exceeds the size of the specified Eaton enclosure.

Table 30.2-27. Fuses—Oversized Enclosure

Fuses			Enclosure Type (Oversized Enclosure)		Enclosure Type (Oversized Enclosure)		Enclosure Type (Oversized Enclosure)	
AC Service Voltage ⑦	Fuse Size and Class	Fuse Vendor	Type 1	SCCR Value	Type 12	SCCR Value	Type 3R	SCCR Value
600 V	30 A—Class RK5 or K	Eaton (Bussmann)	Eaton Box F or UL Listed equivalent ⑧	100 kA	Eaton Box I or UL Listed equivalent ⑧	100 kA	Eaton Box L or UL Listed equivalent ⑧	100 kA
600 V	30 A—Class H	Eaton (Bussmann)		10 kA		10 kA		10 kA
600 V	40 A—Class J or RK1	Eaton (Bussmann)		100 kA		100 kA		100 kA

⑦ 600 volts covers all lower voltage values (200 to 600 Vac). Fuse interrupt rating must meet or exceed SCCR value shown above.

⑧ Any UL Listed enclosure may be used that meets or exceeds the size of the specified Eaton enclosure.

Wiring Diagrams**Figure 30.2-5. C30CNM Wiring Diagram**

Mechanically Held, 30 A, 2–12 Pole—C30CNM

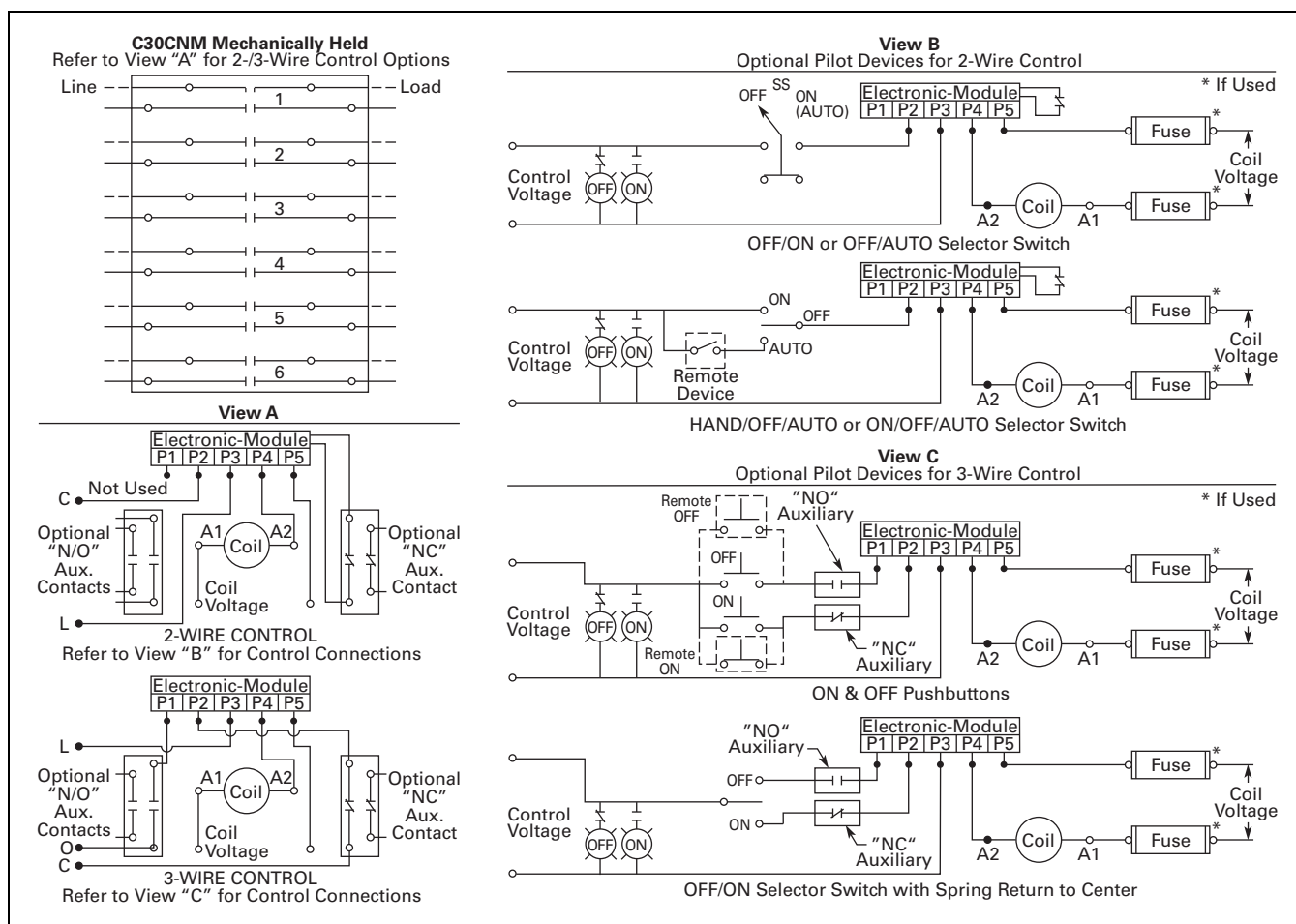


Figure 30.2-6. C30CNM Wiring Diagram

Dimensions

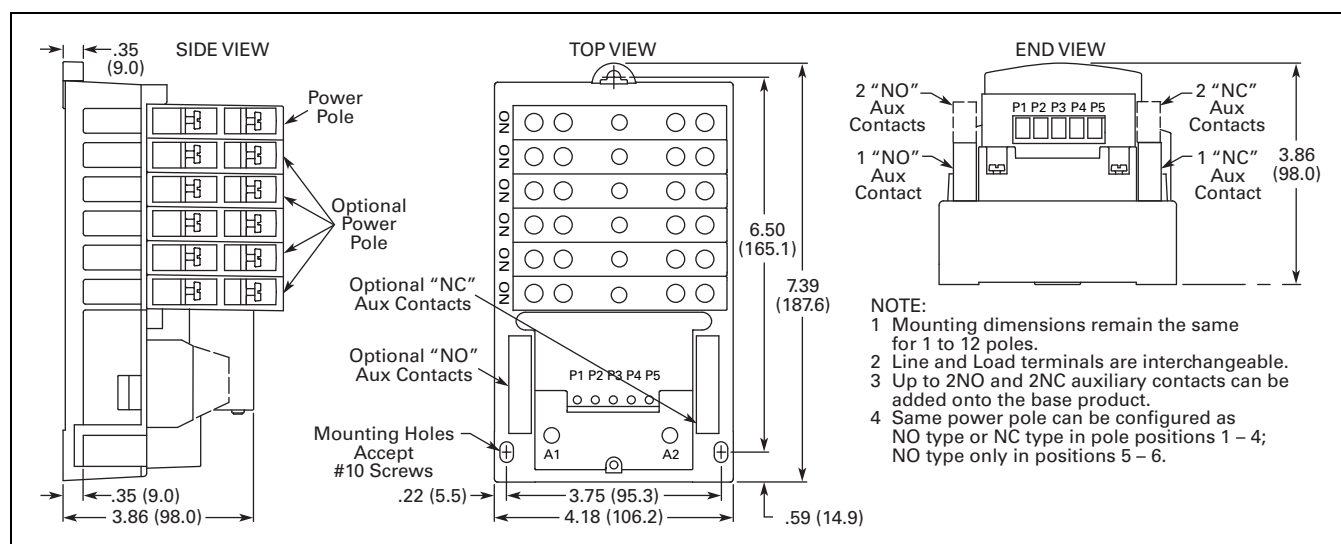
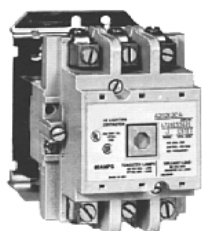


Figure 30.2-7. Approximate Dimensions in Inches (mm)

A202—Open (ECL04—Enclosed)



60 Ampere Size

General Description

AC lighting contactors provide a safe convenient means for local or remote switching of relatively large tungsten, fluorescent or mercury arc lamp loads. They are also suitable for low pressure and high pressure sodium lamp loads.

These lighting contactors are designed to withstand the large initial inrush currents of tungsten lamp loads without contact welding. They are full rated and do not require derating as do standard motor control contactors.

Operation (Magnetic Latch)

A permanent magnet is built into the contactor structure that will maintain the contactor in its energized state indefinitely without using control power. When energized, a DC current is applied to the latch coil producing a magnetic field that reinforces the polarity of the permanent magnet, pulling in the contactor. The current to the coil is disconnected by the coil clearing interlock. In order to drop out the contactor, it is necessary to apply a field through the STOP coil in the reverse direction to the permanent magnet. This momentarily cancels the magnetic attraction and the contactor drops out.

Enclosures

Open and NEMA Types 1, 3R, 4X and 12.

Specifications

- Terminals:
 - All except 30 A devices Al/Cu
 - 30 A devices Cu only
- Ballast load 600 Vac, breaking all lines
- Tungsten lamp loads, maximum volts:
 - Line-to-line. 480 Vac
 - Line-to-neutral. 277 Vac

Typical Specifications

Magnetically-held lighting contactors are Eaton's Type A202 or approved equal for lighting loads of 30–400 A. Magnetically-held combination lighting contactors are Type ECL15 (breaker) or ECL13 (fusible) or approved equal for loads of 30–200 A when integral short circuit protection is required.

These contactors are designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contacts welding. The contactors are capable of being "magnetically held" via a magnetic latch design using a permanent magnet.

The contactor shall be operated by a RUN signal and a STOP signal preventing the contactor from switching to "OFF" during control circuit power failures.

Table 30.2-28. Ratings—Latched AC Lighting Contactors

Holding Circuit Auxiliary Contact or Pushbutton Station not Included	
Continuous Amperes (Enclosed)	Number of Poles
30	2, 3, 4, 5, 6, 8, 10, 12
60	2, 3, 4, 5, 6, 8, 10, 12
100	2, 3, 4, 5, 6, 8, 10, 12
200	2, 3, 4, 5, 6, 8, 10, 12
300	2, 3
400	2, 3

Table 30.2-29. Non-Combination Lighting Contactors—6 to 12 Pole

Continuous Amperes (Enclosed)	Number of Poles	Pole Configuration	Dimensions in Inches (mm)	
			Open Type	
			Wide A	High B
30	6	3 x 3	7.13 (181.1)	4.46 (113.3)
	8	4 x 4	7.13 (181.1)	4.46 (113.3)
	10	5 x 5	10.63 (270.0)	4.46 (113.3)
	12	4 x 4 x 4	12.38 (314.5)	6.88 (174.8)
60	6	3 x 3	7.13 (181.1)	4.46 (113.3)
	8	4 x 4	10.63 (270.0)	4.46 (113.3)
	10	5 x 5	10.63 (270.0)	4.46 (113.3)
	12	5 x 5 x 2	15.00 (381.0)	6.88 (174.8)
100	6	3 x 3	9.75 (247.7)	6.88 (174.8)
	8	5 x 3	12.38 (314.5)	6.88 (174.8)
	10	5 x 5	15.00 (381.0)	6.88 (174.8)
	12	5 x 5 x 2	34.13 (866.9)	27.50 (698.5)
200	6	3 x 3	9.75 (247.7)	6.88 (174.8)
	8	5 x 3	12.38 (314.5)	6.88 (174.8)
	10	5 x 5	15.00 (381.0)	6.88 (174.8)
	12	5 x 5 x 2	34.13 (866.9)	27.50 (698.5)

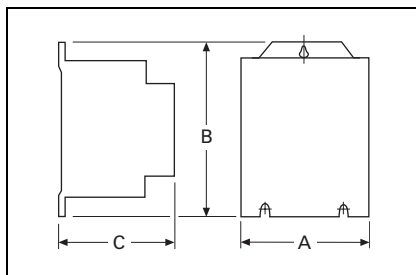


Figure 30.2-8. Open Type

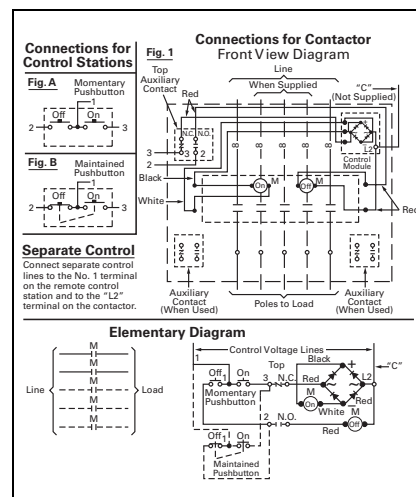


Figure 30.2-9. Connection Diagram

For enclosure box dimensions, refer to Page 30.6-3.

Magnetically Latched (Mechanically Held)—A202

Enclosed Box Selection

Table 30.2-30. Type 1 Non-combination Lighting Contactors—Magnetically Latched—A202

Ampere Size (Poles)	Box No.	Shipping Weight Lb (kg)
---------------------	---------	-------------------------

Contactors—without Control Power Transformers

30 A (2P, 3P, 4P, 5P)	2	8.5 (3.9)
30 A (6P, 8P, 10P, 12P)	3	13 (5.9)
30 A (20P)	4	35 (16)
60 A (2P, 3P, 4P, 5P)	2	8.7 (3.9)
60 A (6P, 8P, 10P, 12P)	3	13.5 (6.1)
60 A (20P)	4	40 (18)
100 A (2P, 3P, 4P, 5P)	4	40 (18)
100 A (6P, 8P, 10P, 12P)	9	85 (39)
100 A (20P)	9	100 (45)
200 A (2P, 3P, 4P, 5P)	4	46 (21)
200 A (6P, 8P, 10P, 12P)	9	95 (43)
200 A (20P)	9	110 (50)
300 A (2P, 3P)	10	115 (52)
400 A (2P, 3P)	10	125 (57)

Contactors—with Control Power Transformers

30 A (2P, 3P, 4P, 5P)	2	12.5 (5.7)
30 A (6P, 8P, 10P, 12P)	3	17 (7.7)
30 A (20P)	4	39 (18)
60 A (2P, 3P, 4P, 5P)	2	12.7 (5.8)
60 A (6P, 8P, 10P)	3	17.5 (7.9)
60 A (12P)	9	87 (39)
60 A (20P)	4	44 (20)
100 A (2P, 3P, 4P, 5P)	4	47 (21)
100 A (6P, 8P, 10P, 12P)	9	92 (42)
100 A (20P)	9	107 (49)
200 A (2P, 3P, 4P, 5P)	4	53 (24)
200 A (6P, 8P, 10P, 12P)	9	102 (46)
200 A (20P)	9	117 (53)
300 A (2P, 3P)	10	122 (55)
400 A (2P, 3P)	10	132 (60)

Table 30.2-31. Type 3R, 4/4X, 12 Non-combination Lighting Contactors—Magnetically Latched—A202

Ampere Size (Poles)	Box No.	Shipping Weight Lb (kg)
---------------------	---------	-------------------------

Contactors—without Control Power Transformers

30 A (2P, 3P, 4P, 5P)	5	13 (5.9)
30 A (6P, 8P, 10P, 12P)	7	21 (10)
30 A (20P)	8	46 (21)
60 A (2P, 3P, 4P, 5P)	5	14 (6.4)
60 A (6P, 8P, 10P, 12P)	7	22 (10)
60 A (20P)	8	48 (22)
100 A (2P, 3P, 4P, 5P)	8	50 (23)
100 A (6P, 8P, 10P, 12P)	9	58 (26)
100 A (20P)	10	100 (45)
200 A (2P, 3P, 4P, 5P)	8	52 (24)
200 A (20P)	10	105 (48)
300 A (2P, 3P)	10	113 (51)
400 A (2P, 3P)	10	125 (57)

Contactors—with Control Power Transformers

30 A (2P, 3P)	6	15 (6.8)
30 A (4P, 5P, 6P, 8P, 10P, 12P)	7	28 (13)
30 A (20P)	8	54 (25)
60 A (2P, 3P)	6	16 (7.3)
60 A (4P, 5P, 6P, 8P, 10P, 12P)	7	29 (13)
60 A (20P)	8	55 (25)
100 A (2P, 3P, 4P, 5P)	8	57 (26)
100 A (6P, 8P, 10P, 12P)	9	65 (30)
100 A (20P)	10	112 (51)
200 A (2P, 3P, 4P, 5P)	8	59 (27)
300 A (2P, 3P)	10	120 (54)
400 A (2P, 3P)	10	132 (60)

Table 30.2-32. Type 1 Combination Lighting Contactors

Ampere Size	Box No.	Shipping Weight Lb (kg)
-------------	---------	-------------------------

Magnetically Latched—Non-reversing (3P Only)—with or without Control Power Transformers

30 A	A	35 (16)
60 A	A	36 (16)
100 A	C	65 (30)
200 A with disconnect switch	D	110 (50)
200 A with thermal-magnetic breaker	E	150 (68)
300 A	E	140 (64)
400 A	E	190 (86)

Table 30.2-33. NEMA 3R, 4/4X, 12 Combination Lighting Contactors

Ampere Size	Box No.	Shipping Weight Lb (kg)
-------------	---------	-------------------------

Magnetically Latched—Non-reversing (3P Only)—with or without Control Power Transformers

30 A	A	35 (16)
60 A	A	36 (16)
100 A	C	65 (30)
200 A with disconnect switch	D	110 (50)
200 A with thermal-magnetic breaker	E	150 (68)
300 A with disconnect switch	72"	375 (170)
300 A with thermal-magnetic breaker	E	160 (73)
400 A with disconnect switch	72"	425 (193)
400 A with thermal-magnetic breaker	E	210 (95)

Combination Lighting Contactors

Types ECL12, ECL13, ECL14 and ECL15

General Description

Catalog Number ECL12, ECL13, ECL14 and ECL15 combination lighting contactors offer convenient installation of switching and overcurrent protection in a single enclosure. Combination lighting contactors are ideally suited for industrial and commercial lighting applications or where a lighting circuit may have to be disconnected for periodic maintenance. They may also be applied on resistance heating loads.

Typical Specifications

Magnetically latched combination lighting contactors are Eaton's Type

ECL15 (breaker) or ECL13 (fusible) or approved equal for loads of 30–200 A when integral short-circuit protection is required.

These contactors are designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding. The contactors are capable of being "magnetically held" via a magnetic latch design using a permanent magnet. The contactor shall be operated by a RUN signal and a STOP signal preventing the contactor from switching to "OFF" during control circuit power failures.

Electrically held combination lighting contactors are Eaton Type ECL14 (breaker) or ECL12 (fusible) or approved equal for loads of 30–400 A when integral short-circuit protection is required.

These contactors shall be designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding. Contactors shall be capable of accepting up to eight auxiliary contacts—top and/or side up to 60 A and side only up to 400 A. Contactors shall be capable of being operated by AC or DC control.

Features

- Disconnect devices—either a Series C circuit breaker or a fusible disconnect switch
- Handle mechanism—flange mounted
- UL listed
- UL service entrance approved for NEMA 3R outdoor enclosure
- Extra room for modifications such as a 24-hour time clock

Catalog Number Selection

Table 30.2-34. Enclosed Lighting Contactor Catalog Numbering System

EC L 12 D 1 A 3 E - X									
Design L = CN35 or A202 lighting contactor C = C30CN lighting contactor				Modification Codes (See PG03300001E)					
Class 03 = Non-combination electrically held lighting contactor 04 = Non-combination mechanically held/magnetically latched lighting contactor 12 = Combination electrically held lighting contactor—fusible disconnect 13 = Combination magnetically latched lighting contactor—fusible disconnect 14 = Combination electrically held lighting contactor—thermal-magnetic circuit breaker 15 = Combination magnetically latched lighting contactor—thermal-magnetic circuit breaker				Disconnect Fuse Clip Ratings A = None B = 30 A/250 V R C = 30 A/600 V R D = 60 A/250 V R E = 30 A/600 V R F = 100 A/250 V R G = 100 A/600 V R H = 200 A/250 V R J = 200 A/600 V R K = 400 A/250 V R L = 400 A/600 V R M = 600 A/250 V R N = 600 A/600 V R P = 800 A/600 V R T = By description					
Ampere Size ^② A = 10 A B = 20 A C = 30 A D = 60 A E = 100 A F = 200 A G = 300 A H = 400 A J = 600 A				Thermal-Magnetic Breaker Ratings A = None D = 20 A E = 30 A F = 60 A G = 100 A H = 200 A J = 300 A K = 400 A L = 600 A M = 800 A T = By description					
Enclosure Types 1 = Type 1—General purpose 2 = Type 3R—Rainproof 3 = Type 4—Watertight (painted) 4 = Type 4X—Watertight (304-grade stainless steel) 6 = Type 7/9—Explosion proof 8 = Type 12—Dust-tight 9 = Type 4X—Watertight (316-grade stainless steel)				Number of Poles ^① 1, 2, 3, 4, 5, 6, 7, 8, 9 = Poles required A = 10 Poles B = 12 Poles C = 20 Poles Combination Devices = Three-pole only					
				Coil Voltage A = 120/60 110/50 B = 240/60 220/50 C = 480/60 440/50 D = 600/60 550/50 E = 208/60 G = 550/50 H = 277/60 J = 208–240/60 K = 240/50 L = 380/50 M = 415/50 P = 12 Vdc Q = 24 Vdc R = 48 Vdc S = 125 Vdc T = 24/60 U = 24/50 V = 32/50 W = 48/60 X = 104–120/60 Y = 48/50 Z = By description					

① For normally closed poles, see PG03300001E.

② C30CN available in 30 A only.

Electrically Held and Magnetically Latched Combination Lighting, Three-Pole Only—Type ECL

Table 30.2-35. Ratings—Latched ELC15 Series C Circuit Breaker Disconnect

Continuous Amperes (Enclosed)	Circuit Breaker	
	Ampere Rating	System Voltage
30	30	600
60	60	600
100	100	600
200	200	600

Table 30.2-36. ELC13—Fusible Disconnect Switch

Continuous Amperes (Enclosed)	Fuse Clip	
	Ampere Rating	System Voltage
30	30	250, 600
60	60	250, 600
100	100	250, 600
200	200	250, 600

Table 30.2-37. Ratings—Electrically-held ELC14 Series C Circuit Breaker Disconnect

Continuous Amperes (Enclosed)	Circuit Breaker	
	Ampere Rating	System Voltage
30	30	600
60	60	600
100	100	600
200	200	600
300	300	600
400 ①	400	600

① UL ballast and resistive ratings only.

Table 30.2-38. ELC12—Fusible Disconnect Switch

Continuous Amperes (Enclosed)	Fuse Clip	
	Ampere Rating	System Voltage
30	30	250, 600
60	60	250, 600
100	100	250, 600
200	200	250, 600
300	300	250, 600
400 ②	400	250, 600

② UL ballast and resistive ratings only.

Table 30.2-39. Factory Modifications

Description	Enclosure	Used On	
		Standard	Combination
Control transformers: 480 to 120 V control transformer 100 VA extra capacity transformer 200 VA extra capacity transformer 240 to 120 V control transformer with fuse in holder 208 to 120 V control transformer with fuse in holder 415 to 110 V control transformer with fuse in holder 277 to 120 V control transformer with fuse in holder	Any	■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■
Lightning arrester Undervoltage relay On-off pushbutton Hand-off-auto selector switch	Any	■ ■	■ ■
Addition of photoelectric receptacle and relay with photo cell installed (two-wire circuit)	—	■	■
24-hour time clock, 120 V 24-hour time clock with day omission, 120 V 7-day time clock, 120 V Cover plate for use in place of watertight hub on enclosure top	—	■ ■ ■ ■	■ ■ ■ ■

**NEMA Motor Starters
Freedom Series**

NEMA AN19DN0A5E005
NEMA Size 1

General Description

The Freedom Series starters and contactors listed in this catalog feature a compact, space-saving design and high strength, impact and temperature-resistant insulating materials. Starters and contactors are available in the NEMA (National Electrical Manufacturers' Association) style. The NEMA devices are sized based on traditional NEMA classifications.

Features**Freedom NEMA**

- Adjustable bimetallic ambient compensated overload relays with interchangeable heater packs—available in three basic sizes, covering applications up to 900 hp—reducing the number of different contactor/overload relay combinations that have to be stocked. Fixed heater overloads are optional
- Electronic overload relay (C440) available as a stand-alone unit and assembled with a Freedom contactor
- A full line of snap-on accessories—top and side mounted auxiliary contacts, solid-state and pneumatic timers, etc.
- Straight-through wiring—line lugs at top, load lugs at bottom
- Horizontal or vertical mounting on upright panel for application freedom
- Screw type power terminals have captive, backed-out self-lifting pressure plates with \pm screws—reduced wiring time
- Accessible terminals for easy wiring. Optional fingerproof shields available to prevent electrical shock
- Top located coil terminals convenient and readily accessible. 45 mm contactor magnet coils have three terminals, permitting either top or diagonal wiring—easy to replace European or U.S. style starters or contactors without changing wiring layout
- Designed to meet or exceed NEMA, UL, CSA, VDE, BS and other international standards and listings
- American engineering—built by Eaton, using the latest in statistical process control methods to produce high quality, reliable products
- Sized based on standard NEMA classifications
- Easy coil change and inspectable/replaceable contacts
- Available in open and NEMA Type 1, 3R, 4/4X and 12 enclosures

Standards and Certifications

- Standard: Designed to meet or exceed UL, NEMA and CSA
- UL listed: UL File #E1491, Guide #NLDX—Open; UL File #E176513—Enclosed Combination Motor Controllers; UL File #E19224—Enclosed Non-Combination Motor Controllers; UL File #E195239—Enclosed Power Conversion Equipment
- CSA certified: CSA File #LR353, Class #321104 Open and NEMA 1 Enclosed

Certified Type 2 Coordination

Eaton's Freedom Series NEMA starters are now UL certified to achieve IEC 947 Type 2 coordination against 100,000 A short-circuit fault currents. Any brand of properly selected fuse can be used. Type 2 coordination means that the starter will be suitable for further use following a short-circuit fault.

Short-Circuit Protection

Fuses and inverse-time circuit breakers may be selected per Article 430, Part D of the National Electrical Code® to protect motor branch circuits from fault conditions. If higher ratings or settings are required to start the motor, do not exceed the maximum as listed in Exception No. 2, Article 430.52.

Technical Data

NEMA Sizes 00-8

Table 30.3-1. AC Coil Data

NEMA Sizes	Motor Voltage	Maximum hp Rating	P.U. Volts		P.U.			Sealed			D.O. Volts		Maximum Operation Rate Operations/Hour	P.U. Time ms	D.O. Time ms
			Cold	Hot	VAR	VA	Watts	VAR	VA	Watts	Cold	Hot			
00	200 230 460 575	1-1/2 1-1/2 2 2	74%	78%	64	80	49	7.1	7.5	2.4	45%	46%	12,000	12	12
0	200 230 460 575	3 3 5 5	74%	78%	78	100	65	9.2	10	3.1	45%	46%	12,000	12	12
1	200 230 460 575	7-1/2 7-1/2 10 10	74%	78%	210	230	95	27	28	7.8	49%	50%	12,000	20	14
2	200 230 460 575	10 15 25 25	74%	78%	210	230	95	27	28	7.8	49%	50%	12,000	20	14
3	200 230 460 575	25 30 50 50	72%	76%	374	390	112	48	49.8	13	50%	52%	7200	14	11
4	200 230 460 575	40 50 100 100	73%	76%	1132	1158	240	96	100	27.2	54%	56%	2400	28	14
5	200 230 460 575	75 100 200 200	75%	77%	1132	1158	240	96	100	27.2	63%	64%	2400	25	13

General Coil Data

- **Coil Offering**—tape wound:
 - NEMA Sizes 00–0
 - UL insulation rating: Class 130 (B)
- **Coil Offering**—encapsulated:
 - NEMA Sizes 1–3
 - UL insulation rating: Class 130 (A)
- **Coil Offering**—encapsulated:
 - NEMA Sizes 4–5
 - UL insulation rating: Class 155 (F)
- **Operational Limits:**
 - 85% to 110% of rated voltage—AC
 - 80% to 110% of rated voltage—DC

Table 30.3-2. Coil Data Notes

Description	
P.U.	Pickup time is the average time taken from closing of the coil circuit to main contact touch.
D.O.	Dropout time is the average time taken from opening of the coil circuit to main contact separation.
Cold	Coil data with a cold coil.
Hot	Coil data with a hot coil.

All data is based on a standard contactor with no auxiliary devices and a 120 Vac or 24 Vdc magnet coil. Coil data has a ±5% range depending on the application, therefore specific data may vary.

Table 30.3-3. DC Coil Data

NEMA Sizes	Motor Voltage	P.U.			Sealed		D.O. Volts (Hot)	P.U. Time ms	D.O. Time ms	Maximum Operation Rate Operations/Hour	Mechanical Life Millions
		Amperes	Watts	Volts (Hot)	Amperes	Watts					
00 and 0	12	6.4	76.8	80%	0.28	3.36	60%	22	17	3600	5
	24	3.2	76.8	80%	0.14	3.36	60%	22	17	3600	5
	48	1.6	76.8	80%	0.07	3.36	60%	22	17	3600	5
	120	0.64	76.8	80%	0.028	3.36	60%	22	17	3600	5
1 and 2	12	15.4	126	68%	0.42	4.98	30%	21	12	3600	2
	24	6.2	88.4	60%	0.21	4.96	29%	20	13	3600	2
	48	2.9	76.2	56%	0.11	5.04	28%	20	14	3600	2
	120	1.1	67.3	53%	0.041	4.87	29%	20	16	3600	2
3	12	24	293	65%	0.40	4.84	23%	39	14	3600	2
	24	12	288	61%	0.20	4.75	22%	38	14	3600	2
	48	6.1	295	62%	0.097	4.67	22%	37	14	3600	2
	120	2.5	298	61%	0.038	4.57	22%	37	16	3600	2
4 and 5	24	18	400	67%	0.22	5.3	25%	53	14	2400	2
	48	9.0	400	67%	0.11	5.2	25%	49	16	2400	2
	120	3.3	450	65%	0.05	5.4	28%	56	19	2400	2
	240	1.7	440	64%	0.02	4.9	26%	49	21	2400	2

General Coil Data

- **Coil Offering**—tape wound:
 - NEMA Sizes 00–0
 - UL insulation rating: Class 130 (B)
- **Coil Offering**—encapsulated:
 - NEMA Sizes 1–3
 - UL insulation rating: Class 130 (A)
- **Coil Offering**—encapsulated:
 - NEMA Sizes 4–5
 - UL insulation rating: Class 155 (F)
- **Operational Limits:**
 - 85% to 110% of rated voltage—AC
 - 80% to 110% of rated voltage—DC

Table 30.3-4. Coil Data Notes

Description	
P.U.	Pickup time is the average time taken from closing of the coil circuit to main contact touch.
D.O.	Dropout time is the average time taken from opening of the coil circuit to main contact separation.
Cold	Coil data with a cold coil.
Hot	Coil data with a hot coil.

All data is based on a standard contactor with no auxiliary devices and a 120 Vac or 24 Vdc magnet coil. Coil data has a $\pm 5\%$ range depending on the application, therefore specific data may vary.

Table 30.3-5. Specifications—Sizes 00–3

Description	Contactor Catalog Number/Size				
	CN15A NEMA Size 00	CN15B NEMA Size 0	CN15D NEMA Size 1	CN15G NEMA Size 2	CN15K NEMA Size 3
Configuration					
Number of poles	2, 3, 4	2, 3	2, 3, 4, 5	2, 3, 4, 5	2, 3
Auxiliary contacts, standard	4th pole NO (1)	Side NO (1)	Side NO (1)	Side NO (1)	Side NO (1)
Add-on auxiliary contacts	Top (4) or side (4)	Top (4) or side (3)	Top (4) or side (3)	Top (4) or side (3)	Left side (4) or right side (3)
Frame size	45 mm	45 mm	65 mm	65 mm	90 mm
Maximum voltage rating	600 Vac	600 Vac	600 Vac	600 Vac	600 Vac
Continuous ampere ratings (I)	9 A	18 A	27 A	45 A	90 A
Maximum horsepower (hp)					
Single-phase 115 V	1/3	1	2	3	7-1/2
230 V	1	2	3	7-1/2	15
Three-phase 200 V	1-1/2	3	7-1/2	10	25
230 V	1-1/2	3	7-1/2	15	30
460 V	2	5	10	25	50
575 V	2	5	10	25	50
Coil operating range % of rated voltage	–15% to +10%	–15% to +10%	–15% to +10%	–15% to +10%	–15% to +10%
Operating temperature	–20 °C to +65 °C	–20 °C to +65 °C	–20 °C to +65 °C	–20 °C to +65 °C	–20 °C to +65 °C
Maximum operating altitude in feet (m)	6000 (1828)	6000 (1828)	6000 (1828)	6000 (1828)	6000 (1828)
Mechanical life	20,000,000	20,000,000	10,000,000	10,000,000	6,000,000
Electrical life (480 V/60 Hz)					
AC-3	4,000,000	3,000,000	5,000,000	3,500,000	1,700,000
AC-4	90,000	85,000	200,000	62,000	80,000
Wire range					
Power terminals	12–16 stranded, 12–14 solid Cu	8–16 stranded, 10–14 solid Cu	8–14 stranded or solid Cu	2–14 (upper) and/or 6–14 (lower) stranded or solid Cu	1/0–14 Cu
Control terminals	12–16 stranded, 12–14 solid Cu	12–16 stranded, 12–14 solid Cu	12–16 stranded, 12–14 solid Cu	12–16 stranded, 12–14 solid Cu	12–16 stranded 12–14 solid Cu
Power terminal torque					
Line and load—Ib-in	7	15	20	40 (14–8 AWG) 45 (6–4 AWG) 50 (3 AWG)	35 (14–10 AWG) 40 (8 AWG) 45 (6–4 AWG) 50 (3–1/0 AWG)
Auxiliary contact rating	A600, P300				

Table 30.3-6. Specifications—Sizes 4–5

Description	Contactor Catalog Number/Size	
	CN15N NEMA Size 4	CN15S NEMA Size 5
Configuration Number of poles Auxiliary contacts, standard Add-on auxiliary contacts	2, 3 Side NO (1) Left side (3) or right side (4)	2, 3 Side NO (1) Left side (3) or right side (4)
Frame size	180 mm	180 mm
Maximum voltage rating	600 Vac	600 Vac
Continuous ampere ratings (i)	135 A	270 A
Maximum horsepower (hp) Single-phase 115 V 230 V	— —	— —
Three-phase 200 V 230 V 460 V 575 V	40 50 100 100	75 100 200 200
Coil operating range % of rated voltage	–15% to +10%	–15% to +10%
Operating temperature Maximum operating altitude in feet (m) Mechanical life	–20 °C to +65 °C 6000 (1828) 5,000,000	–20 °C to +65 °C 6000 (1828) 5,000,000
Electrical life (480 V/60 Hz) AC-3 AC-4	800,000 70,000	500,000 34,000
Wire range Power terminals	Open—3/0–8 Cu; Enclosed—250 kcmil–6 Cu/Al	750 kcmil—2 or (2) 250 kcmil–3/0 Cu/Al
Control terminals	12–16 stranded, 12–14 solid Cu	12–16 stranded, 12–14 solid Cu
Power terminal torque Line and load—Ib-in	200	550
Auxiliary contact rating	A600, P300	

Freedom Line—Technical Data—NEMA

Table 30.3-7. 380V, 50 Hz Starters—Maximum hp Ratings

Description	NEMA Size					
	1	2	3	4	5	6
Maximum hp	10	25	50	75	150	300

Table 30.3-8. Motor FLA Current Ranges

Description	NEMA Size						
	1 ①	1	2	3	4	5	6
1.15 to 1.25 S.F.	0.47–3.81	3.15–27.00	3.15–45.00	9.90–90.00	9.90–135.00	38.30–270.00	38.30–540.00
1.0 S.F.	0.51–4.14	3.43–27.00	3.43–45.00	10.80–90.00	10.80–135.00	41.70–270.00	41.70–540.00

① Size 1 Lower Current Range for motor hp range 1/4 hp to 2 hp at 460 V.

Table 30.3-9. Wire (75 °C) Sizes—AWG or kcmil—NEMA Sizes 00–2—Open and Enclosed

NEMA Size	Cu Only
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Power Terminals—Line

00	#12–#16 stranded, #12–#14 solid
0	#8–#16 stranded, #10–#14 solid
1	#8–#14 stranded or solid
2	#3–#14 (upper) and/or #6–#14 (lower) stranded or solid ②

② Two compartment box lug.

Table 30.3-10. Overload Relay UL/CSA Contact Ratings Control Circuit ③

AC Volts	120 V	240 V	480 V	600 V
NC Contact B600				
Make and break amperes	30	15	7.5	6
Break amperes	3	1.5	0.75	0.6
Continuous amperes	5	5	5	5
NO Contact C600				
Make and break amperes	15	7.5	3.375	3
Break amperes	1.5	0.75	0.375	0.3
Continuous amperes	2.5	2.5	2.5	2.5

③ DC ratings cover Freedom Series coils only.

Table 30.3-11. Electronic Overload Relays up to 1500 A

Description	Specification	
	45 mm	55 mm
Capacity		
Load terminals		
Terminal capacity	12–10 AWG (4–6 mm ²) 8–6 AWG (6–16 mm ²)	6–1 AWG (16–50 mm ²)
Tightening torque	20–25 lb-in (2.3–2.8 Nm) 25–30 lb-in (2.8–3.4 Nm)	25–30 lb-in (2.8–3.4 Nm)
Input, auxiliary contact and remote reset terminals		
Terminal capacity	2 x (18–12) AWG	2 x (18–12) AWG
Tightening torque	5.3 lb-in (0.8–1.2 Nm)	5.3 lb-in (0.8–1.2 Nm)
Voltages		
Insulation voltage U _i (three-phase)	690 Vac	690 Vac
Insulation voltage U _i (control)	500 Vac	500 Vac
Rated impulse withstand voltage	6000 Vac	6000 Vac
Overvoltage category/pollution degree	III/3	III/3

Table 30.3-12. Wire (75 °C) Sizes—AWG or kcmil—NEMA Sizes 00–2 Open and Enclosed

Terminal	Wire Size ④	Catalog Number
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Power Terminals—Load—Cu Only (Stranded or Solid)

32 A	14–6 AWG	C306DN3B
75 A	14–2 AWG	C306GN3B
45 A	14–6 AWG	C396A_

④ Minimum per NEC. Maximum wire size: Sizes 00–0 to 8 AWG and Sizes 1–2 to 2 AWG.

Table 30.3-13. Wire (75 °C) Sizes—AWG or kcmil—NEMA Sizes 3–8—Open and Enclosed

NEMA Size	Wire Size
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C306 Power Terminals—Line and Load

3	10–14 AWG Al Cu
4	Open—#8–#3/0 Cu Enclosed—#6 250 kcmil—Al Cu
5	750 kcmil—#2 or (2) #3/0 250 kcmil—Al Cu

Table 30.3-14. C306 Control Terminals—Cu Only

Description
(2) #12–#16 stranded
(2) #12–#14 solid

**Electrical Life—AC-3 and AC-4
Utilization Categories****Life Load Curves**

Eaton's Freedom Series NEMA contactors have been designed and manufactured for superior life performance in any worldwide application. All testing has been based on requirements as found in NEMA and UL standards and conducted by Eaton. Actual application life may vary depending on environmental conditions and application duty cycle.

Utilization Categories

AC-1—Non-inductive or slightly inductive loads, such as resistance furnaces and heating.

AC-2—Starting of slip-ring motors.

AC-3—Squirrel cage motors; starting, switching off motors during running.

AC-4—Squirrel cage motors; starting, plugging, inching or jogging.

Note: AC-3 tests are conducted at rated device currents and AC-4 tests are conducted at six times rated device currents. All tests have been run at 460 V, 60 Hz.

Contactors Choice

- Decide what utilization category your application is and choose the appropriate curve
- Locate the intersection of the life-load curve of the appropriate contactor with the applications operational current (I_e), as found on the horizontal axis
- Read the estimated contact life along the vertical axis in number of operational cycles

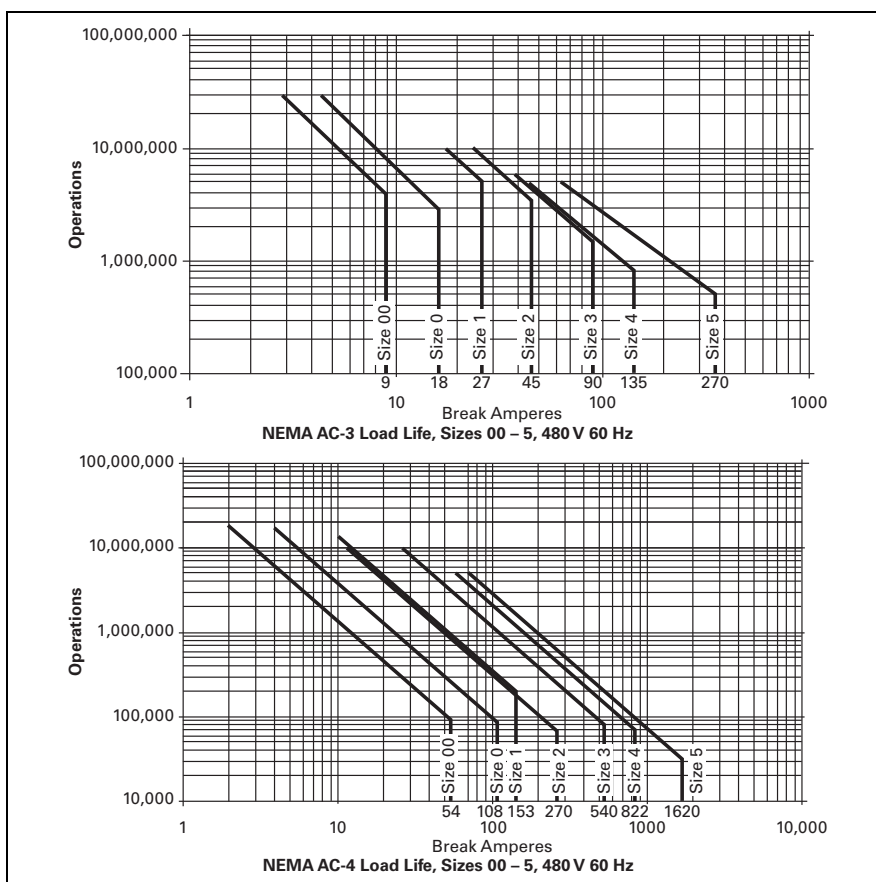


Figure 30.3-10. AC-3 and AC-4 Utilization Categories

AN19 Competitive Retrofit Kits

The retrofit kits provide a packaged solution to replace competitive starters with the Freedom AN19 starter using existing hole patterns. Suitable for replacement of Allen-Bradley, Square D, GE and Siemens starters.

**Kit contents**

- Competitive mounting plate
- AN19 starter
- Remote reset module
- NO 10250T pushbutton
- RESET pushbutton legend plate
- 16 gauge control wire

Table 30.3-15. AN19 Competitive Retrofit Kit—Product Selection

Size	Description	Catalog Number
1	120 Vac coil, 4–20 A overload	AN19DN0A5E020-CRK
2	120 Vac coil, 9–45 A overload	AN19GN0A5E045-CRK
3	120 Vac coil, 20–100 A overload	AN19KN0A5E100-CRK
4	120 Vac coil, 28–140 A overload	AN19NN0A5E140-CRK
5	120 Vac coil, 60–300 A overload	AN19SN0A5E300-CRK

Catalog Number Selection

Table 30.3-16. NEMA Freedom Line Enclosed Control Catalog Numbering System

ECN 22 2 1 A A F -																										
<div>Design</div> <div>N = Freedom NEMA 2 = A200</div>		<div>Modification Codes</div> <div>(See PG03300001E)</div>																								
<div>Class</div> <div>01 = Non-reversing contactor—three-pole Non-reversing contactor—two-pole Non-reversing contactor—four-pole Non-reversing contactor—five-pole</div> <div>02 = Reversing contactor—three-pole</div> <div>05 = Non-combination non-reversing starter</div> <div>06 = Non-combination reversing starter</div> <div>07 = Non-combination non-reversing starter with CPT</div> <div>08 = Non-combination single-phase non-reversing starter</div> <div>16 = Combination non-reversing starter—fusible disconnect Combination non-reversing starter—non-fusible disconnect Special enclosure combination non-reversing starter fusible/non-fusible disconnect</div> <div>17 = Combination reversing starter—fusible disconnect Combination reversing starter—non-fusible disconnect</div> <div>18 = Combination reversing starter—fusible disconnect with CPT Combination reversing starter—non-fusible disconnect with CPT</div> <div>22 = Combination non-reversing starter—circuit breaker Special enclosure combination non-reversing starter— circuit breaker</div> <div>23 = Combination reversing starter—circuit breaker</div> <div>24 = Combination non-reversing starter—circuit breaker with CPT</div>		<div>Cover Control</div> <div>Type 1 non-combination All others E22 style combination (Contact Eaton)</div> <div>Contactors</div> <div>3 = Three-pole</div>																								
		<div>Coil Voltage and/or Control Transformers</div> <div>See Table 30.3-17 and Table 30.3-18</div>																								
		<div>Disconnect Fuse Clip Ratings</div> <table><tr><td>A = None</td><td>G = 100 A/600 V R</td><td>N = 600 A/600 V R</td></tr><tr><td>B = 30 A/250 V R</td><td>H = 200 A/250 V R</td><td>P = 800 A/600 V L</td></tr><tr><td>C = 30 A/600 V R</td><td>J = 200 A/600 V R</td><td>Q = 1200 A/600 V L</td></tr><tr><td>D = 60 A/250 V R</td><td>K = 400 A/250 V R</td><td>R = 1600 A/600 V L</td></tr><tr><td>E = 60 A/600 V R</td><td>L = 400 A/600 V R</td><td>S = 2000 A/600 V L</td></tr><tr><td>F = 100 A/250 V R</td><td>M = 600 A/250 V R</td><td>T = By description</td></tr></table>	A = None	G = 100 A/600 V R	N = 600 A/600 V R	B = 30 A/250 V R	H = 200 A/250 V R	P = 800 A/600 V L	C = 30 A/600 V R	J = 200 A/600 V R	Q = 1200 A/600 V L	D = 60 A/250 V R	K = 400 A/250 V R	R = 1600 A/600 V L	E = 60 A/600 V R	L = 400 A/600 V R	S = 2000 A/600 V L	F = 100 A/250 V R	M = 600 A/250 V R	T = By description						
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F = 100 A/250 V R	M = 600 A/250 V R	T = By description																								
		<div>HMCP/E or Breaker Ratings</div> <table><tr><td>A = None</td><td>H = 150 A</td><td>R = 3000 A</td></tr><tr><td>B = 3 A</td><td>J = 250 A</td><td>T = By description</td></tr><tr><td>C = 7 A</td><td>K = 400 A</td><td>5 = 3 A ①</td></tr><tr><td>D = 15 A</td><td>L = 600 A</td><td>6 = 7 A ①</td></tr><tr><td>E = 30 A</td><td>M = 800 A</td><td>7 = 15 A ①</td></tr><tr><td>F = 50 A</td><td>N = 1000 A</td><td>8 = 30 A ①</td></tr><tr><td>W = 70 A</td><td>P = 1200 A</td><td>9 = 50 A ①</td></tr><tr><td>G = 100 A</td><td>Q = 2000 A</td><td>I = 100 A ①</td></tr></table>	A = None	H = 150 A	R = 3000 A	B = 3 A	J = 250 A	T = By description	C = 7 A	K = 400 A	5 = 3 A ①	D = 15 A	L = 600 A	6 = 7 A ①	E = 30 A	M = 800 A	7 = 15 A ①	F = 50 A	N = 1000 A	8 = 30 A ①	W = 70 A	P = 1200 A	9 = 50 A ①	G = 100 A	Q = 2000 A	I = 100 A ①
A = None	H = 150 A	R = 3000 A																								
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W = 70 A	P = 1200 A	9 = 50 A ①																								
G = 100 A	Q = 2000 A	I = 100 A ①																								
<div>NEMA Size</div> <table><tr><td>A = Size 00</td><td>3 = Size 3</td><td>7 = Size 7</td></tr><tr><td>0 = Size 0</td><td>4 = Size 4</td><td>8 = Size 8</td></tr><tr><td>1 = Size 1</td><td>5 = Size 5</td><td>9 = Size 9</td></tr><tr><td>2 = Size 2</td><td>6 = Size 6</td><td></td></tr></table>		A = Size 00	3 = Size 3	7 = Size 7	0 = Size 0	4 = Size 4	8 = Size 8	1 = Size 1	5 = Size 5	9 = Size 9	2 = Size 2	6 = Size 6		<div>Enclosure Type</div> <div>1 = Type 1—General purpose</div> <div>2 = Type 3R—Rainproof</div> <div>3 = Type 4—Watertight (painted steel)</div> <div>4 = Type 4X—Watertight (304-Grade stainless steel)</div> <div>5 = Type 4X—Corrosion (nonmetallic)</div> <div>6 = Type 7/9—Bolted hazardous location</div> <div>7 = Type 7/9—Threaded hazardous location</div> <div>8 = Type 12—Dust-tight</div> <div>9 = Type 4X—316-Grade stainless steel</div>												
A = Size 00	3 = Size 3	7 = Size 7																								
0 = Size 0	4 = Size 4	8 = Size 8																								
1 = Size 1	5 = Size 5	9 = Size 9																								
2 = Size 2	6 = Size 6																									

① Use for Sizes 0–3, HMCP 600 V applications only.

Table 30.3-17. Magnetic Coil Codes (System Voltage) ②

Code	Magnet Coil	Code	Magnet Coil	Code	Magnet Coil
A	120/60 110/50	K	240/50	U	24/50
B	240/60 220/50	L	380/50	V	32/50
C	460/60 440/50	M	415/50	W	48/60
D	575/60 550/50	P	12 Vdc	X	104–120/60
E	208/60	Q	24 Vdc	Y	48/50
G	550/50	R	48 Vdc	Z	By description
H	277/60	S	125 Vdc		
J	208–240/60	T	24/60		

② When control power transformer modification codes (**C1–C11**) are used or when starter class includes CPT (i.e., ECN07, 18) see Table 30.3-18 for system voltage code.

Table 30.3-18. Control Power Transformer Codes (System Voltage)

Code	Primary	Secondary
B	240/480–220/440 wired for 240 V	120/60–110/50
C	240/480–220/440 wired for 480 V	120/60–110/50
D	600/60–550/50	120/60–110/50
E	208/60	120/60
H	277/60	120/60
L	380/50	110/50
M	415/50	110/50
Q	208/60	24
R	240/480–220/440 wired for 240 V	24
S	240/480–220/440 wired for 480 V	24
T	600/60	24
U	277/60	24
V	380/50	24
W	415/50	24
X	240/480/600 wired for 480 V	120
Y	240/480/600 wired for 480 V	24
Z	By description	

Enclosed Box Selection

Table 30.3-19. Type 1 Freedom Contactors

NEMA Size (Poles)	Box No.	Shipping Weight Lb (kg)
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Non-reversing Contactors—
without Control Power Transformers

00 (2P, 3P, 4P)	1	5.25 (2.4)
00 (2P, 3P, 4P) with top adders	2	7.3 (3.3)
0 (2P, 3P, 4P)	1	5.25 (2.4)
0 (2P, 3P, 4P) with top adders	2	7.3 (3.3)
0 (5P)	2	7.3 (3.3)
1 (2P, 3P)	1	7.9 (3.6)
1 (2P, 3P) with top adders	3	11 (5.0)
1 (4P, 5P)	2	8.3 (3.8)
2 (2P, 3P, 4P, 5P)	2	8.5 (3.9)
3 (2P, 3P)	4	35 (16)
4 (2P, 3P)	4	47 (21)
5	10	113 (51)
6	F1E	325 (148)
7	F1E	①
8	F1E	①
9	F1E	①

Non-reversing Contactors—
with Control Power Transformers

00 (2P, 3P, 4P)	2	12 (5.4)
00 (2P, 3P, 4P, 5P) with top adders	3	15 (6.8)
0 (2P, 3P, 4P, 5P)	2	12 (5.4)
0 (2P, 3P, 4P, 5P) with top adders	3	15 (6.8)
1 (2P, 3P)	2	12.2 (5.5)
1 (2P, 3P) with top adders	3	12.5 (5.7)
1 (4P, 5P)	2	12.6 (5.7)
2 (2P, 3P, 4P, 5P)	2	12.8 (5.8)
3 (2P, 3P)	4	40 (18)
4 (2P, 3P)	4	52 (24)
5	10	120 (54)
6	F1E	335 (152)
7	F1E	①
8	F1E	①
9	F1E	①

Three-Pole Reversing Contactors—
without Control Power Transformers

00	2	7.8 (3.5)
0	2	8 (3.6)
1	3	11 (5.0)
2	3	12 (5.4)
3	4	67 (30)
4	4	154 (70)
5	10	170 (77)
6	F1E	425 (193)
7	F1E	①
8	F1E	①
9	F2E	①

① Consult factory.

Table 30.3-20. Type 3R, 4/4X, 12 Freedom
Contactors

NEMA Size (Poles)	Box No.	Shipping Weight Lb (kg)
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Non-reversing Contactors—
without Control Power Transformers

00	5	14 (6.4)
0 (2P, 3P, 4P)	5	14 (6.4)
1 (2P, 3P, 4P, 5P)	5	15 (6.8)
2 (2P, 3P, 4P, 5P)	5	15.5 (7.0)
3 (2P, 3P)	8	45 (20)
4 (2P, 3P)	8	56 (25)
5	10	140 (64)
6	F1E	385 (175)
7	F1E	②
8	F1E	②
9	F1E	②

Non-reversing Contactors—
with Control Power Transformers

00	5	18 (8.2)
0 (2P, 3P, 4P)	5	18 (8.2)
1 (2P, 3P, 4P, 5P)	6	19 (8.6)
2 (2P, 3P, 4P, 5P)	6	19.5 (8.9)
3 (2P, 3P)	8	52 (24)
4 (2P, 3P)	8	63 (29)
5	10	147 (67)
6	F1E	405 (184)
7	F1E	②
8	F1E	②
9	F1E	②

Three-Pole Reversing Contactors—
with or without Control Power Transformers

00	6	18 (8.2)
0	6	18 (8.2)
1	6	19 (8.6)
2	6	19 (8.6)
3	8	47 (21)
4	9	69 (31)
5	10	170 (77)
6	F1E	495 (225)
7	F1E	②
8	F1E	②
9	F2E	②

② Consult factory.

Note: All Type 7 and 9, see PG03300001E.

Table 30.3-21. Type 1 Freedom
Non-combination Starters

NEMA Size	Box No.	Shipping Weight Lb (kg)
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Non-reversing Starters—
without Control Power Transformers

00	1	7 (3.2)
00 with top adders/SSOL	2	10 (4.5)
0	1	7.1 (3.2)
0 with top adders/SSOL	2	10 (4.5)
1	1	7.9 (3.6)
1-2 with top adders/SSOL	3	11.5 (5.2)
2	2	8.5 (3.9)
3	4	35 (16)
4	4	47 (21)
5	10	139 (63)
6	F1E	360 (163)
7	F1E	③
8	F1E	③
9	F1E	③

Non-reversing Starters—
with Control Power Transformers

00	3	15 (6.8)
0	3	15 (6.8)
1	3	16 (7.3)
2	3	16.2 (7.4)
3	4	42 (19)
4	4	54 (25)
5	10	146 (66)
6	F1E	385 (175)
7	F1E	③
8	F1E	③
9	F1E	③

Reversing Starters—
without Control Power Transformers

00	2	8 (3.6)
0	2	8 (3.6)
0 with top adders	3	11 (5)
1	3	13 (5.9)
1 with top adders	3	13.4 (6.1)
2	3	15 (6.8)
3	4	43 (20)
4	9	65 (30)
5	10	165 (75)
6	F1E	450 (204)
7	F1E	③
8	F2E	③
9	F2E	③

Reversing Starters—
with Control Power Transformers

00 with top adders	3	15 (6.8)
0	3	15 (6.8)
1 with top adders	3	17 (7.7)
2	3	19 (8.6)
3	4	50 (23)
4	9	72 (33)
5	10	172 (78)
6	F1E	495 (225)
7	F1E	③
8	F2E	③
9	F2E	③

③ Consult factory.

For enclosure box dimensions,
refer to Page 30.6-3.

**Table 30.3-22. Type 3R, 4/4X, 12 Freedom
Non-combination Starters**

NEMA Size / IEC Frame	Box No.	Shipping Weight Lb (kg)
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**Non-reversing Starters—
without Control Power Transformers**

0	5	14.3 (6.5)
1	5	15.3 (6.9)
2	7	16 (7.3)
3	8	46 (21)
4	8	60 (27)
5	10	150 (68)
6	F1E	415 (188)
7	F1E	①
8	F1E	①
9	F1E	①

**Non-reversing Starters—
with Control Power Transformers**

0	6	18 (8.2)
1	6	19 (8.6)
2	6	20 (9)
3	8	53 (24)
4	8	67 (30)
5	10	157 (71)
6	F1E	①
7	F1E	①
8	F1E	①
9	F1E	①

**Reversing Starters—
with or without Control Power Transformers**

0	7	18.5 (8.4)
1	7	19.5 (8.9)
2	7	21 (10)
3	8	48 (22)
4	9	72 (33)
5	10	175 (79)
6	F1E	525 (238)
7	F1E	①
8	F2E	①
9	F2E	①

① Consult factory.

**Table 30.3-23. Type 1 Freedom
Combination Starters**

NEMA Size (Device)	Box No.	Shipping Weight Lb (kg)
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**Non-reversing —
with and without Control Power Transformers**

0	A	37 (17)
1	A	38 (17)
2	A	39 (18)
3	C	72 (33)
4 (HMCP)	C	90 (41)
4 (Disconnect switch)	D	150 (68)
5	E	180 (82)
6	F1E	435 (197)
7	F2E	②
8	F2E	②
9	F2E	②

**Reversing —
with and without Control Power Transformers**

0	B	42 (19)
1	B	43 (20)
2	B	44 (20)
3	C	84 (38)
4	D	173 (79)
5	F1E	②
6	F1E	550 (250)
7	F2E	②
8	F2E	②
9	②	②

Non-reversing—Oversized

0–1–2	B	44 (20)
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② Consult factory.

**Table 30.3-24. Type 1 Freedom Non-reversing
Combination Starters—Narrow Enclosure**

NEMA Size	Box No.	Shipping Weight Lb (kg)
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NEMA 1 Enclosed

0–1–2	I	35 (16)
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NEMA 12 Enclosed

0–1–2	I	36 (16)
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NEMA 12 Enclosed with Safety Door Interlock

0–1–2	I	37 (17)
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**Table 30.3-25. Type 3R, 4/4X, 12 Freedom
Combination Starters**

NEMA Size (Device)	Box No.	Shipping Weight Lb (kg)
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**Non-reversing—
with and without Control Power Transformers**

0	A	37 (17)
1	A	38 (17)
2	A	39 (18)
3	C	72 (33)
4 (HMCP)	C	90 (41)
4 (Disconnect switch)	D	150 (68)
5	E	180 (82)
6	F1E	435 (197)
7	F2E	③
8	F2E	③
9	F2E	③

**Reversing—
with and without Control Power Transformers**

0	B	42 (19)
1	B	43 (20)
2	B	44 (20)
3	C	84 (38)
4	D	173 (79)
5	E	550 (250)
6	F1E	③
7	F2E	③
8	F2E	③
9	③	③

Non-reversing—Oversized

0–1–2	B	44 (20)
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③ Consult factory.

 For enclosure box dimensions,
refer to Page 30.6-3.




C440 Series

C440 Series

Overview

Eaton's C400 series of advanced motor protection offers innovative solutions with varying levels of capability. From basic monitoring and protection to advanced motor management and efficiency calculations, the C400 series has the exact solution to meet the needs of your application.

Table 30.3-26. C440 Series Comparison

Product	 C440	 C441	 C445
Range	0.3–1500 A Up to 690 Vac (50/60 Hz)	1–540 A Up to 600 Vac (50/60 Hz)	0.3–800 A Up to 690 Vac (20–80 Hz) Up to 4160 Vac w/PTs
Features	Selectable trip class (10 A, 10, 20, 30), ground fault and phase imbalance protections Flexible communication options for both monitoring and control	Highly configurable line (voltage), load (power) and motor (current) monitoring and protection Optional remote user interface allows user to configure and monitor without opening a panel door All-in-one design reduces inventory costs by covering 1–540 A applications with only two SKU numbers	Full line, load and motor system coverage, including advanced monitoring and protection algorithms USB connectivity (both inside and outside the control panel door) provide monitoring and configuration with a PC Multiple predefined operating modes with corresponding control station options Global modular design allows for customization of system to match exact customer needs
Benefits	Extends the life of plant assets with selectable motor protection features Status LED provides added assurance that valuable assets are protected by indicating the overload operational status	Advanced diagnostics allow for quick and accurate identification of the root source of motor, pump or power quality faults Configurable low-power trip capability provides superior protection for smaller motors, slow speed motors and lightly loaded large motors	Voltage Loss Restart ability removes the need for users to manually restart motors after momentary voltage dips by automatically staggering restarts Multiple embedded fieldbus options allow integration into widest range of PLC and DCS control systems without additional modules or supply power Motor efficiency, motor torque and peak energy monitoring enhance users' understanding of their application

C441 Motor Insight
Table 30.3-27. Features

Features	C440	C441	C445
Protection			
Thermal overload	■	■	■
Phase loss	■	■	■
Selectable trip class	■	■	■
Ground fault	■	■	■
Current unbalance	—	■	■
Voltage unbalance	—	■	■
Phase reversal	—	■	■
Jam	—	■	■
Under/overpower trip	—	■	■
Under/overvoltage trip	—	■	■
Under/overcurrent trip	—	■	■
Under/overfrequency	—	—	■
Stall	—	—	■
Instantaneous overcurrent	—	—	■
PTC (motor temperature)	—	—	■
Energy deviations	—	—	■
Voltage loss restart	—	—	■

Control

Hard wire/local reset	■	■	■
Network/electronic reset	■	■	■
Programmable alarms	—	■	■
Programmable trips	—	■	■
Multiple operation modes	—	—	■
Control user interface	—	—	■

Motor Control Center Availability

IEC—Power Xpert CX [®]	■	—	■
IEC—Power Xpert CXH [™]	■	—	■
NEMAT—Freedom	■	■	■
NEMA—FlashGard [®]	■	■	■
NEMA—Freedom ARC	■	■	■
NEMA—Aftermarket buckets	■	■	■

Note: Not all options are standard. Please consult factory.

Table 30.3-28. Supporting Documentation

Description	Publication number
Motor Control and Protection Catalog	CA08100006E
C441 User Manual	MN04209001E
C445 User Manual	MN042001EN
EIP-Assist Tag Generation Tool User Manual	MN181001EN
FlashGard NEMA MCC Brochure	BR04302001E
Power Xpert CX IEC MCC Brochure	BR043003EN
Power Xpert CXH IEC MCC Brochure	BR043008EN

Features	C440	C441	C445
Monitoring			
Thermal capacity	■	■	■
Phase currents	■	■	■
Current unbalance	■	■	■
Ground fault current	■	■	■
Frequency	—	■	■
Voltage unbalance	—	■	■
Phase voltages	—	■	■
Real power (kW)	—	■	■
Under/overpower trip	—	■	■
Under/overvoltage trip	—	■	■
Under/overcurrent trip	—	■	■
Motor start time/count	—	—	■
Motor efficiency	—	—	■
Motor torque	—	—	■
Energy (kWh)	—	—	■
Apparent power (kVA)	—	—	■
Trip snapshot	—	—	■

Communications

Modbus [®] RTU	■	■	■
PROFIBUS [®]	■	■	■
Modbus TCP	■	■	■
EtherNet/IP	■	■	■
DeviceNet [™]	■	■	Future
USB	—	—	■

C441 Motor Insight

C441 Motor Insight

C441 Motor Insight Overload
and Monitoring Relay

General Description

Eaton's C441 Motor Insight®, the first product in the intelligent power control solutions family, is a highly configurable motor, load and line protection device with power monitoring, diagnostics and flexible communications, allowing the customer to save energy, optimize their maintenance schedules and configure greater system protection, thus reducing overall costs and downtime.

C441 Motor Insight is available in either a line-powered or 120 Vac control powered design, capable of monitoring voltages up to 660 Vac. Each of these units is available in a 1–9 A or a 5–90 A FLA model. With external CTs, C441 Motor Insight can protect motors up to 540 A FLA. Available add-on accessories include communication modules for Modbus®, DeviceNet™ and PROFIBUS®, all with I/O options. For ease-of-use and operator safety, C441 Motor Insight offers a remote display that mounts easily with two 30 mm knockouts.

Features

Size/Range

- Broad FLA range of 1–540 A
- Selectable trip class (5–30)
- Four operating voltage options
 - Line-powered from 240 Vac, 480 Vac, 600 Vac
 - Control-powered from 120 Vac

Motor Control

- Two output relays
 - One B300 Form C fault relay and one B300 ground fault shunt relay
 - Other relay configurations are available, including one Form A and one Form B SPST (fault and auxiliary relays) allowing programmable isolated relay behavior and unique voltages

- One external remote reset terminal
- Trip status indicator

Motor Protection

- Thermal overload
- Jam/stall protection
- Current level alarming
- Current imbalance
- Current phase loss
- Ground fault
- Phase reversal

Load Protection

- Undercurrent
- Low power (kW)
- High power (kW)

Line Protection

- Overvoltage
- Undervoltage
- Voltage imbalance
- Voltage phase loss

Monitoring Capabilities

- Current—average and phase rms
- Voltage—average and phase rms
- Power—motor kW
- Power factor
- Frequency
- Thermal capacity
- Run hours
- Ground fault current
- Current imbalance %
- Voltage imbalance %
- Motor starts
- Motor run hours

Options

- Type 1, 12 remote display
- Type 3R remote display kit
- Communication modules
 - Modbus
 - Modbus with I/O
 - DeviceNet with I/O
 - PROFIBUS with I/O
 - Modbus TCP with I/O (contact product line)
 - EtherNet/IP with I/O (contact product line)

Benefits

Reliability and Improved Uptime

- Advanced diagnostics allows for quick and accurate identification of the root source of a motor, pump or power quality fault; reducing troubleshooting time and the loss of productivity, reducing repeat faults due to misdiagnosis, and increasing process output and profitability

- Provides superior protection of motors and pumps before catastrophic failure occurs
- Increases profitability with greater process uptime and throughput, reduced costs per repair, reduced energy consumption and extended equipment life
- Adjustments to overload configuration can be made at any time

Safety

- IP 20 rated terminal blocks
- Terminal blocks are set back from the display to reduce operator shock hazard
- Remote display (optional) does not require that the operator open the panel to configure the device

Flexibility

- Communications modules
 - Offered in a variety of configurations
 - External snap-on modules provide support for multiple communications protocols
- Advanced power, voltage and current monitoring capabilities
- Communications modules and remote display can be used simultaneously
- Highly configurable fault and reset characteristics for numerous applications
- Fully programmable isolated fault and auxiliary relays

Ease of Use

- Bright LED display with easy-to-understand setting and references
- Powered from line voltage or 120 Vac control power
- Remote display powered from base unit
- Full word descriptions and units on user interface

Standards and Certifications

- cULus listed NKCR, NKCR7, 508
- UL 1053 applicable sections for ground fault detection
- CSA certified (Class 3211-02)
- CE
- NEMA
- IEC EN 60947-4-1
- RoHS

C441 Motor Insight

Product Selection

Table 30.3-29. C441 Motor Insight

Power Source	Monitoring Range	Current Range	Catalog Number
240 Vac (170–264)	170–264 Vac	1–9 A 5–90 A	C441BA C441BB
480 Vac (323–528)	323–528 Vac	1–9 A 5–90 A	C441CA C441CB
600 Vac (489–660)	489–660 Vac	1–9 A 5–90 A	C441DA C441DB
120 Vac (93.5–132)	170–660 Vac	1–9 A 5–90 A	C4410109NOUI C4410590NOUI

Table 30.3-30. C441 Motor Insight CT Multiplier and Wire Wrap Schedule

Catalog Number ①	Motor FLA	No. of Loops	No. of Conductors Through CT Primary	CT Multiplier Setting	External CT Kit Catalog Number ②
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Current Range: 5–90 A

C441_B and C4410590NOUI	5–22.5 A	3	4	4	—
	6.67–30 A	2	3	3	—
	10–45 A	1	2	2	—
	20–90 A	0	1	1	—

Current Range: 1–9 A

C441_A and C4410109NOUI	1–5 A	1	2	2	—
	2–9 A	0	1	1	—
	60–135 A	0	1	150–(150:5)	C441CTKIT150
	120–270 A	0	1	300–(300:5)	C441CTKIT300
	240–540 A	0	1	600–(600:5)	C441CTKIT600

① Underscore indicates Operating Voltage Code required.
Operating Voltage Codes:

Code	Voltage
B	240 Vac
C	480 Vac
D	600 Vac
<empty>	120 Vac control power

② Any manufacturer's CTs may be used.

Accessories

Table 30.3-31. Communication Modules

Description	I/O	Catalog Number
Modbus		
Modbus communication module	None	C441M
Modbus communication module 4IN/2OUT	120 Vac	C441N
	24 Vdc	C441P
DeviceNet		
DeviceNet communication module 4IN/2OUT	120 Vac	C441K
	24 Vdc	C441L
PROFIBUS		
PROFIBUS communication module 4IN/2OUT	120 Vac	C441S
	24 Vdc	C441Q
EtherNet/IP and Modbus TCP		
Ethernet-based communication module 4IN/2OUT	120 Vac	C441R
	24 Vdc	C441T

Type 3R Kit with Remote Display Mounted Inside

C441 Motor Insight offers several accessories for the customer's ease of use and safety:

- Types 1 and 12 remote display
- Type 3R remote display kit
- Mounting plate adapter

Features and Benefits

- Remote display unit:
 - Same user interface as the overload relay
 - Enhanced operator safety—operator can configure the overload without opening the enclosure door
- Type 3R kit mounts with standard 30 mm holes
- Mounting plate for retrofit in existing installations

Table 30.3-32. Type 3R Kit with Remote Display Mounted Inside

Description	Catalog Number
Remote display Types 1 and 12 (UL 508) Type 3R kit for remote display (UL 508) Conversion plate	C4411 C4413 C441CMP1

Communication Cables

The remote display requires a communication cable to connect to the C441 Motor Insight overload relay:

Table 30.3-33. Communication Cable Lengths

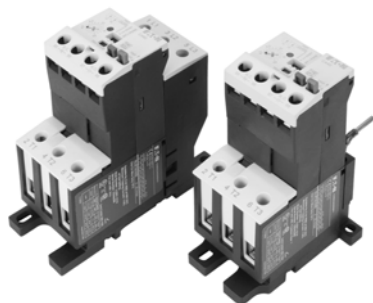
Length in Inches (meters)	Catalog Number
9.8 (0.25) 39.4 (1.0)	D77E-QPIP25 D77E-QPIP100
78.7 (2.0) 118.1 (3.0)	D77E-QPIP200 D77E-QPIP300

Table 30.3-34. Current Transformer Kits

Description	Catalog Number
Three 150:5 CTs to be used with C441 Motor Insight Three 300:5 CTs to be used with C441 Motor Insight Three 600:5 CTs to be used with C441 Motor Insight	C441CTKIT150 C441CTKIT300 C441CTKIT600

For more information about technical data and specifications as well as dimensions, see Volume 5—Motor Control and Protection, CA08100006E, Section 31.

C440/XT Electronic Overload Relay

C440/XT Electronic
Overload Relay

C440/XT Electronic Overload Relay

General Description

Eaton's electronic overload relay (EOL) is the most compact, high-featured, economical product in its class. Designed on a global platform, the new EOL covers the entire power control spectrum, including NEMA, IEC and DP contactors. The NEMA and DP versions are offered with the *C440* designation while the IEC offering has the *XT* designation. The electronic design provides reliable, accurate and value-driven protection and communications capabilities in a single compact device. It is the flexible choice for any application requiring easy-to-use, reliable protection.

Eaton has a long history of innovations and product development in motor control and protection, including both traditional NEMA, as well as IEC control. It was from this experience that the C440 was developed, delivering new solutions to meet today's demands.

C440 is a self-powered electronic overload relay available up to 100 A as a self-contained unit. With external CTs, C440 can protect motor up to 1500 FLA. Available add-on accessories include remote reset capability and communication modules with I/O for DeviceNet, PROFIBUS and Modbus.

Features

- Reliable, accurate, electronic motor protection
- Easy to select, install and maintain
- Compact size
- Flexible, intelligent design
- Global product offering—available with NEMA, IEC and DP power control

Size/Range

- Broad FLA range (0.33–1500 A)
- Selectable trip class (10A, 10, 20, 30)
- Direct mounting to NEMA, IEC and DP contactors
- Most compact electronic overload in its class

Motor Control

- Two B600 alarm (NO) and fault (NC) contacts
- Test/Trip button

Motor Protection

- Thermal overload
- Phase loss
- Selectable (ON/OFF) phase imbalance
- Selectable (ON/OFF) ground fault

User Interface

- Large FLA selection dial
- Trip status indicator
- Operating mode LED
- DIP switch selectable trip class, phase imbalance and ground fault
- Selectable Auto/Manual reset

Feature Options

- Remote reset
 - 120 Vac
 - 24 Vac
 - 24 Vdc
- Tamper-proof cover
- Communications modules
 - Modbus RTU RS-485
 - DeviceNet with I/O
 - PROFIBUS with I/O
 - Modbus RTU with I/O (Q4 2010)
 - EtherNet/IP (planned)
 - Smartwire (planned)

Benefits

Reliability and Improved Uptime

- C440 provides the users with peace of mind knowing that their assets are protected with the highest level of motor protection and communication capability in its class
- Extends the life of plant assets with selectable motor protection features such as trip class, phase imbalance and ground fault
- Protects against unnecessary downtime by discovering changes in your system (line/load) with remote monitoring capabilities
- Status LED provides added assurance that valuable assets are protected by indicating the overload operational status

Flexibility

- Available with NEMA, IEC and DP contactors
- Improves return on investment by reducing inventory carrying costs with wide FLA adjustment (5:1) and selectable trip class
- Design incorporates built-in ground fault protection, thus eliminating the need for separate CTs and modules
- Flexible communication with optional I/O enables easy integration into plant management systems for remote monitoring and control
- Available as an open component and in enclosed control and motor control center assemblies

Monitoring Capabilities

- Individual phase currents rms
- Average three-phase current rms
- Thermal memory
- Fault indication (overload, phase loss, phase imbalance, ground fault)

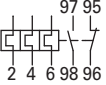
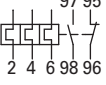
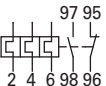
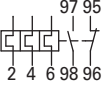
Safety

- IP 20 rated terminal blocks
- Available in Eaton's industry-leading FlashGuard MCCs
- Tested to the highest industry standards, such as UL, CSA, CE and IEC
- RoHS compliant

Standards and Certifications

- UL
- CSA
- CE
- NEMA
- IEC/EN 60947 VDE 0660
- ISO 13849-1 (EN954-1)
- RoHS
- ATEX directive 94/9/EC
- Equipment Group 2, Category 2

C440/XT Electronic Overload Relay
Product Selection
Table 30.3-35. XT Electronic Overload Relays

For Use with XT Contactor Frame	For Use with Contactor	Overload Range (Amps)	Contact Sequence	Frame Size	Auxiliary Contact Configuration	Type	Catalog Number
For Direct Mount to XT Contactors							
B	XTCE007B..., XTCE009B..., XTCE012B..., XTCE015B...	0.33–1.65		45 mm	NO-NC	ZEB12-1,65	XTOE1P6BCS
		1–5				ZEB12-5	XTOE005BCS
		4–20				ZEB12-20	XTOE020BCS
C	XTCE018C..., XTCE025C..., XTCE032C	0.33–1.65		45 mm	NO-NC	ZEB32-1,65	XTOE1P6CCS
		1–5				ZEB32-5	XTOE005CCS
		4–20				ZEB32-20	XTOE020CCS
		9–45				ZEB32-45	XTOE045CCS
D	XTCE040D..., XTCE050D..., XTCE065D..., XTCE072D...	9–45		45 mm	NO-NC	ZEB65-45	XTOE045DCS
		20–100		55 mm		ZEB65-100	XTOE100DCS
F, G	XTCE080F..., XTCE095F..., XTCE115G..., XTCE150G..., XTCE170G...	20–100		55 mm	NO-NC	ZEB150-100	XTOE100GCS

With Ground Fault for Direct Mount to XT Contactors

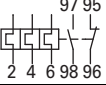
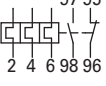
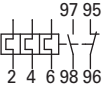
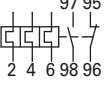
B	XTCE007B..., XTCE009B..., XTCE012B..., XTCE015B...	0.33–1.65		45 mm	NO-NC	ZEB12-1.65-GF	XTOE1P6BGS
		1–5				ZEB12-5-GF	XTOE005BGS
		4–20				ZEB12-20-GF	XTOE020BGS
C	XTCE018C..., XTCE025C..., XTCE032C	0.33–1.65		45 mm	NO-NC	ZEB32-1.65-GF	XTOE1P6CGS
		1–5				ZEB32-5-GF	XTOE005CGS
		4–20				ZEB32-20-GF	XTOE020CGS
		9–45				ZEB32-45-GF	XTOE045CGS
D	XTCE040D..., XTCE050D..., XTCE065D..., XTCE072D...	9–45		45 mm	NO-NC	ZEB65-45-GF	XTOE045DGS
		20–100		55 mm		ZEB65-100-GF	XTOE100DGS
F, G	XTCE080F..., XTCE095F..., XTCE115G..., XTCE150G..., XTCE170G...	20–100		55 mm	NO-NC	ZEB150-100-GF	XTOE100GGS

Table 30.3-36. XT Electronic Overload Relays for Use with Large Frame XT Contactors (L–R)

Use CTs and 1–5 A XT overload relay. CT kit does not include overload relay (order separately).

XT Contactor Frame	For Use with IEC Contactor Ampere Range (AC-3)	CT Range (Ampere)	Description	CT Kit Catalog Number	Terminal Size	Overload Relay Catalog Number
L, M	185–500	60–300	300: 5 panel-mount CT kit with integrated lugs	ZEB-XCT300	750 kcmil (2) 250 kcmil 3/0 Cu/Al	XTOE005CCSS
M, N	300–820	120–600	600: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT600	(2) 750 kcmil 3/0 Cu/Al	XTOE005CCSS
N	580–1000	200–1000	1000: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT1000	(3) 750 kcmil 3/0 Cu/Al	XTOE005CCSS
R	1600	300–1500	1500: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT1500	(4) 750 kcmil 1/0 Cu/Al	XTOE005CCSS

C440/XT Electronic Overload Relay

Table 30.3-37. XT Electronic Overload Relays for Separate Mount

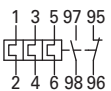
Overload Range (Amps)	Frame Size	Contact Sequence	Type	Overload Relay Catalog Number	Overload Relay with Ground Fault Catalog Number
0.33–1.65	45 mm		ZEB32-1.65/KK	XTOE1P6CCSS	XTOE1P6CGSS
1–5			ZEB32-5/KK	XTOE005CCSS	XTOE005CGSS
4–20			ZEB32-20/KK	XTOE020CCSS	XTOE020CGSS
9–45			ZEB32-45/KK	XTOE045CCSS	XTOE045CGSS
20–100	55 mm		ZEB150-100/KK	XTOE100GCSS	XTOE100GGSS

Table 30.3-38. C440 Electronic Overload Relays for Direct Mount to Freedom Series Contactors

For Use with Freedom NEMA Contactor Size	For Use with Contactor ①	Overload Range (Amps)	Standard Feature Set Catalog Number	Standard Feature Set with Ground Fault Catalog Number
00	CN15AN3_B	0.33–1.65	C440A1A1P6SF00	C440A2A1P6SF00
		1–5	C440A1A005SF00	C440A2A005SF00
		4–20	C440A1A020SF00	C440A2A020SF00
0	CN15BN3_B	0.33–1.65	C440A1A1P6SF0	C440A2A1P6SF0
		1–5	C440A1A005SF0	C440A2A005SF0
		4–20	C440A1A020SF0	C440A2A020SF0
1	CN15DN3_B	0.33–1.65	C440A1A1P6SF1	C440A2A1P6SF1
		1–5	C440A1A005SF1	C440A2A005SF1
		4–20	C440A1A020SF1	C440A2A020SF1
		9–45	C440A1A045SF1	C440A2A045SF1
2	CN15GN3_B	1–5	C440A1A005SF2	C440A2A005SF2
		4–20	C440A1A020SF2	C440A2A020SF2
		9–45	C440A1A045SF2	C440A2A045SF2
3	CN15KN3_	20–100	C440B1A100SF3	C440B2A100SF3

① CN15 contactor listed is non-reversing with a 120 Vac coil. For more options, see Volume 5—Motor Control and Protection, CA08100006E, Tab 33, Section 33.1.

Table 30.3-39. C440 Electronic Overload Relays for Use with NEMA Contactors Sizes 4–8

Use CTs and 1–5 A C440 overload relay. CT kit does not include overload relay (order separately).

For Use with NEMA Contactor Size	CT Range (Ampere)	Description	CT Kit Catalog Number	Terminal Size	Overload Relay Catalog Number
4 and 5	60–300	300: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT300	750 kcmil (2) 250 kcmil 3/0 Cu/Al	C440A1A005SAX
6	120–600	600: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT600	(2) 750 kcmil 3/0 Cu/Al	C440A1A005SAX
7	200–1000	1000: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT1000	(3) 750 kcmil 3/0 Cu/Al	C440A1A005SAX
8	300–1500	1500: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT1500	(4) 750 kcmil 1/0 Cu/Al	C440A1A005SAX

Table 30.3-40. C440 Electronic Overload Relays for Separate Mount

Overload Range	Frame Size	Overload Relay Catalog Number	Overload Relay with Ground Fault Catalog Number
0.33–1.65	45 mm	C440A1A1P6SAX	C440A2A1P6SAX
1–5		C440A1A005SAX	C440A2A005SAX
4–20		C440A1A020SAX	C440A2A020SAX
9–45		C440A1A045SAX	C440A2A045SAX
20–100	55 mm	C440B1A100SAX	C440B2A100SAX

C440/XT Electronic Overload Relay
Table 30.3-41. Type AN19/59 Freedom Series Starters—Non-Reversing and Reversing

NEMA Size	Continuous Ampere Rating	Service Limit Current Rating (Amps)	Maximum UL Horsepower						Three-Pole Non-Reversing ①② Catalog Number	Three-Pole Reversing ①② Catalog Number
			Single-Phase		Three-Phase					
			115 V	230 V	208 V	240 V	480 V	600 V		

C440 Electronic Overload Relays

00	9	11	1/3	1	1-1/2	1-1/2	2	2	AN19AN0_5E _	AN59AN0_5E _
0	18	21	1	2	3	3	5	5	AN19BN0_5E _	AN59BN0_5E _
1	27	32	2	3	7-1/2	7-1/2	10	10	AN19DN0_5E _	AN59DN0_5E _
2	45	52	3	7-1/2	10	15	25	25	AN19GN0_5E _	AN59GN0_5E _
3	90	104	—	—	25	30	50	50	AN19KN0_5E _	AN59KN0_5E _
4 ^③	135	156	—	—	40	50	100	100	^③ AN19SN0_5E _	^③ AN59SN0_5E _
5 ^④	270	311	—	—	75	100	200	200		

C440 with Ground Fault Electronic Overload Relays

00	9	11	1/3	1	1-1/2	1-1/2	2	2	AN19AN0_5G _	AN59AN0_5G _
0	18	21	1	2	3	3	5	5	AN19BN0_5G _	AN59BN0_5G _
1	27	32	2	3	7-1/2	7-1/2	10	10	AN19DN0_5G _	AN59DN0_5G _
2	45	52	3	7-1/2	10	15	25	25	AN19GN0_5G _	AN59GN0_5G _
3	90	104	—	—	25	30	50	50	AN19KN0_5G _	AN59KN0_5G _
4 ^③	135	156	—	—	40	50	100	100	^③ AN19SN0_5G _	^③ AN59SN0_5G _
5 ^④	270	311	—	—	75	100	200	200		

^① Underscore (_) indicates coils suffix required, see Coil Suffix table below.

^② Underscore (_) indicates OLR designation required, see C440 FLA Range table below.

^③ Starter not shipped as an assembled unit. Order NEMA Size 4 contactor (CN15NN3A) plus current transformers (ZEB-XCT300) and 1–5 A C440 overload relay (C440A1A005SELAX or C440A2A005SELAX).

^④ NEMA Size 5 starter available with 60–300 A panel-mounted CTs. Starter shipped as an assembled unit with 1–5 A C440 overload relay (C440A1A005SELAX or C440A2A005SELAX).

Table 30.3-42. Coil Suffix Codes

Suffix	Coil Volts and Hertz
A	120/60 or 110/50
B	240/60 or 220/50
C	480/60 or 440/50
D	600/60 or 550/50
E	208/60
H	277/60
J	208–240/60
K	240/50
L	380–415/50
N	550/50
T	24/60, 24/50
U	24/50
V	32/50
W	48/60
Y	48/50

Table 30.3-43. C440 FLA Range (FVNR and FVR Starters Only)

NEMA Size	OLR Code	FLA Range	OLR Code	FLA Rating
00	1P6	0.33–1.65 A	020	4.0–20 A
	005	1.0–5.0 A	—	—
0	1P6	0.33–1.65 A	020	4.0–20 A
	005	1.0–5.0 A	—	—
1	1P6	0.33–1.65 A	020	4.0–20 A
	005	1.0–5.0 A	045	9.0–45 A
2	005	1.0–5.0 A	045	9.0–45 A
	020	4.0–20 A	—	—
3	100	20–100 A	—	—
4 ^⑤	300	—	—	60–300 A
5 ^⑤	300	60–300 A	—	—

^⑤ Starter not shipped as an assembled unit. Order NEMA Size 4 contactor (CN15NN3A) plus current transformers (ZEB-XCT300) and 1–5 A C440 overload relay (C440A1A005SELAX or C440A2A005SELAX).

C440/XT Electronic Overload Relay

Accessories

Table 30.3-44. CT Kits

Description	Catalog Number
Safety Cover	
Clear Lexan® cover that mounts on top of the FLA dial and DIP switches when closed	ZEB-XSC
Reset Bar	
Assembles to the top of the overload to provide a larger target area for door-mounted reset operators	ZEB-XRB
Remote Reset	
Remote reset module (24 Vdc) ①	C440-XCOM
Remote reset module (120 Vac) ①	ZEB-XRR-120
Remote reset module (24 Vac) ①	ZEB-XRR-24

① Customer can wire remote-mounted button to reset module (i.e., 22 mm pushbutton, catalog number M22-D-B-GB14-K10).

Communication

The C440 is provided with two levels of communication capability.

Basic Communication via Expansion Module—Monitoring Only

Basic communication on the C440 is accomplished using an expansion module. The expansion module plugs into the expansion bay on the C440 overload relay, enabling communications with the overload via their Modbus RTU (RS-485) network. No additional parts are required.

**Basic Communication—Modbus****Advanced Communication—Monitoring and Control**

C440 also has the ability to communicate on industrial protocols such as DeviceNet, PROFIBUS, Modbus RTU and Modbus TCP, and Ethernet (planned) while providing control capability using I/O.

An expansion module (mentioned earlier) combined with a communication adapter and a communication module allows easy integration onto the customer's network.

Advanced Communication—Communication Module

The communication adapter comes standard with four inputs and two outputs (24 Vdc or 120 Vac) while providing the customer with flexible mounting options (DIN rail or panel).

For more information about technical data and specifications as well as dimensions, see Volume 5—Motor Control and Protection, CA08100006E, Section 31.

**Advanced Communication—Communication Adapter with Communication Module**

XT IEC Power Control



XT IEC Power Control

Product Overview

The **XT** line of IEC power control offers starting and protection solutions ideal for control panels.

Innovations in the design and development allow users to reduce material costs, reduce installation effort, and enhance panel safety and performance all in a compact design. Some of these key innovations include:

- Toolless assembly of manual motor controllers and reversing contactors
- Low coil consumption
- Front accessibility to coil terminations
- Built-in surge suppression on electronic coils
- Built-in auxiliary contact for contactors up to 32 A in a 45 mm frame
- Finger-safe and back-of-hand proof ratings
- Direct PLC control on 185–2000 A contactors

The **XT** line includes a large offering of power control components and accessories that cover a broad range of applications and ratings:

- Three-pole contactors to 2000 A
- Four-pole contactors to 200 A
- Capacitor contactors to 680 kvar
- Mini contactors to 9 A
- Relays to 16 A
- Thermal overload relays to 630 A
- Electronic overload relays to 1500 A
- Manual motor protectors to 65 A
- Manual motor controllers and combination motor controllers to 65 A

Contactors and Starters

Product Description

The Eaton **XT** contactors and starters includes non-reversing and reversing contactors, overload relays and a variety of related accessories. Because **XT** meets IEC, UL®, CSA® and CE standards, it is the perfect product solution for IEC applications all over the world. The compact, space saving and easy to install **XT** line of IEC contactors and starters is the efficient and effective solution for customer applications from 7 A to 2450 A.

Application Description

The **XT** line of IEC power control was engineered to provide highly effective control and protection for a variety of loads, including motors, compressors, pumps, resistive, capacitor banks, isolation, and others. **XT** also includes IEC ratings for lighting applications as well.

XT contactors can be used in safety applications according to EN 954-1, EN ISO 13849-1 and IEC 62061 up to Category 4, PL e and SIL 3. Information concerning safety-related characteristics (B10 and B10d values) is available online. The auxiliary contact modules and built-in auxiliary contacts meet IEC EN 60947-5-1 Annex L (positively driven) and IEC EN 60947-4-1 Annex F (mirror contacts).

Features and Benefits

- AC control from 12 V to 600 V 50/60 Hz
- DC control from 12 V to 220 V
- Available with screw or spring cage terminals
- Reversing or non-reversing contactors and starters
- AC-3 contactor ratings to 1000 A and AC-1 contactor ratings to 2000 A
- Non-reversing starters to 650 A
- Panel or DIN rail mounting to 65 A
- IP20 finger and back-of-hand proof
- Large ambient temperature range, –25 to 50 °C (–13 to 122 °F)
- AC and DC controlled contactors in the same compact frame
- Low power consumption AC and DC coils
- Built-in NO or NC auxiliary contacts to 32 A
- Plug-in accessories for reduced installation time
- Coil replacement on Frames C–N (18–820 A)
- Contact replacement on Frames D–N (40–820 A)
- Integrated suppressor 7–150 A DC operated contactors and 185–2000 A AC and DC operated contactors

Standards and Certifications

- IEC EN 60947
- CE approved
- UL
- CSA
- ATEX
- RoHS

Technical Data

Table 30.3-45. XT Coil Data

XT Frame	Motor Voltage	Max. hp Rating	PU. (x Uc)		PU.			Sealed			Maximum Operation Rate Operations/Hour	PU. Time ms	D.O. Time ms
			AC	DC	VA	Watts	Watts (DC)	VA	Watts	Watts (DC)			
B	200	5	0.8–1.1	0.8–1.1	30	23	4.5	4.4	1.4	4.5	9000	21	18
	230	5											
	460	10											
	575	10											
C	200	10	0.8–1.1	0.7–1.2	67	50	12.0	9	2.6	0.5	5000	22	14
	230	10											
	460	20											
	575	25											
D	200	20	0.8–1.1	0.7–1.2	178	117	24.0	19	5.3	0.5	5000	18	13
	230	25											
	460	50											
	575	60											
F	200	25	0.8–1.1	0.7–1.2	345	190	90.0	30	7.1	1.3	3600	20	14
	230	40											
	460	75											
	575	100											
G	200	40	0.8–1.1	0.7–1.2	170	130	149.0	3.1	2.1	2.1	3600	33	41
	230	60											
	460	125											
	575	125											
H	200	60	0.8–1.15	0.8–1.15	210	180	180	2.6	2.1	2.1	3000	60	40
	230	75											
	460	150											
	575	200											
L	200	100	0.7–1.15	0.7–1.15	250	200	200	4.3	3.3	3.3	3000	100	80
	230	125											
	460	250											
	575	300											
M	200	150	0.7–1.15	0.7–1.15	450	350	350	4.3	3.3	3.3	2000	80	80
	230	200											
	460	400											
	575	500											
N	200	350	0.7–1.15	0.7–1.15	800	700	700	7.5	6.5	6.5	1000	70	70
	230	420											
	460	850											
	575	980											
R	200	560	0.7–1.15	0.7–1.15	1600	1400	1400	15.0	13.0	13.0	1000	70	40
	230	640											
	460	1200											
	575	1300											

Integrated suppressor

7–150 A DC operated contactors and 185–2000 A AC and DC operated contactors.

Table 30.3-46. Coil Data Notes

Description	
P.U.	Pickup time is the average time taken from closing of the coil circuit to main contact touch.
D.O.	Dropout time is the average time taken from opening of the coil circuit to main contact separation.
Cold	Coil data with a cold coil.

All data is based on a standard contactor and a 120 Vac or 24 Vdc magnet coil. Coil data has a $\pm 5\%$ range depending on the application, therefore, specific data may vary.

XTIEC Power Control
Table 30.3-47. Specifications

Frame	R	N	M	L	H	G	F	D	C	B
Catalog Number Series	XTCE1600	XTCE750	XTCE500	XTCE300A	XTCE225A	XTCE150	XTCE095	XTCE072	XTCE032	XTCE015

Electrical Data

AC-3 at 400 V (A)	1600	750	500	300	225	150	95	72	32	15.5
Electrical Life	300,000	1,400,000	1,500,000	1,500,000	1,500,000	1,300,000	1,300,000	750,000	1,300,000	800,000
Maximum Operating Freq. AC-3 (Ops./h)	380	500	850	850	1000	800	800	800	800	1000
AC-1 at 40 °C (A)	2200	1102	857	490	386	190	130	98	45	22
Max. Nominal Power 460 V (hp)	1200	600	400	250	150	125	75	40	20	10

General

Mechanical Life	5,000,000	5,000,000	7,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000
Width (mm)	515	250	160	140	140	90	90	55	45	45
Height (mm)	392	296	200	200	164	170	170	115	85	68
Depth (mm)	252	232	216	216	208	150	150	132.1	97	75
Weight (kg)	32	15	8	8	6.5	2	2	0.9	0.42	0.23
Min. Ambient Temperature (°C)	-25	-25	-25	-25	-25	-25	-25	-25	-25	-25
Max. Ambient Temperature (°C)	60	60	60	60	60	60	60	60	60	60

Contacts

Wire Range Solid or Stranded (AWG)	2/0–500 kcmil	2/0–500 kcmil	1/0–250 kcmil	2/0–500 kcmil	1/0–350 kcmil	8–3/0	8–3/0	14–1	14–8	18–14
Power Terminal Torque Lb/in (Nm)	311 (35)	213 (24)	213 (24)	213 (24)	213 (24)	123.9 (14)	123.9 (14)	29.2 (3.3)	26.6 (3)	10.6 (1.2)
Control Circuit	18–14	18–14	18–14	18–14	18–14	18–14	18–14	18–14	18–14	18–14
Control Terminal Torque	10.6 (1.2)	10.6 (1.2)	10.6 (1.2)	10.6 (1.2)	10.6 (1.2)	10.6 (1.2)	10.6 (1.2)	10.6 (1.2)	10.6 (1.2)	10.6 (1.2)

Auxiliary Contacts

Number of Auxiliary Contact Modules in Basic Unit	4	4	4	4	4	0	0	0	1	1
Number of Additional Auxiliary Contact Modules	4	4	4	4	4	8	8	6	4	4
Ie AC-15/230 V (A)	6	6	6	6	6	6	6	6	4	4

Mounting Method

Dimensions of Drilled Hole Width A (mm)	430	165	130	130	120	70	70	45	35	35
Dimensions of Drilled Hole Height B (mm)	270	215	180	180	160	156	156	105	75	60
Mounting Screws	4xM6	4xM6	4xM6	4xM6	4xM6	4xM6	4xM6	2xM4	2xM4	2xM4

Thermal Overload Relays
Thermal Overload Relays

XTOB, XTOT Overload Relays
Product Description

The **XT** line of IEC motor thermal overload relays provides an efficient motor protection solution, available up to 630 A. XTOB units can be directly mounted to the contactor or mounted separately.

Features and Benefits

- Direct connect up to 250 A
- Stand alone and CT type up to 630 A
- Large thermal overcurrent range
- Test button
- Manual/automatic selectable reset
- NO-NC auxiliary as standard
- Class 10A (to 250 A)
- Class 30 (CT type)

Standards and Certifications

- IEC EN 60947
- CE approved
- UL
- CSA
- ATEX
- RoHS

Note: Short-circuit protection: Observe the maximum permissible fuse of the contactor with direct device mounting. See MN03402001E for more information on overload relays for Frames B–G. Trip Class: 10A
 Suitable for protection of EEx e-motors. EC prototype test certificate available upon request. See manuals MN03402001E and MN03407001E.

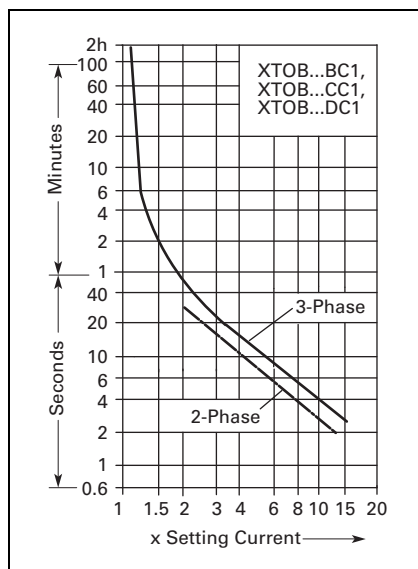
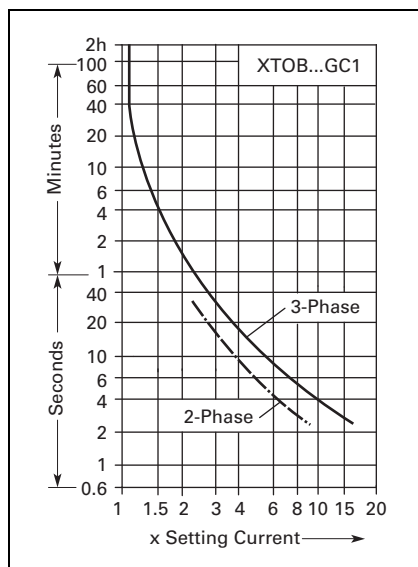
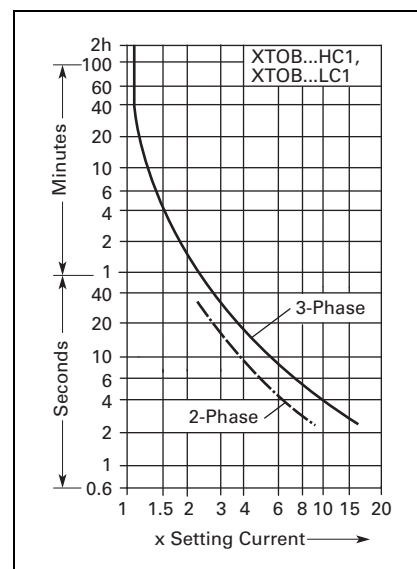
Instructional Leaflets

- Pub51221: XTOB, D Frame overload relays (inside of packaging)
- Pub51222: XTOB, B–C Frame overload relays (inside of packaging)

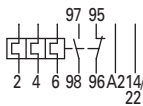
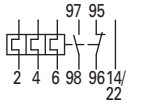
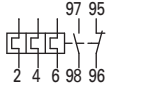
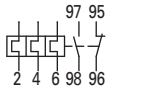
Tripping Characteristics

These tripping characteristics are the mean values of the spread at 20 °C ambient temperature in a cold state.

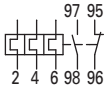
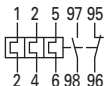
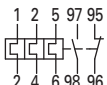
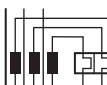
Tripping time depends on response current. With devices at operating temperature, the tripping time of the overload relay reduces to approximately 25% of the read off value. Specific characteristics for each individual setting range can be found in MN03402001E.


Figure 30.3-11. XTOB...BC1, XTOB...CC1, XTOB...DC1

Figure 30.3-12. XTOB...GC1

Figure 30.3-13. XTOB...HC1, XTOB...LC1

Thermal Overload Relays
Technical Data
Table 30.3-48. Direct Mount to XT Contactors—For Use with XT Contactor Frame

Frame	Overload Releases, Ir	Contact Sequence	Contact Configuration	For Use with Contactor Ampere Range	Fuse Type 1 Coordination, gG/gL	Type 2 Coordination, gG/gL	Maximum Circuit Breaker	CEC/ NEC Fuse	Catalog Number
B	0.1–0.16 0.16–0.24 0.24–0.4 0.4–0.6		1NO-1NC	7–15 A	25	0.5	25	3	XTOBP16BC1
			1NO-1NC	7–15 A	25	1	25	3	XTOBP24BC1
			1NO-1NC	7–15 A	25	2	25	3	XTOBP40BC1
			1NO-1NC	7–15 A	25	4	25	3	XTOBP60BC1
	0.6–1 1–1.6 1.6–2.4 2.4–4		1NO-1NC	7–15 A	25	4	25	3	XTOB001BC1
			1NO-1NC	7–15 A	25	6	25	6	XTOB1P6BC1
			1NO-1NC	7–15 A	25	10	25	6	XTOB2P4BC1
			1NO-1NC	7–15 A	25	16	25	15	XTOB004BC1
	4–6 6–10 9–12 12–16		1NO-1NC	7–15 A	25	20	25	20	XTOB006BC1
			1NO-1NC	7–15 A	50	25	25	35	XTOB010BC1
			1NO-1NC	9–15 A	50	25	25	45	XTOB012BC1
			1NO-1NC	12–15 A	50	25	30	45	XTOB016BC1
C	0.1–0.16 0.16–0.24 0.24–0.4 0.4–0.6		1NO-1NC	18–32 A	25	0.5	25	3	XTOBP16CC1
			1NO-1NC	18–32 A	25	1	25	3	XTOBP24CC1
			1NO-1NC	18–32 A	25	2	25	3	XTOBP40CC1
			1NO-1NC	18–32 A	25	4	25	3	XTOBP60CC1
	0.6–1 1–1.6 1.6–2.4 2.4–4		1NO-1NC	18–32 A	25	4	25	3	XTOB001CC1
			1NO-1NC	18–32 A	25	6	25	6	XTOB1P6CC1
			1NO-1NC	18–32 A	25	10	25	6	XTOB2P4CC1
			1NO-1NC	18–32 A	25	16	25	15	XTOB004CC1
	4–6 6–10 10–16 16–24 24–32		1NO-1NC	18–32 A	25	20	25	20	XTOB006CC1
			1NO-1NC	18–32 A	50	25	25	25	XTOB010CC1
			1NO-1NC	18–32 A	63	35	30	25	XTOB016CC1
			1NO-1NC	18–32 A	100	35	30	25	XTOB024CC1
1NO-1NC		25–32 A	125	63	30	25	XTOB032CC1		
D	6–10 10–16 16–24 24–40		1NO-1NC	40–72 A	50	25	25	25	XTOB010DC1
			1NO-1NC	40–72 A	63	35	25	25	XTOB016DC1
			1NO-1NC	40–72 A	63	50	30	25	XTOB024DC1
			1NO-1NC	40–72 A	125	63	125	125	XTOB040DC1
	40–57 50–65 65–75		1NO-1NC	50–72 A	160	80	150	150	XTOB057DC1
			1NO-1NC	65–72 A	160	100	150	200	XTOB065DC1
F–G	25–35 35–50 50–70 70–100		1NO-1NC	80–170 A	125	100	125	125	XTOB035GC1
			1NO-1NC	80–170 A	160	125	150	200	XTOB050GC1
			1NO-1NC	80–170 A	250	160	150	200	XTOB070GC1
			1NO-1NC	80–170 A	315	200	400	400	XTOB100GC1
	95–125 120–150 145–175		1NO-1NC	80–170 A	315	200	500	400	XTOB125GC1
			1NO-1NC	80–170 A	315	200	600	600	XTOB150GC1
			1NO-1NC	150–170 A	315	200	600	600	XTOB175GC1

Thermal Overload Relays
Table 30.3-49. Separate Mount to XT Contactors—For Use with XT Contactor Frame

Frame	Overload Releases, Ir	Contact Sequence	Contact Configuration	For Use with Contactor Ampere Range	Fuse Type 1 Coordination, gG/gL	Type 2 Coordination, gG/gL	Maximum Circuit Breaker	CEC/NEC Fuse	Catalog Number
F-G	25–35 35–50 50–70 70–100		1NO-1NC	80–170 A	125	100	125	125	XTOB035GC1S
			1NO-1NC	80–170 A	160	125	150	200	XTOB050GC1S
			1NO-1NC	80–170 A	250	160	150	200	XTOB070GC1S
			1NO-1NC	80–170 A	315	200	400	400	XTOB100GC1S
	95–125 120–150 145–175		1NO-1NC	80–170 A	315	250	500	400	XTOB125GC1S
			1NO-1NC	150–170 A	315	250	600	600	XTOB175GC1S
H	50–70 70–100 95–125		1NO-1NC	185–250 A	250	160	150	200	XTOB070HC1
			1NO-1NC	185–250 A	315	200	400	400	XTOB100HC1
			1NO-1NC	185–250 A	315	250	500	400	XTOB125HC1
			1NO-1NC	185–250 A	400	250	600	600	XTOB160HC1
	120–160 160–220 200–250		1NO-1NC	185–250 A	400 ①	315 ①	600	800	XTOB220HC1
			1NO-1NC	225–250 A	400 ①	315 ①	600	700	XTOB250HC1
L	50–70 70–100 95–125 120–160		1NO-1NC	185–250 A	250	160	150	200	XTOB070LC1
			1NO-1NC	185–250 A	315	200	400	400	XTOB100LC1
			1NO-1NC	185–250 A	315	250	500	400	XTOB125LC1
			1NO-1NC	185–250 A	400	250	600	600	XTOB160LC1
	160–220 200–250 200–300		1NO-1NC	185–250 A	400 ①	315 ①	600	800	XTOB220LC1
			1NO-1NC	225–250 A	400 ①	315 ①	600	700	XTOB250LC1
M-N (CT Operated)	42–63 60–90 85–125 110–160		1NO-1NC	300–500 A	—	—	150	200	XTOT063C3S
			1NO-1NC	300–500 A	—	—	250	250	XTOT090C3S
			1NO-1NC	300–500 A	—	—	500	400	XTOT125C3S
			1NO-1NC	300–500 A	—	—	600	600	XTOT160C3S
	160–240 190–290 270–400 360–540 420–630		1NO-1NC	300–500 A	—	—	600	700	XTOT240C3S
			1NO-1NC	300–500 A	—	—	600	700	XTOT290C3S
			1NO-1NC	300–500 A	—	—	1000	1000	XTOT400C3S
			1NO-1NC	500 A	—	—	600	1000	XTOT540C3S
			1NO-1NC	630 A	—	—	600	1000	XTOT630C3S
			1NO-1NC	630 A	—	—	600	1000	XTOT630C3S

① For separate mounting, short-circuit Type 1 rating is 500 A and short-circuit Type 2 rating is 400 A.

② The main current parameters are defined by the main current wiring that is used.

③ Go datasheet.moeller.net for more information complete data sheet by Article number.

Thermal Overload Relays

Dimensions

Approximate Dimensions in Inches (mm)

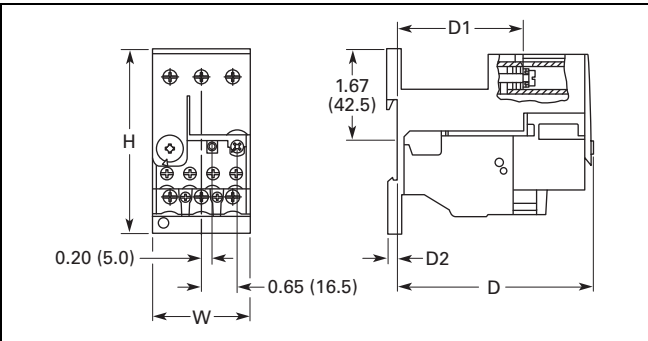


Figure 30.3-14. Frames B–C, XTOBXDINC DIN Rail or Panel Mount Adapter and Frame D, XTOBXDIND DIN Rail or Panel Mount Adapter

	H	W	D	D1	D2
XTOB...CC1	3.46 (85.0)	1.77 (45.0)	3.56 (90.5)	2.30 (58.3)	0.15 (3.8)
XTOB...DC1	3.39 (86.0)	2.36 (60.0)	4.41 (112.0)	3.17 (80.5)	0.19 (4.7)

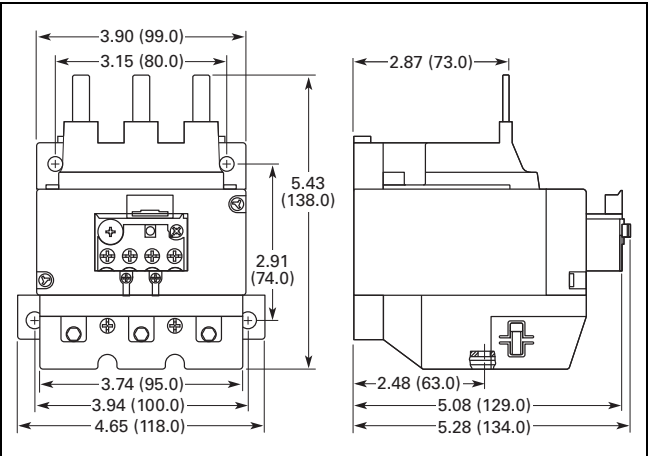


Figure 30.3-15. Frames F–G, XTOB...GC1 Overload Relay

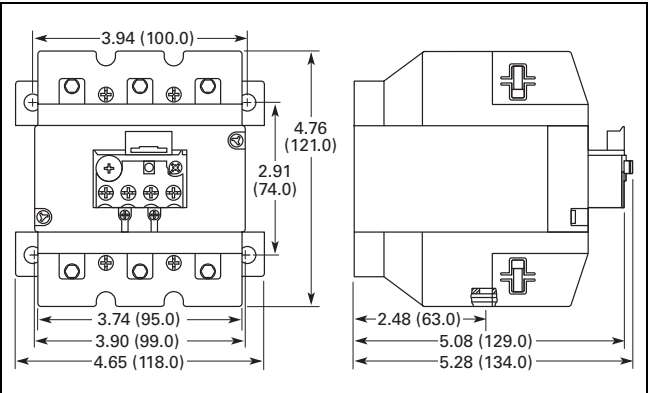


Figure 30.3-16. Frames F–G, XTOB...G1CS Overload Relay

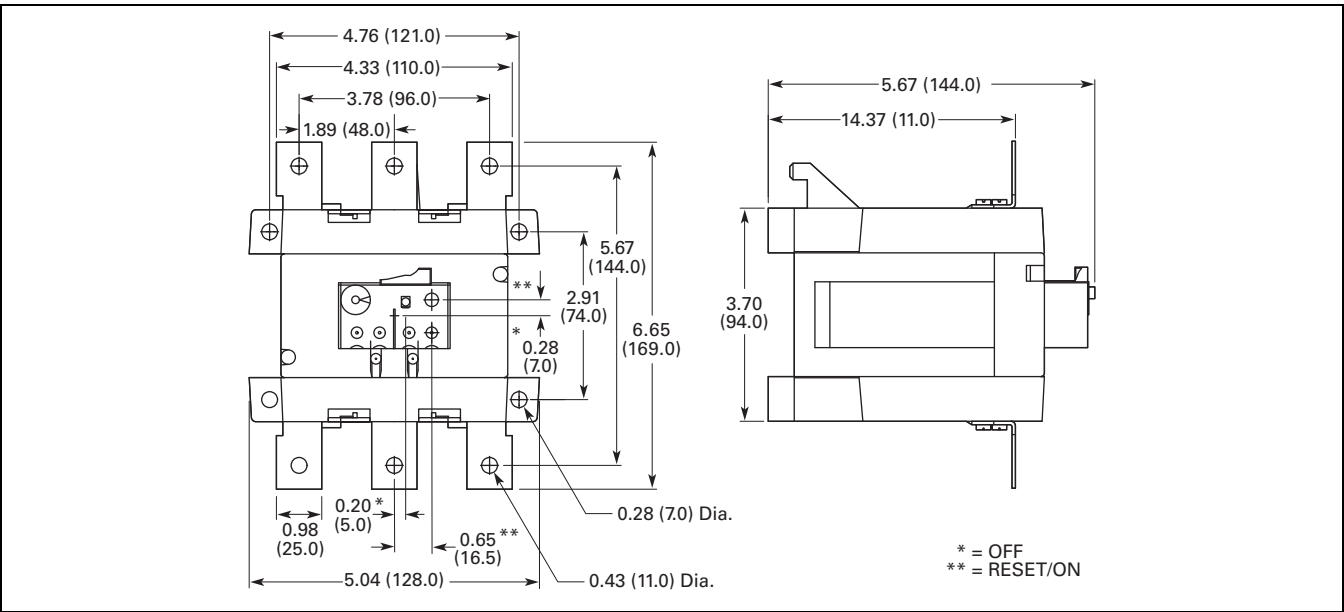


Figure 30.3-17. Frames L and H, XTOB...LC1, HC1 Overload Relay

Thermal Overload Relays

Dimensions

Approximate Dimensions in Inches (mm)

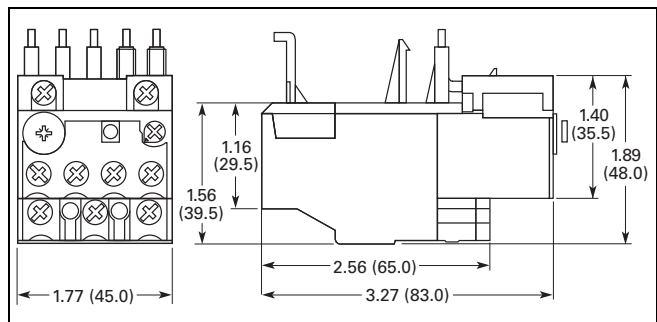


Figure 30.3-18. Frames B–C, XTOB...BC1 and XTOB...CC1 Overload Relays

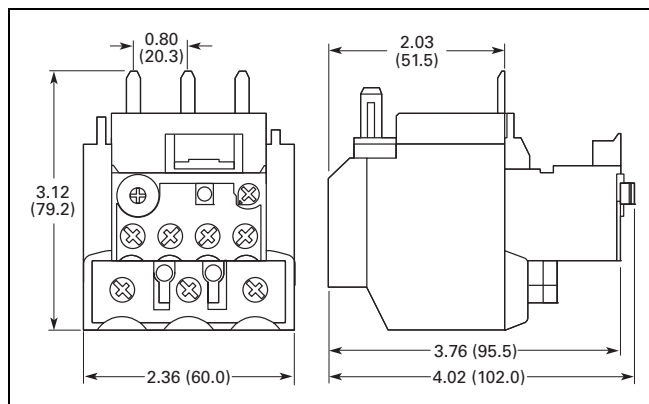


Figure 30.3-19. Frame D, XT0B...DC1 Overload Relay

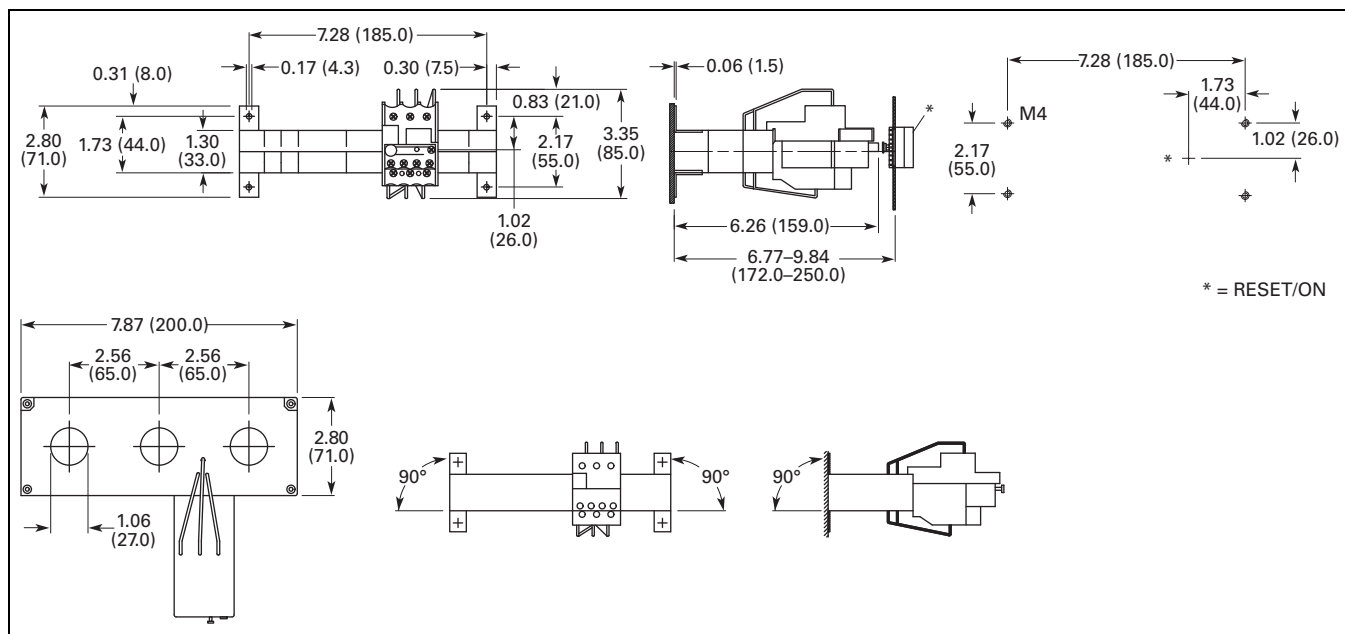


Figure 30.3-20. XTOT...C3S Current Transformer Operated Overload Relay

Combination Motor Controllers

Combination Motor Controllers



Combination Motor Controllers

30

General Description

Eaton's **XT** IEC open non-reversing and reversing manual motor controllers combine a manual motor protector with an IEC contactor(s) to provide a complete motor protection solution by combining motor disconnect function, thermal overload protection, magnetic short-circuit protection and remote control operation in one compact, assembled unit. These assembled manual motor controllers cover motors with FLA ratings from 0.10 A to 65 A.

The UL 508 Type F labeled combination motor controller (CMC) includes a line side adapter (LSA). These assembled combination motor controllers cover motors with FLA ratings from 0.10 A to 65 A.

Application Description

The **XT** IEC non-reversing and reversing manual and combination motor controllers can be used in the following applications:

Group Motor Control

Manual motor controllers (MMCs) are ideal for group motor applications where an upstream breaker or fuse provides protection for two or more motors. **XT** manual motor controllers (MMC) combine a manual motor protector, a wiring connector link and IEC contactor.

Individual Branch Circuit for Motor Loads

Combination motor controller (CMC), consisting of a line side adapter, manual motor protector, wiring connector link and IEC contactor, provide an efficient means to build an entire branch circuit.

The **XT** CMC is UL 508 Type F approved, meaning it is "self-protected" and doesn't require the use of an additional fuse or breaker for short circuit protection. This approval means CMC's can be used in place of a traditional fuse-starter and breaker-starter motor circuit.

Based around two key functional components (MMP and contactor), the CMC is a very cost effective means to build a branch circuit. Fuses and breakers must be oversized to prevent tripping during motor start up, and thus these oversized devices can no longer protect the motor. To compensate for this, a motor overload relay is necessary to protect the motor.

The manual motor protector was invented in Germany by Moeller to correct this inefficiency. The MMP operates similarly to a circuit breaker, except the inrush (magnetic) protection is set to 14 times the running current, thus accounting for motor start-up current without the necessity to over-size. A overcurrent dial was added to the face of the MMP to serve as the motor overload protection. This "motor protective circuit breaker", as it is referred to in Europe, now accomplishes all four key functions of a motor branch circuit: disconnect, short circuit, motor controller and motor overload protection. With the addition of a contactor, users have the ability to remotely control the starter device.

Whether a single motor application or a multiple motor application, CMCs are an ideal solution for machinery OEMs and panel builders.

Features

- ON/OFF rotary handle with lockout provision
- Visible trip indication
- Test trip function
- Motor applications from 0.10 A to 65 A
- Class 10 overload protection
- Built-in heater and magnetic trip elements to protect the motor
- Phase loss sensitivity
- Type 2 coordination
- Ambient compensated up to 55 °C (140 °F)
- Control inputs located at front of starter for easy access and wiring
- Wide range of coils
- DIN rail mount—XTSC...BB_
- Mounting plates—XTSC...BC_, XTSC...D motor controllers
- Adjustment dial for setting motor FLA
- Short-circuit trip at 14 times the maximum setting of the FLA adjustment dial
- UL 508 Type F CMC high fault short-circuit ratings
- 1NO-1NC auxiliary contact as standard on manual motor controller and combination motor controller

Standards and Certifications

- UL 508 Type F combination motor controller
- IEC Type 2 Approved per IEC 60947-4-1
- UL Listed File No. E245398
- CE Mark

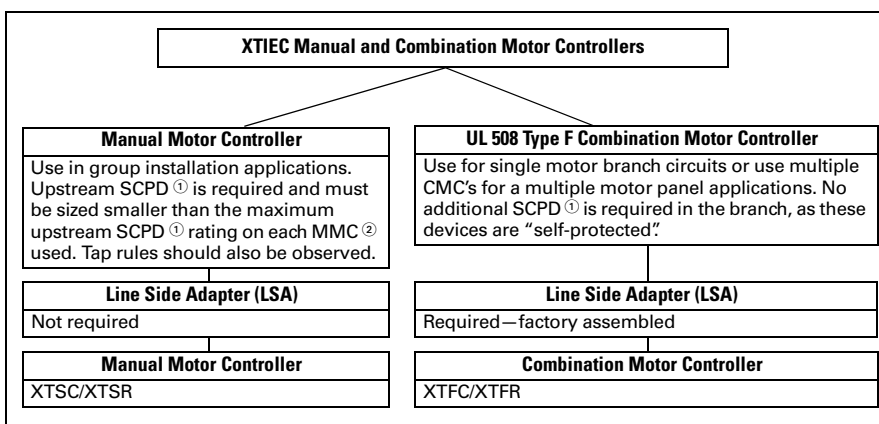


Figure 30.3-21. MMC and CMC Applications

Note: Technical Paper AP03402001E. Line side adapters are not required for non-U.S. applications. Most countries outside of the U.S. classify the MMP as a motor-protective circuit breaker.

① SCPD = Short-circuit protective device (circuit breaker, fuses).

② MMC = Manual motor controller

Combination Motor Controllers

Technical Data

Table 30.3-50. Combination Motor Controller Ratings

Frame MMP/ Frame Contactor	FLA Maximum Adjustment	Short Circuit Release—I _{rm} (Amperes)	Three-Phase Hp UL				Three-Phase kW IEC				Non- Reversing Catalog	Reversing Catalog
			200 V	240 V	480 V	600 V	220–240 V	380–415 V	500 V	660–690 V		
Manual Motor Controller/Starter Combinations												
B/B	16	224	3	3	10	7.5	4	7.5	9	12.5	XTSC_____	XTSR_____
B/C	32	448	7.5	10	20	25	7.5	15	22	30	XTSC_____	XTSR_____
D/C	32	448	7.5	10	20	30	7.5	15	17.5	22	XTSC_____	XTSR_____
D/D	65	882	15	15	40	30	18.5	34	37	55	XTSC_____	XTSR_____
Combination Motor Controllers (CMC), UL 508 Type F												
B/B	16	224	3	5	10	7.5	4	7.5	9	12.5	XTFC_____	XTFR_____
B/C	32	448	7.5	10	20	—	7.5	15	22	30	XTFC_____	XTFR_____
D/C	32	448	7.5	10	25	30	7.5	15	17.5	22	XTFC_____	XTFR_____
D/D	65	882	15	15	40	30	18.5	34	37	55	XTFC_____	XTFR_____

Dimensions

Approximate Dimensions in Inches (mm)

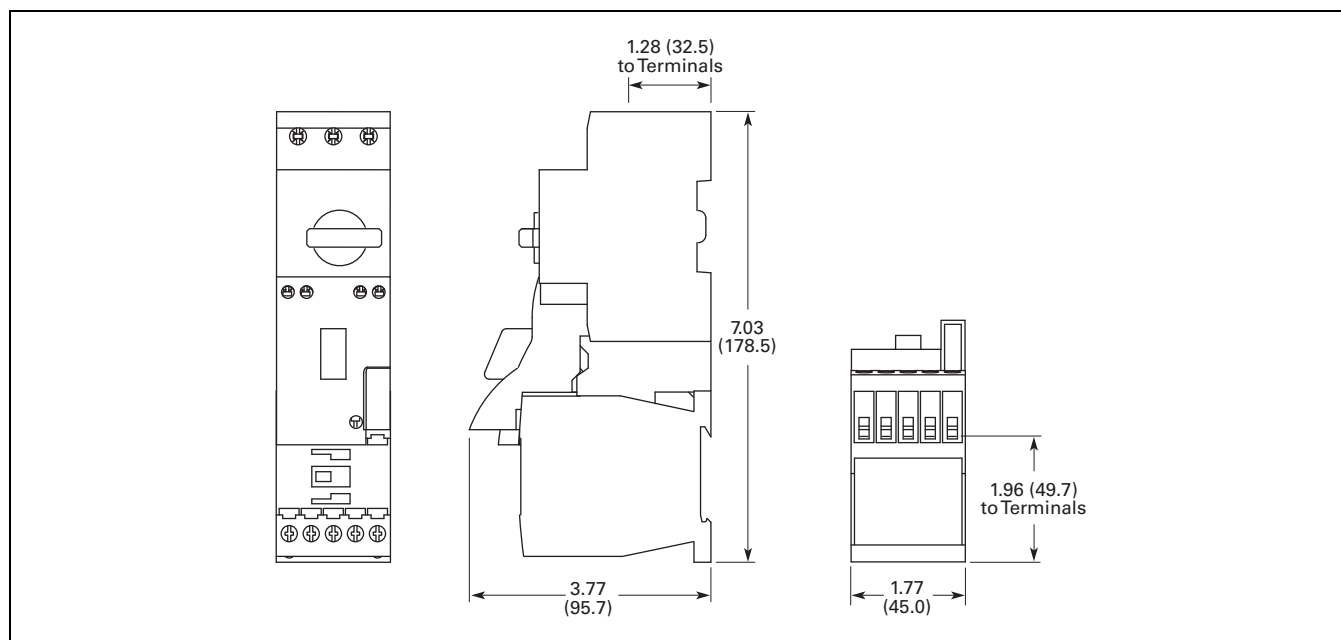


Figure 30.3-22. XTSC...BB_

Combination Motor Controllers

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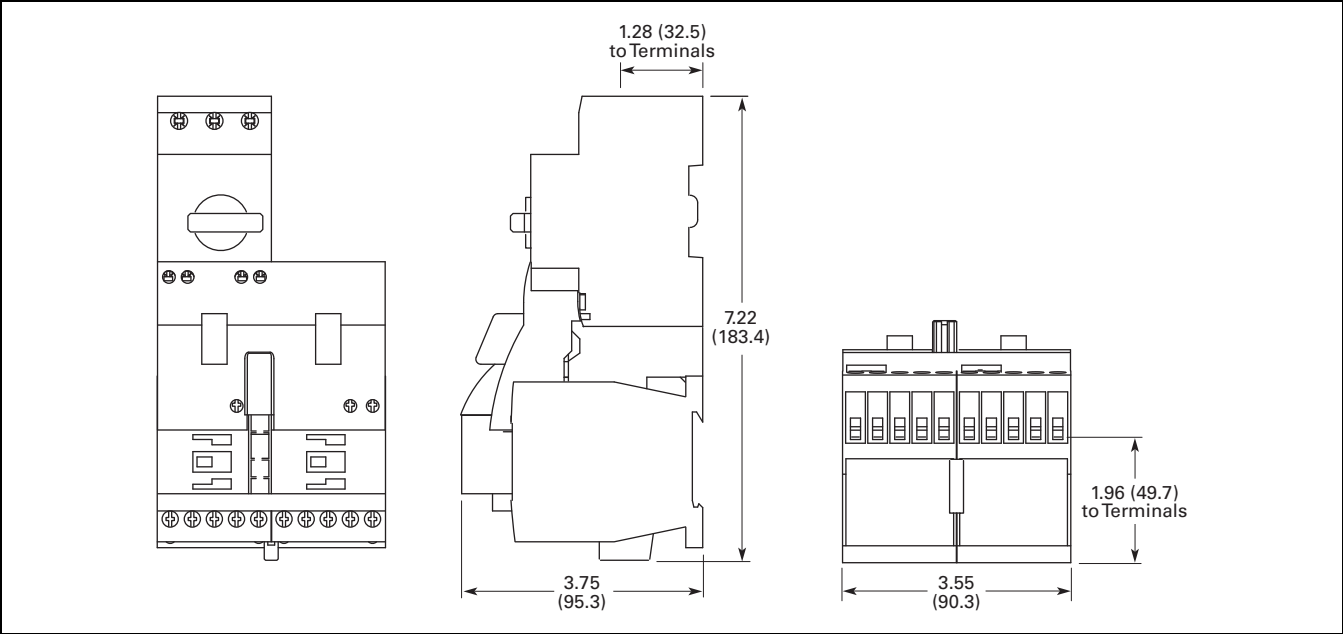


Figure 30.3-23. XTSC...BB_

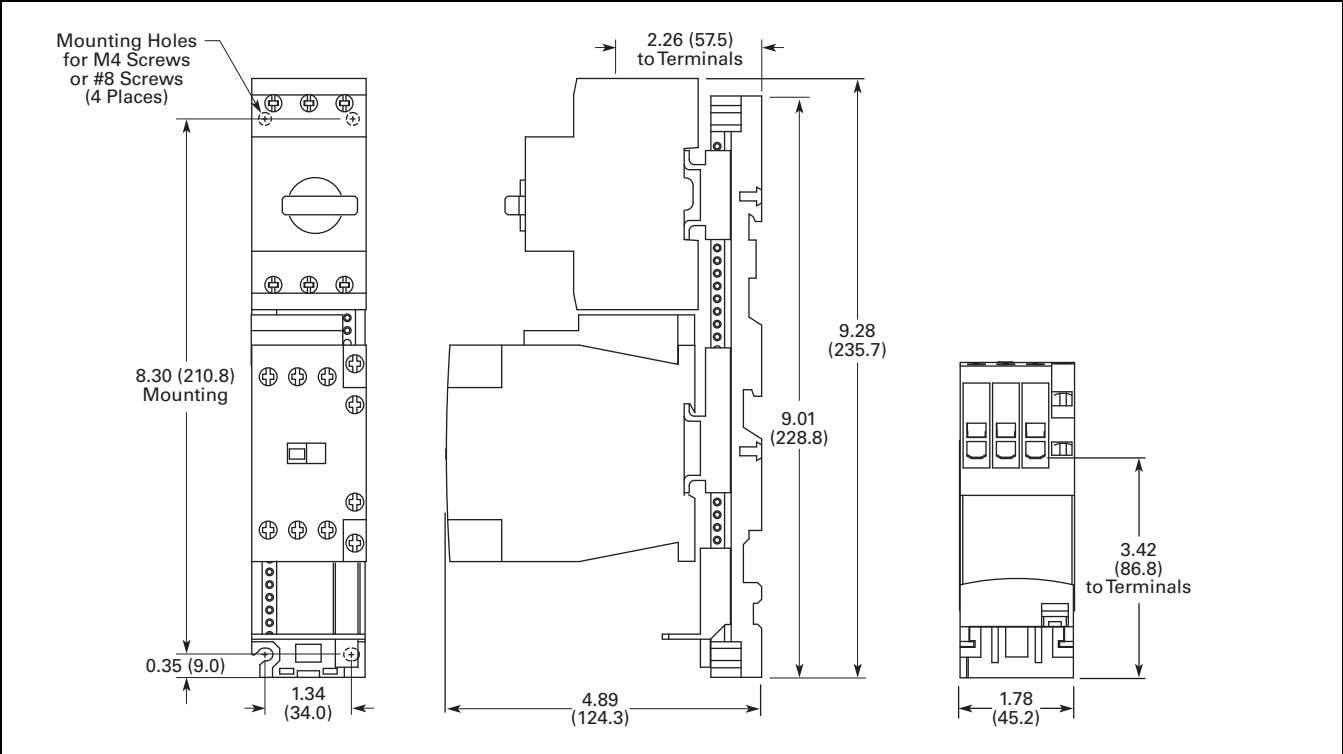
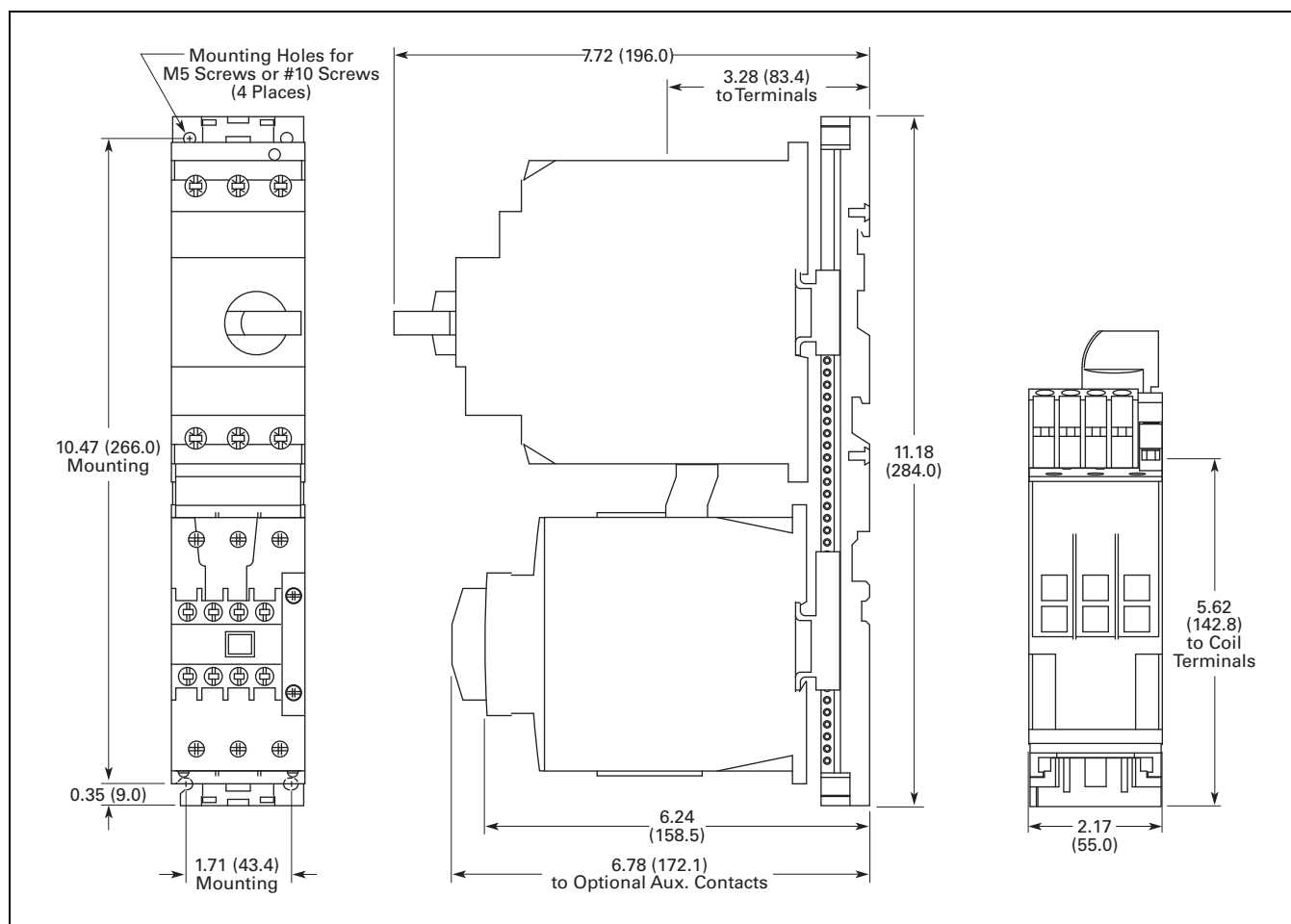


Figure 30.3-24. XTSC...BC_

Combination Motor Controllers

Figure 30.3-25. XTSC...DD

XT Electronic Manual Motor Protector



XT Electronic Manual Motor Protector

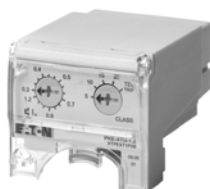
General Description

The **XT** Electronic Manual Motor Protector provides the same functionality as the **XT** thermal manual motor protector, but with an added level of flexibility and selectability. The XTPE incorporates electronic control technology to enable more options and larger dial setting ranges. The trip units are interchangeable, allowing users to exchange as needed using the same base. The reduced number of part numbers decreases bill of material complexity while reducing inventory demands. The XTPE electronic manual motor protector includes the following features:

- 4:1 maximum to minimum overcurrent dial setting range
- Selectable trip class (5, 10, 15, 20)
- Interchangeable trip units
- Three base units (12, 32 and 65 A)
- Common accessories with the XTPR

Features and Benefits

Advanced Trip Unit



In addition to the selectability, the XTPE is also available with an advanced trip unit that can communicate system data and protector data through SmartWire-DT®. SmartWire-DT is an innovative cost-effective connection technology that enables quick installation of control wiring to the starter through a single green cable. When on SmartWire-DT, the XTPE can communicate the following:

- Current values
 - Maximum phase current
 - Overload warning
- Diagnostics data
 - Overload fault
 - Cause of trip (overcurrent or short circuit)
 - Phase loss
 - Trip via TEST
- Status messages
 - Control unit type
 - Overload setting
 - Time-lag
 - Switching status

XTPE Electronic MMP



The XTPE Electronic MMP provides the selectability, control, and insight options that give panel builders and OEMs the solutions necessary to enhance motor control designs while reducing total costs.

Standards and Certifications

- CE approved
- UL Listed File No. E36332
- UL 508 group motor and Type E
- IEC/EN 60947
- CSA File 012528, Class 3211-05

Catalog Number Selection

Table 30.3-51. XT—Manual Motor Protector Catalog Numbering System

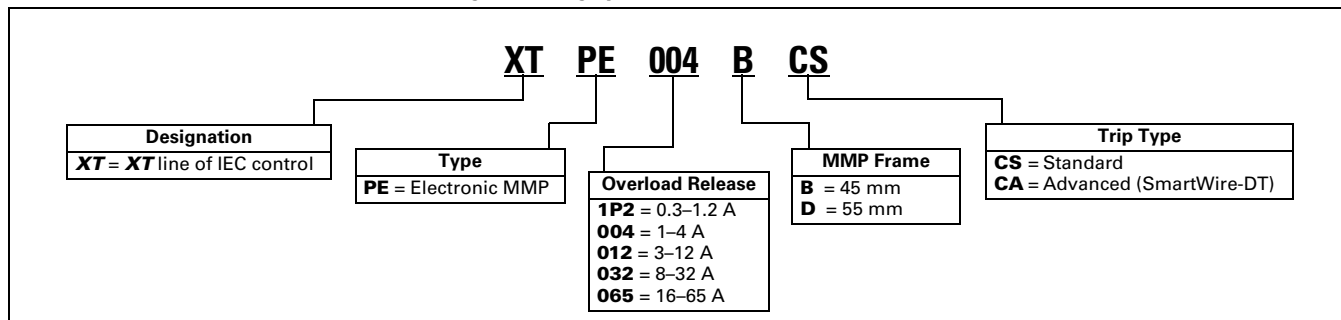
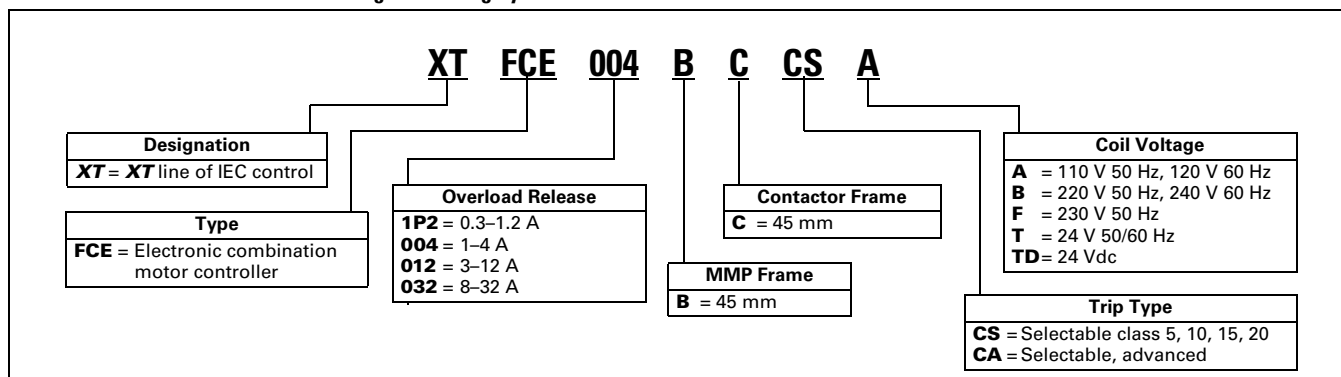


Table 30.3-52. XT—Combinations Catalog Numbering System



Trip Characteristics

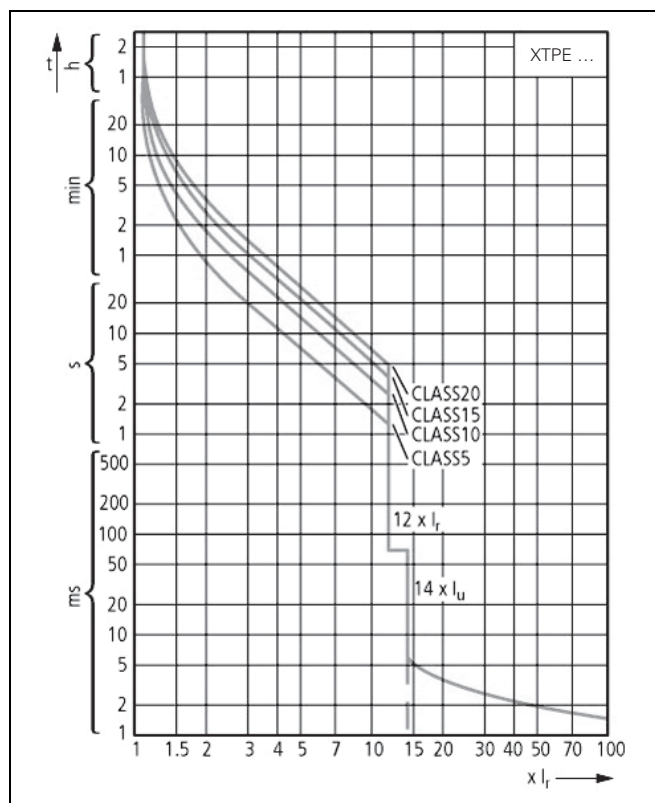


Figure 30.3-26. XT Electronic Manual Motor Controllers

Dimensions

Approximate Dimensions in Inches (mm)

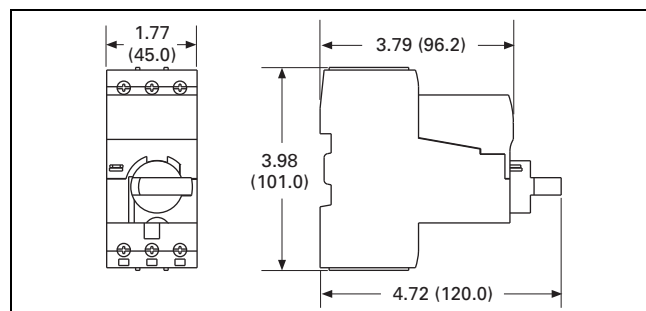


Figure 30.3-27. XT Electronic MMP—B Frame

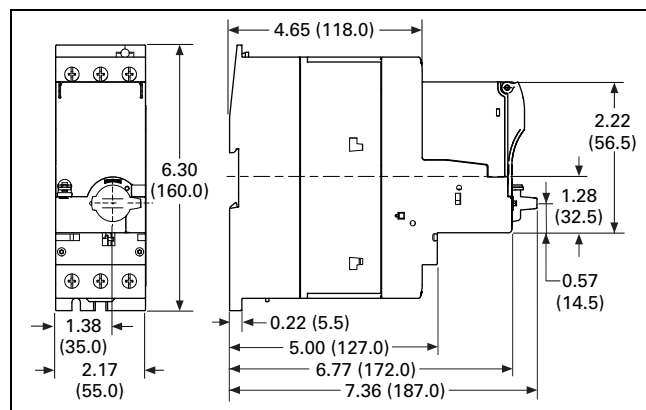


Figure 30.3-28. XT Electronic MMP—D Frame

EMS—Electronic Motor Starter

EMS—Electronic
Motor Starter



EMS—Electronic Motor Starter

30

General Description

The electronic motor starter (EMS) is the latest technology in safe and efficient motor starting from Eaton's Electrical Sector. The EMS is a full starter with built-in solid-state contacts and integral overload protection. Its compact size and high-electrical life make it an ideal replacement for the traditional contactor/overload relay starter configuration.

Application Description

A versatile solution, the EMS also supports the following installation applications:

- Logistics
- Conveyor control
- Production machines
- Tooling machines
- Packaging machines
- Small elevators

Features and Benefits

Multifunctional

The EMS comes with an optional reversing start feature, eliminating the need for an additional contactor. The optional E-stop functionality eliminates the need for a separate E-stop contactor. Available with SmartWire-DT connection, reducing installation cost and providing communication means of critical data.

Extended Life

High-electrical life provides up to 30 million operations. The EMS is ideal for customer applications requiring multiple motor start/stops per hour.

Easy Installation

The EMS comes equipped with push-in terminals for quick and easy wiring of power and control circuits. Push-in terminals provide 60% time savings over screw-in terminals and better contact against vibrations.

Standards and Certifications

- UL

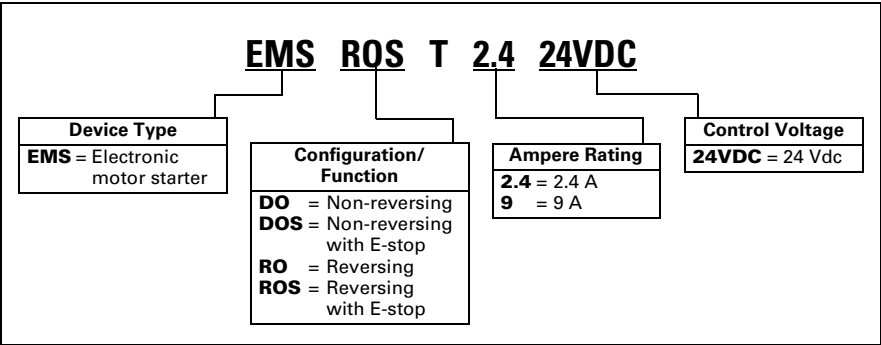
Safety Rated

Functional safety is growing in importance for the machinery OEM. The EMS is rated at SIL3 per IEC 62061 and PLe per ISO® 13849, meeting the most stringent of safety requirements.

The EMS carries IEC and UL short-circuit ratings, with 100 kAIC UL short-circuit rating when mated with 30 A Class J fuse.

Catalog Number Selection

Table 30.3-53. EMS—Electronic Motor Starter Catalog Numbering System



Dimensions

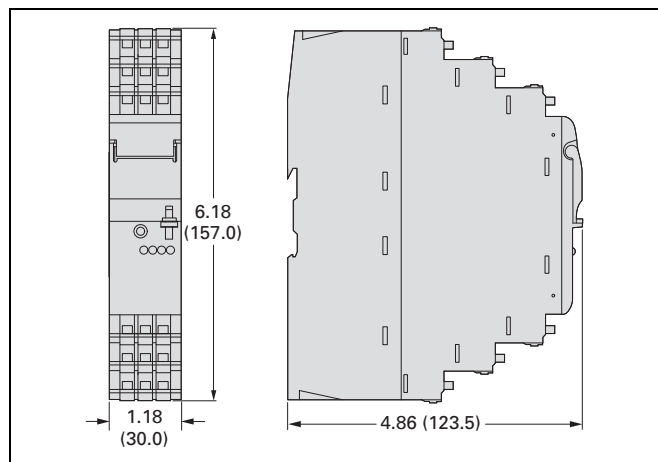


Figure 30.3-29. EMS without SmartWire-DT

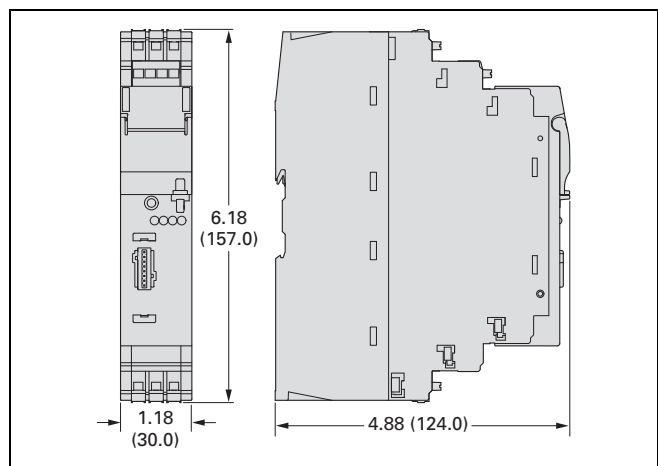


Figure 30.3-30. EMS with SmartWire-DT

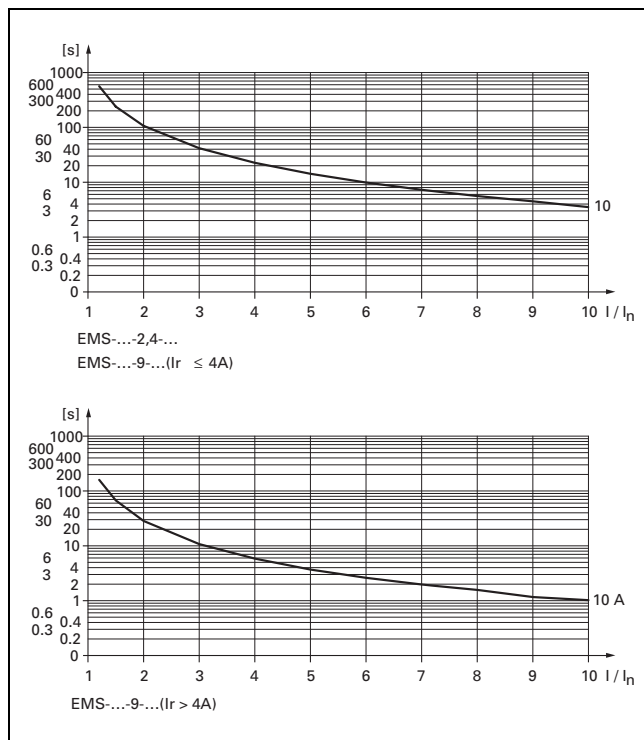


Figure 30.3-31. Trip Type EMS

Table 30.3-54. Rated Operational Current EMS-...-SWD

Temperature (°C)	40	45	50	55	60
EMS-...- 2,4 - SWD					
Stand-alone device	2.4	2.4	2.4	2.4	2.4
Connected in series, with a distance equal to one housing width	2.4	2.4	2.4	2.4	2.4
Connected in series, without any distance	2.4	2.4	2.4	2.4	—
EMS-...- 9 - SWD					
Stand-alone device	9	9	9	9	7.6
Connected in series, with a distance equal to one housing width	9	9	7.6	7.6	5.2
Connected in series, without any distance	7.6	6.8	5.2	2.4	—

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Low Voltage Reduced Voltage

Starter Selection Guide

In general, the application will determine the type of starter required. In cases where more than one type starter will meet the application requirements, reference to the table below will show which starter is best suited for the application.

Table 30.4-1. Reduced Voltage Starting Characteristics and Index

Starter Type	Starting Characteristics Expressed in % of Rated Starting Values (Approximate)				Remarks	Page
	Motor Voltage	Motor Current	Line Current	Torque		
Autotransformer Class ECA42						30.4-2
80% Tap	80	80	67 ①	64	The adjustable voltage taps permit wide adjustment of characteristics in the field.	
65% Tap	65	65	45 ①	42		
50% Tap	50	50	28 ①	25		
Part winding Class ECA45	100	65	65	50	Requires part winding motor. A nine-lead 230/460 V dual voltage motor may be used in 230 V applications. Closed transition.	30.4-3
Wye-delta Class ECA48 Class ECA51	100	33	33	33	Requires delta wound motor with wye connections. Ideal for long accelerations. Closed transition is available.	30.4-4
Solid-state S801/811 S611 DS6/DS7	Ramps 0–100%	Adjustable 0–92%	Adjustable 0–92%	Adjustable 0–85%	Compatible with NEMA Design A, B or C motors. Adjustable ramp up and ramp down.	30.5-1 thru 30.5-49

① Includes autotransformer magnetizing current.

General Application

The following factors should be considered when applying reduced-voltage starters to a squirrel cage motor-driven load.

1. The motor characteristics that will satisfy the starting requirements of the load.
2. The source of power and the effect the motor starting current will have on the line voltage.
3. The load characteristics and the effect the motor starting torque will have on the driven parts during acceleration.

The starter protection required to protect the load, motor, starter, cables and power source during overload, undervoltage and fault conditions.

A typical NEMA B motor started with full voltage will develop as much as 150% full-load torque when started with a starting current of around 600% full-load current. These values may exceed

the mechanical limitations of the load or electrical limitations of the source, or both.

A reduced-voltage or reduced-inrush starter will reduce both starting current and starting torque. Care must be taken when meeting power company limitations that the motor will produce sufficient torque to accelerate the load to near rated speed.

Part-winding starters are suited to low starting torque loads such as fans, blowers and m-g sets. Autotransformer starters should be used with “hard to start” loads such as reciprocating compressors, grinding mills, and pumps. Wye-delta starters are applicable to high inertia loads with long acceleration times which as centrifugal compressors and centrifuges.

All starters, in addition to overload protection, will provide either low voltage release or low voltage protection depending upon the pilot device used

with the starter. Low voltage release, where power is applied to the motor after a power failure, can be obtained by using a two-wire pilot device (temperature, switch and so on). Low voltage protection, where power is not applied to the motor after a power failure until restarted by an operator, can be obtained by using three-wire control such as START STOP pushbuttons.

Closed transition wye-delta types require adequate ventilation to remove resistor heat.

Eaton also offers a line of solid-state reduced-voltage starters known as Easy-start.

Solid-state starters are ideally suited for many loads including conveyor applications since they provide controlled acceleration from zero to full load.

UL listing—Combination E176513, Non-Combination E19224.

Starting Characteristics

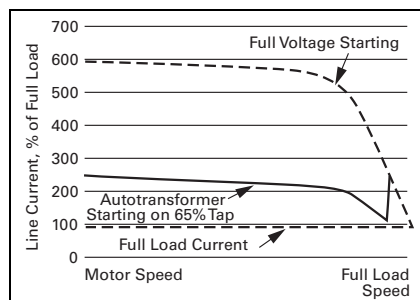


Figure 30.4-1. Autotransformer Starting

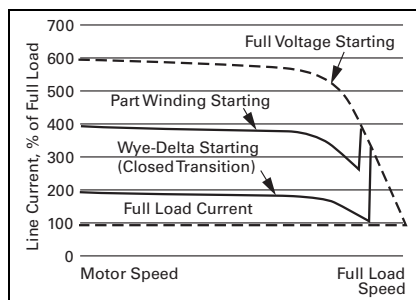


Figure 30.4-2. Wye-Delta or Part Winding Starting

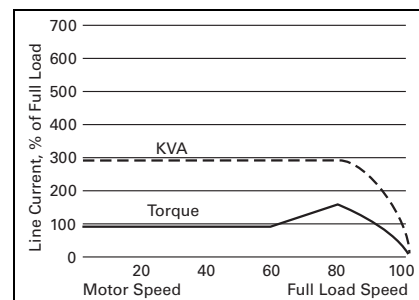


Figure 30.4-3. Solid-State Starter

Autotransformer Type

General Description

Autotransformer type starters are the most widely used reduced-voltage starter because of their efficiency and flexibility. All power taken from the line, except transformer losses, is transmitted to the motor to accelerate the load. Taps on the transformer allow adjustment of the starting torque and inrush to meet the requirements of most applications. The following characteristics are produced by the three voltage taps:

Table 30.4-2. Starting Characteristics

Tap	Starting Torque % Locked Torque	Line Inrush % Locked Ampere
50% ①	25%	28% ②
65%	42%	45% ②
80%	64%	67% ②

① Not included 50 hp and below.

② Includes transformer magnetizing current.

Closed transition is standard on all sizes ensuring a smooth transition from reduced to full voltage. Since the motor is never disconnected from the line there is no interruption of line current which can cause a second inrush during transition.

Duty cycle of these starters is as follows: up to 200 hp, 15 seconds on each 4 minutes for 1 hour, repeated after 2 hours. Over 200 hp, three periods of 30 seconds ON, 30 seconds OFF repeated after 1 hour.

Design Features

Contactors—(1S) (2S) (Run)

A three-pole (1S) ③ and a three-pole contactor (2S) connect the motor to the auto-transformer for reduced-voltage starting (see **Table 30.4-3** for size).

A three-pole contactor (Run) bypasses the autotransformer and connects the motor for full-voltage across-the-line running (see **Table 30.4-3** for size).

Table 30.4-3. NEMA Contactor Size Guidelines within Autotransformer Starters

Maximum hp	NEMA Size			
	Starter	Contactor		
		Run	Starting	
			(1S) (3-Pole)	(2S) (3-Pole)
230 V, 60 Hz				
15	2	2	2	2
30	3	3	3	3
50	4	4	4	4
100	5	5	5	5
200	6	6	6	6
300	7	7	6 ③	6
450	8	8	7 ③	7

460–575 V, 60 Hz

25	2	2	2	2
50	3	3	3	3
100	4	4	4	4
200	5	5	5	5
400	6	6	6	6
600	7	7	6 ③	6
900	8	8	7 ③	7

③ 1S is two-pole on sizes 7 and 8.

Operation (Refer to Schematic Diagram)

Closing the START button or other pilot device energizes the start contactor

(1S). The interlock (1S) closes, energizing the timing relay (TR) and contactor (2S) which seal in through the interlock (2S). With the (1S) and (2S) contactors closed, the motor is connected through the autotransformer for reduced-voltage start. After a preset time interval, the (TR_{TO}) contacts time open, de-energizing contactor (1S) and connecting the autotransformer as a reactor in series with the motor. Interlock (1S) immediately energizes the run contactor (R) which seals in through its interlock (R). The run contacts are now closed, and the motor is running at full voltage. Start contactor (2S) and relay (TR) are de-energized when interlock (R) opens.

An overload, opening the STOP push-button or other pilot device de-energizes the (R) contactor removing the motor from the line.

Other Types

Autotransformer starters are also available in combination and reversing types.

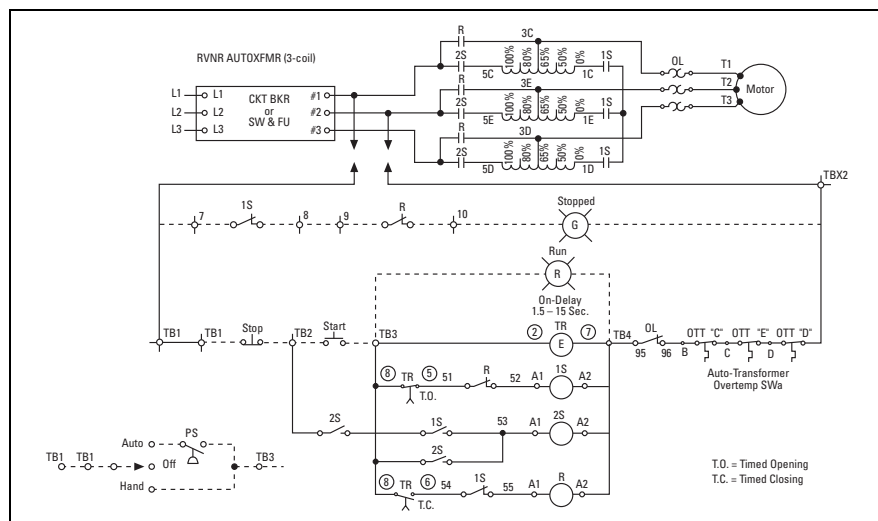


Figure 30.4-4. Typical Schematic Diagram

Table 30.4-4. Type 1, 3R, 4/4X, 12 Freedom Reduced Voltage Enclosures

Size	Type 1		Type 3R, 4X, 12	
	Box No.	Shipping Weight Lb (kg)	Box No.	Shipping Weight Lb (kg)

Class 42: Autotransformer—Non-combination

Class 43: Autotransformer—with Disconnect

Class 44: Autotransformer—with HMCP

2–4	E2	124 (56)	E2	149 (68)
5	F1E	885 (402)	F1E	1010 (459)
6 ④	F1E	1220 (554)	F1E	1345 (611)
6 ③	F2E	1400 (636)	F2E	1525 (692)
7	F2E	⑤	F2E	⑤
8	F2E	⑤	F2E	⑤
9	⑤	⑤	⑤	⑤

④ Non-combination and breaker.

⑤ Consult factory.

For enclosure box dimensions, refer to Page 30.6-3.

Part-Winding Type

General Description

Part-winding starting provides convenient, economical one-step acceleration at reduced current where the power company specifies a maximum or limits the increments of current drawn from the line. These starters can be used with nine-lead dual-voltage motors on the lower voltage and with special part-winding motors designed for any voltage. When used with dual-voltage motors, it should be established that the torque produced by the first half-winding will accelerate the load sufficiently so as not to produce a second undesirable inrush when the second half-winding is connected to the line. Most motors will produce a starting torque equal to between 1/2 to 2/3 of NEMA standard values with half of the winding energized and draw about 2/3 of normal line current inrush.

Design Features

Contactors—(1M) (2M)

A three-pole contactor (1M) connects only the first half-winding of the motor for reduced inrush current on starting (see table below for size). A three-pole contactor (2M) connects the second half-winding of the motor for running (see table below for size).

Table 30.4-5. NEMA Contactor Size Guidelines within Part Winding Starters

Maximum hp	NEMA Size	
	Starter	Contactor
		(1M) (2M)

230 V, 60 Hz

15	1 PW	1	1
25	2 PW	2	2
50	3 PW	3	3
75	4 PW	4	4
150	5 PW	5	5
300	6 PW	6	6

460–575 V, 60 Hz

15	1 PW	1	1
40	2 PW	2	2
75	3 PW	3	3
150	4 PW	4	4
350	5 PW	5	5
600	6 PW	6	6

Overload Relay—(OL)

Two three-pole Type B overload relays provide starting and running overcurrent protection.

Timing Relay—(TR)

An electrically operated pneumatic relay provides accurate, adjustable start-to-run transfer timing.

Other Types

Part-winding Type ECN45 starters are also available in combination (Type 46 and 47), reversing and three-point (primary resistor) types.

Operation (Refer to Schematic Diagram)

Closing the START button or other pilot device energizes the start contactor

(1M) which seals in through its interlock (1M) and energizes the timer (TR). The (1M) contacts connect the first half-winding of the motor across the line. After a preset time interval, the timer (TR_{TC}) contact closes energizing contactor (2M). The (2M) contact connects the second half-winding of the motor across-the-line.

Opening the STOP button or other pilot device de-energizes contactors (1M), (2M) and timer (TR), removing the motor from the line.

Table 30.4-6. Contactor Sequence

Contactor	Start	Run
1M	●	●
2M	—	●

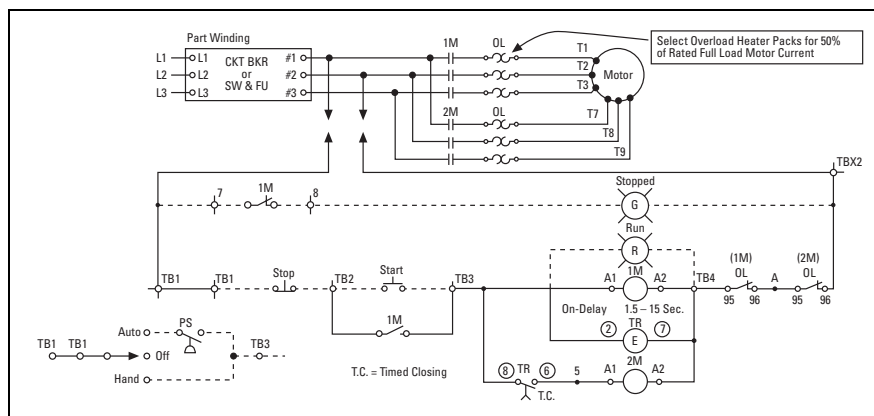


Figure 30.4-5. Typical Schematic Diagram

Table 30.4-7. Type 1, 3R, 4/4X, 12 Freedom Reduced Voltage Enclosures

Size	Type 1		Type 3R, 4X, 12	
	Box No.	Shipping Weight Lb (kg)	Box No.	Shipping Weight Lb (kg)

Class 45: Part Winding—Non-combination

2PW	3	25 (11)	7	75 (34)
3PW–4PW	9	47 (21)	9	95 (43)
5PW	E	125 (47)	E	180 (82)
6PW	F1E	780 (354)	F1E	880 (400)
7PW	F2E	①	F2E	①
8PW	F2E	①	F2E	①

Class 46: Part Winding—with Disconnect

Class 47: Part Winding—with Thermal-Magnetic Trip Circuit Breaker

2PW	C	68 (31)	C	88 (40)
3PW	D	162 (74)	D	190 (86)
4PW	E	230 (104)	E	270 (123)
5PW	F1E	440 (200)	F1E	530 (241)
6PW ②	F1E	440 (200)	F1E	620 (281)
6PW ③	F2E	515 (234)	F2E	①
7PW	F2E	①	F2E	①
8PW	F2E	①	F2E	①

① Consult factory.

② Non-combination and breaker.

③ Fusible.

For enclosure box dimensions, refer to Page 30.6-3.

Wye-Delta Type

General Description

Wye-delta type starters are applied extensively to industrial air conditioning installations because they are particularly suited for starting motors driving high inertia loads with resulting long acceleration times. They are not, however, limited to this application. When six- or 12-lead delta-connected motors are started wye-connected, approximately 58% of line voltage is applied to each winding and the motor develops 33% of full-voltage starting torque and draws 33% of normal locked-rotor current from the line. When the motor is accelerated, it is reconnected for normal data operation.

Design Features

Contactors—(1S) (1M) (2S) (2M)

A three-pole contactor (1S) ① shorts the motor leads T4-T5-T6 during starting to connect motor in wye (see **Table 30.4-8** for size).

A three-pole contactor (1M) energizes motor leads T1-T2-T3 for both wye and delta connections (see **Table 30.4-8** for size).

A three-pole contactor (2S) connects resistors in series with the motor windings during the start-to-run transition period (see **Table 30.4-8** for size).

A three-pole contactor (2M) energizes the motor leads T4-T5-T6 during running to connect the motor in delta (see **Table 30.4-8** for size).

Table 30.4-8. NEMA Contactor Size Guidelines

Max. hp	NEMA Size				
	Starter	Contactor			
		(1M)	(2M)	(1S)	(2S)

230 V, 60 Hz

10	1 YD	1	1	1	1
25	2 YD	2	2	2	1
50	3 YD	3	3	3	1
75	4 YD	4	4	4	2
150	5 YD	5	5	4	3
300	6 YD	6	6	5	4
500	7 YD	7	7	6 ①	5
800	8 YD	8	8	7 ①	6

460–575 V, 60 Hz

15	1 YD	1	1	1	1
40	2 YD	2	2	2	1
75	3 YD	3	3	3	1
150	4 YD	4	4	4	2
300	5 YD	5	5	4	3
700	6 YD	6	6	5	4
1000	7 YD	7	7	6 ①	5
1500	8 YD	8	8	7 ①	6

① 1S is two-pole on sizes 7 and 8.

Operation (Refer to Schematic Diagram)

Closing the START button or other pilot device energizes contactor (1S) whose contacts connect the motor in a wye connection. Interlock (1S) closes, energizing contactor (1M) and timer (TR). The (1M) contacts energize the motor windings in a wye. After a preset time interval, timer (TR_{TC}) contact closes energizing contactor (2S). Interlock (2S) opens, dropping out contactor (1S). The motor is now energized in series with the resistors. Interlock (1S) closes, energizing contactor (2M), bypassing the resistors and energizing the delta connected motor at full voltage.

Interlock opens, de-energizes the timer (TR) opening timer (TR_{TC}) thus energizing contactor (2S).

An overload, opening the STOP button or other pilot device de-energizes contactors (1M) and (2M), removing the motor from the line. (TRP) de-energizes and locks out the control circuit if the duty cycle of the transition resistors is exceeded.

Wye-delta Class ECN51 closed transition starters are also available in combination types and Class ECN48 open transition non-combination and combination starters.

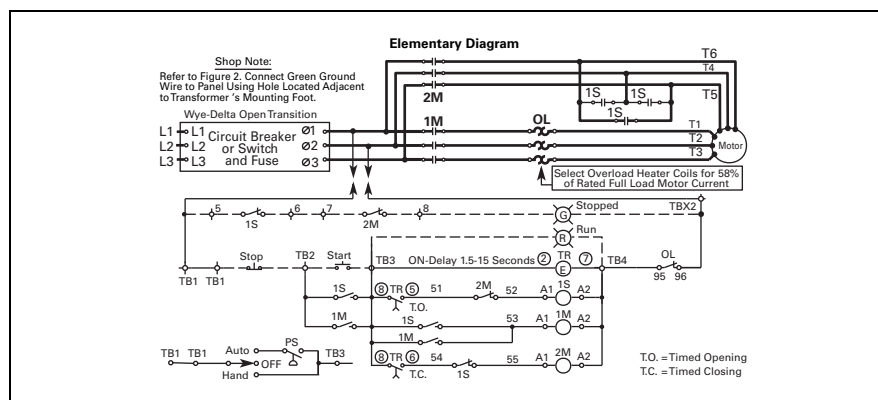


Figure 30.4-6. Wye-Delta—Open Transition

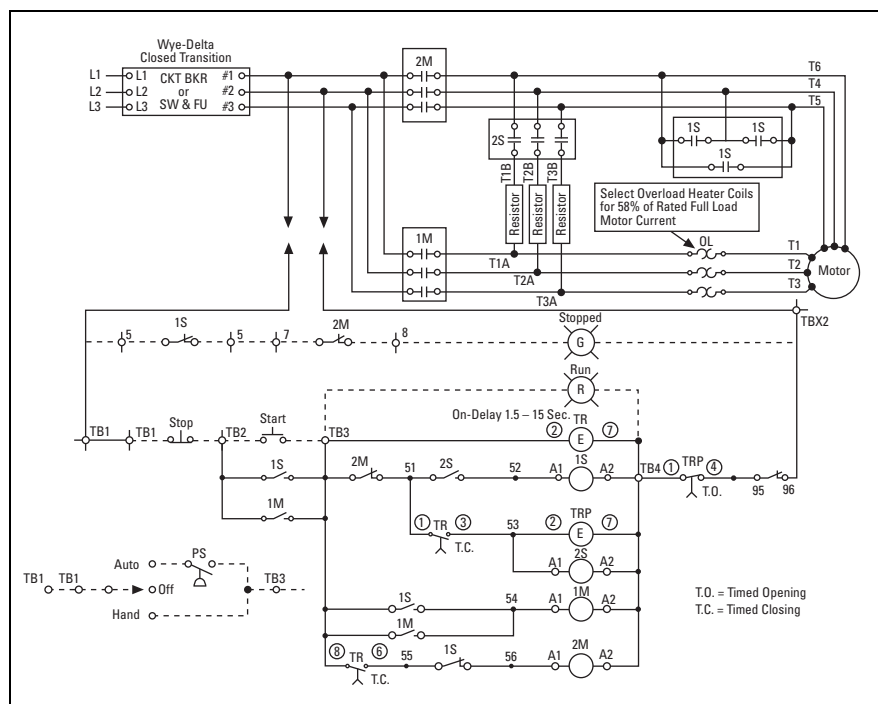


Figure 30.4-7. Wye-Delta—Closed Transition

Wye-Delta Type

Table 30.4-9. Type 1, 3R, 4/4X, 12 Freedom Reduced Voltage Enclosures

Size	Type 1		Type 3R, 4X, 12	
	Box No.	Shipping Weight Lb (kg)	Box No.	Shipping Weight Lb (kg)

Classes 48 & 51: Wye-Delta—Non-combination

Classes 49 & 52: Wye-Delta—with Disconnect

Classes 50 & 53: Wye-Delta—with Thermal
Magnetic Trip Circuit Breaker

2YD-4YD	E	185 (84)	E	225 (102)
5YD	F1E	605 (275)	F1E	705 (320)
6YD ①	F1E	635 (288)	F1E	735 (334)
6YD ②	F2E	715 (325)	F2E	830 (377)
7YD	F2E	③	F2E	③
8YD	F2E	③	F2E	③

① Non-combination and breaker.

② Fusible.

③ Consult factory.

*For enclosure box dimensions,
refer to Page 30.6-3.*

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Solid-State Reduced Voltage Starters*Reduced Voltage Starters***General Description**

Eaton offers a complete line of solid-state reduced voltage devices ranging from fractional horsepower applications to 1000 A devices. The line comes in voltages from 200 to 600 Vac and operates on 50 or 60 Hz applications. Units can be ordered as open components or mounted in enclosures (NEMA 1, 3R, 4X and 12). Motor control center (MCC) mounting is also possible with units through 700 hp fitting inside of a standard MCC.

These soft starters provide reduced voltage starting of AC induction motors. Motor voltage is controlled by means of back-to-back SCRs (silicon controlled rectifiers) providing a smooth, stepless start (and stop) of the motor driven load.

For more information, please visit the Eaton Web site at www.eaton.com/electrical.

Designed to control acceleration and deceleration of three-phase motors, products are available from 0.25 to 50 A and are suitable for mounting in a variety of enclosures including Type 1, 12, 3R, 4, 4X and 7/9.

Application Description

Eaton's soft starters can be applied in a wide array of customer applications. Typical benefits of soft starters include:

- Reduced starting torque stress on mechanical equipment, allowing longer life of belts, gears, pulleys and motor shafts commonly weakened during "across-the-line" starting
- Reduction of voltage drop during starting on weak utility systems where the performance of nearby equipment would be negatively affected
- Reduced inrush current during starting which can result in lower utility bills due to the reduction in peak current demand charges
- Smooth, stepless starting of a motor, allowing superior flexibility over typical electromechanical starting methods
- Ability to start large loads on backup generators during power outages
- Elimination of the water-hammer effect in hydraulic systems, which can help to eliminate additional pipe hangers and extend the life of the system, pumps, valves and gaskets

Typical Applications

- Centrifugal and screw compressors
- Material handling equipment
- Fans and blowers
- Pumps
- Cranes and hoists
- Food processing
- Machinery
- Rock crushers
- HVAC industry

Enclosure Types

Airborne particulate may be detrimental to starter performance and reliability, so caution must be exercised in choosing the enclosure best suited to the environment. The NEMA rating of the enclosure defines its ability to withstand the ingress of foreign particulate as described below:

NEMA 1

A general purpose, indoor-type enclosure.

NEMA 12

A dust-tight and drip-tight enclosure for indoor industrial applications.

NEMA 3R

Enclosures are intended for outdoor use, primarily to provide a degree of protection against falling rain, sleet and external ice formation.

NEMA 4

A watertight and dust-tight enclosure for either indoor or outdoor use.

NEMA 4X

Identical to NEMA 4, with the additional requirement that the enclosure be corrosion-proof as well.

NEMA 7/9

Enclosures capable of preventing the entrance of dust and withstanding pressure resulting from an internal explosion of specified gas.

General Description

Catalog Number Selection

Table 30.5-1. Solid-State Enclosed Control Catalog Numbering System

EC S 90 S 1 C A A																																									
<table><tr><td>Type</td></tr><tr><td>S = Solid-state</td></tr></table>			Type	S = Solid-state																																					
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S = Solid-state																																									
<table><tr><td>Class</td></tr><tr><td>90 = Non-combination reduced voltage soft starter—S801</td></tr><tr><td>91 = Combination reduced voltage soft starter—fusible disconnect—S801</td></tr><tr><td>92 = Combination reduced voltage soft starter—circuit breaker—S801</td></tr><tr><td>93 = Non-combination reduced voltage soft starter—S811</td></tr><tr><td>94 = Combination reduced voltage soft starter—fusible disconnect—S811</td></tr><tr><td>95 = Combination reduced voltage soft starter—circuit breaker—S811</td></tr></table>			Class	90 = Non-combination reduced voltage soft starter—S801	91 = Combination reduced voltage soft starter—fusible disconnect—S801	92 = Combination reduced voltage soft starter—circuit breaker—S801	93 = Non-combination reduced voltage soft starter—S811	94 = Combination reduced voltage soft starter—fusible disconnect—S811	95 = Combination reduced voltage soft starter—circuit breaker—S811																																
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General Description

Table 30.5-2. Solid-State Product Comparison

Description	S801 Soft Starter	S811 Communicating Soft Starter
Maximum current range Start type Operating voltage	1–1000 A Ramp or current limit 200–600 Vac	1–1000 A Ramp or current limit 200–600 Vac
Operating frequency Control voltage Kick start	47–63 Hz 24 Vdc 0–2 seconds adjustable	47–63 Hz 24 Vdc 0–2 seconds adjustable
Ramp time range Initial torque setting Current limit setting	0.5–180 seconds 0%–85% 0%–550%	0.5–180 seconds 0%–85% 0%–550%
Soft stop Pump control option Overtemperature protection	0–60 seconds Yes Yes	0–60 seconds Yes Yes
Overload Overload setting Trip class setting Phase loss/unbalance Jam Stall Phase reversal	Yes 30%–100% 5, 10, 20 and 30 Yes Yes Yes Yes	Yes 30%–100% 5, 10, 20 and 30 Yes Yes Yes Yes
Jog Extended start LED status indication LED fault indication	Yes Yes Yes Yes	Yes Yes LCD—Yes LCD—Yes

Table 30.5-3. Application and Environmental Considerations

The installation environment for a solid-state reduced voltage starter is of a prime concern. Conditions such as ambient temperature, altitude and the presence of corrosives or moisture must all be considered when choosing the appropriate starter size and enclosure type.

Description	S801 Soft Starter	S811 Communicating Soft Starter
Temperature—operating (No derating) Current rating (50 °C) Limited duty cycle (50 °C)	–25° C to +40 °C 100% Fully rated	–30 °C to +50 °C 100% Fully rated
Current rating (60 °C) Limited duty cycle (60 °C) Temperature—storage Altitude (meters)	10% reduction Continuous duty cycle at 90% –40 °C to +70 °C 2000	Consult factory Consult factory –50 °C to +70 °C 2000

Note: Consult factory for applications outside of these parameters for additional information and sizing requirements.

General Description

Multi-Motor Operation

The S801/S811 line can be used to control multiple motors if the following conditions are met:

- The current rating of the S801/S811 should be equal to or greater than the total of the individual motor full load amperes and the S801/S811 overload must be set for the cumulative full load amperes of the motors
- Individual motor overcurrent protection is provided by other devices
- The motors should not be mechanically coupled together, i.e., two motors on same shaft
- NEC and local code requirements for individual motor protection and branch short circuit protection are met
- Motors are closely matched in total load and size

Frequent Starting/Stopping

The number of starts and stops allowable depends upon many factors. The most important ones are:

1. Set level of the starting current limit
2. Start time
3. Run time
4. Off time before next start

The number of starts per hour is based on the current carrying capacity of the SCRs. A high start/stop duty may require the oversizing of a soft starter. If a high number of multiple starts occur, the starter may trip due to the overload protection for the motor or it may trip on overtemperature of the soft starter. In this situation, it is advisable to wait a period of 10 minutes before restarting to avoid damage to the soft starter and motor and allow the units to cool down. The motor manufacturer should be consulted about the effect of a high number of multiple starts on motor life.

Starting Torque

The reduced voltage applied to the motor results in reduced inrush current and a soft start. However, it reduces the starting torque of the motor. The relationship is as follows:

$$\frac{\text{Torque at reduced current}}{\text{Torque at full current}} =$$

$$\frac{\text{Current at reduced voltage}^2}{\text{Current at full voltage}}$$

EXAMPLE: A 100 hp, 1800 RPM, 460 V NEMA B motor draws six times full load amperes for starting, and starting torque is 150% of full load torque.

If the same motor were started with the S801 at 300% current limit, then the available torque would be:

$$\frac{300^2}{600} = \frac{90,000}{360,000} =$$

$$1/4 \times 150\% \text{ full load torque} =$$

$$37.5\% \text{ full load torque available}$$

Heat Generation

Due to the voltage drop that occurs across a SCR, there is heat generated in the unit. For sizing an enclosure or box size for the soft starters, it is important to account for this heat generation.

The S801/S811 lines use a bypass contactor, so heat generation is minimized. During steady-state conditions, it generates about the same amount of heat as an across-the-line starter of the same size. During start and stopping ramps it will generate three watts of heat per ampere.

EXAMPLE: A 100 hp, 480 V NEMA B motor has a full load current of 125 amperes. A typical soft start on this motor is 300% current limit for 40 seconds. The heat generation during this time period is:

$$125 \text{ amperes} \times 300\% = 375 \text{ watts for 40 seconds}$$

At the end of the ramp, the bypass contactor closes and total heat generation is reduced to much lower levels.

NEMA Design C and D Motors, Wound Rotor Motors

These motors are used due to their high starting torque characteristics. When high starting currents and high starting torques are required, it may be necessary to order the extended ramp option and oversize the soft starter to match the application requirements. Consult the factory for application considerations.

General Description

Solid-State Reduced
Voltage Starters

Enclosed Box Selection

Table 30.5-4. Non-combination Solid-State
Reduced Voltage

Rating	SSRV	Non-combination Box No. ①
37 A	S801/S811	7A
66 A	S801/S811	7A
105 A	S801/S811	7A
135 A	S801/S811	B1
180 A	S801/S811	C
240 A	S801/S811	②
304 A	S801/S811	②
360 A	S801/S811	②
420 A	S801/S811	10
500 A	S801/S811	10
650 A	S801/S811	10
720 A	S801/S811	10
850 A	S801/S811	10
1000 A	S801/S811	10

① Enclosure space will also accommodate for an DC Power Supply, two four-pole relays, CPT, and terminal blocks. Also includes space for a DNA module or MOV.

② Contact Eaton for Box Dimensions not shown in PG03300001E.

Note: All Type 7 and 9, see PG03300001E.

Table 30.5-5. Combination Solid-State
Reduced Voltage

Rating	SSRV	Comb. with Fuses Box No. ③	Comb. with HMCP Box No. ③
37 A	S801/S811	B1	A1 ④
66 A	S801/S811	C	A1
105 A	S801/S811	D	B1
135 A	S801/S811	D	C
180 A	S801/S811	E	E
240 A	S801/S811	F1E	E
304 A	S801/S811	F1E	E
360 A	S801/S811	F1E	E
420 A	S801/S811	F1E	E
500 A	S801/S811	F1E	E
650 A	S801/S811	F1E	F1E
720 A	S801/S811	F1E	F1E
850 A	S801/S811	F1E	F1E
1000 A	S801/S811	F1E	F1E

③ Enclosure space will also accommodate for an DC Power Supply, two four-pole relays, CPT, and terminal blocks. Also includes space for a DNA module or MOV.

④ Same as footnote ③, but CPT is not included. Upsize to B1 enclosure to include space for a CPT and a full voltage bypass contactor.

**For enclosure box dimensions,
refer to Page 30.6-3.**

S801 Solid-State Reduced Voltage Starter

S801 Solid-State Reduced Voltage Soft Starter



S801 Reduced Voltage Soft Starters

General Description

Eaton's S801 line of reduced voltage soft starters is very compact, multi-functional, easy-to-install and easy-to-program. Designed to control acceleration and deceleration of three-phase motors, the line is available in current ranges from 12 to 1000 A and is suitable for mounting in motor control centers or in enclosed control (NEMA 1, 4, 4X and 12) applications.

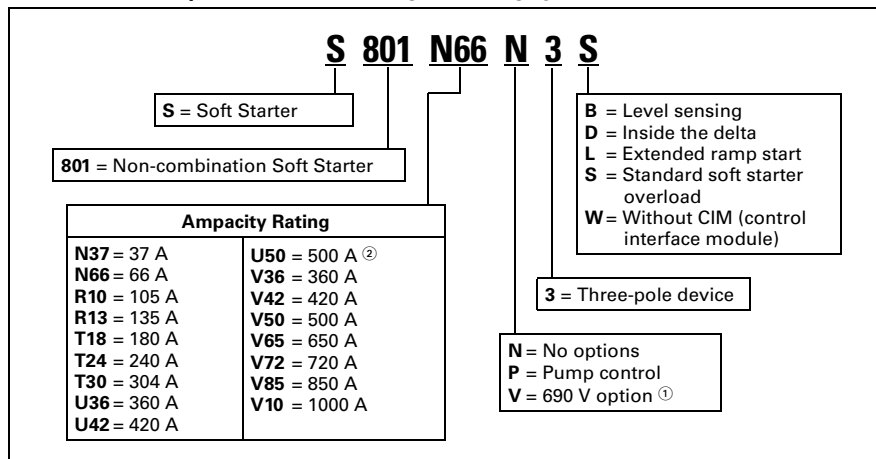
This product line is designed to compete head-to-head with the high-end soft starter market, offering improved performance and dramatically smaller size versus the competition. By having the over-load functionality and bypass contactors built into the unit, it reduces the amount of wiring required during installation and offers huge space savings in the panel or enclosure. The product is also designed to be small enough to replace an existing across-the-line starter (NEMA or IEC) in the existing enclosure. This allows customers to upgrade their existing motor control centers and enclosed control by replacing the starter they have today with a soft starter, gaining the benefits of lower utility charges, longer component life and less stress on products and material systems. This size benefit allows users to save the expense of replacing the existing structure or adding a new one to house a much larger soft starter.

Application Description

The S801 line uses a total of six SCRs to control the motor (three matched pairs). The unit has a built-in overload

Catalog Number Selection

Table 30.5-6. S801 Open Soft Starters Catalog Numbering System



^① Not available on U-Frame.

^② U-Frame 500 A unit does not have IEC Certification.

that is adjustable from 30% to 100% of rating and can be set for Trip Class 5, 10, 20 or 30. It also provides additional protection for jam, stall, phase reversal, phase loss, overtemperature, under-voltage and so on. Along with the overload, the unit has a built-in run bypass contactor. This device is closed when the soft starter is up to speed providing a low impedance bypass for the SCRs and significantly reducing the amount of heat that is generated in the soft starter.

The S801 is designed to work with three-phase motors in a delta (three-lead) configuration. The S801 works with all motors from fractional horsepower up to motors requiring 1000 A of steady-state current. The built-in overload (in ranges from 12 to 1000 A) and run bypass contactor makes installation and setup quick and easy. The overload also offers some advanced protective functions to give additional motor protection.

With the pump control option, it is the number one soft starter available for pumping applications. The unique soft stopping control provides a smooth transition for stopping a motor and eliminating the "water-hammer" effect that can damage pipes, valves and pumps.

Features

- Built-in overload protection:
 - 30%–100% adjustment range
 - Trip Class 5, 10, 20 and 30
 - Jam

- Stall
- Phase reversal
- Phase loss/unbalance
- Shorted SCR detection
- Overtemperature
- Selectable ramp or current limit start.
- Kick Start:
 - Adjustable from 0%–85% initial torque
 - 0–2.0 seconds adjustment time
- Ramp Start:
 - Adjustable from 0%–85% initial torque
 - 0.5–180 seconds adjustment time
- Current Limit Start:
 - Adjustable from 0%–550% FLA
 - 0.5–180 seconds adjustment time
- Soft Stop:
 - Adjustable from 0%–60 seconds
- Built-in run bypass contact
- 24 Vdc control
- IP20 finger protection
- Optional pump control

Standards and Certifications

- IEC 947 compliant
- EN 60947-4-2
- CE marked
- CSA certified
- UL listed

S801 Enclosed Soft Starter



Enclosed S801 Soft Starter

General Description

24 Vdc Control—S801 soft starters superiority begins with the control package that features 24 Vdc control running a digital signal processor, or DSP, and using a low impedance run circuit, all of which contribute to the S801 soft starter's safety, advanced functionality and compact size.

Built-in Overload Protection—With most wye-delta starters, many of the advanced features of the S801 are functions that must be added at the expense of cost and space. The S801 soft starter, for example, has built-in overload protection (overloads must be added to wye-delta starters). So, S801 soft starters are more compact, easier to wire and less costly than their wye-delta counterparts.

Reduced Power Consumption—The S801 soft starter costs less in terms of power consumption. An S801 soft starter also reduces line brown-outs and decreases overall energy usage. For example, an S801 soft starter controls peak power demand while a full-voltage starter can apply 600–800% FLA on startup.

Lower Starting Torque—System cost savings are significant with an S801 soft starter versus a full voltage starter. With an S801 soft starter, mechanical components can have longer life or be reduced in size because of lower starting torque values (250–500% FLA current with SSRV).

Fewer Mechanical Problems—Because an S801 soft starter reduces stress on a system by eliminating the jolts and violent speed variations that full-voltage starters introduce to a process, fewer mechanical breakdowns occur, improving the quality of the product and process.

Features and Benefits

- **Longer Life of System Equipment** — With the impressive list of control and protective functions, this new line of products is designed to significantly increase the protection it offers to system equipment (e.g., motors, belts, pumps and so on). The benefit of increased system equipment protection is longer life and longer system equipment uptime
- **Reduced Power Draw**—Power control features like Ramp Start, Current Limit Start and Jog Forward provide maximum flexibility in selecting start profiles, minimizing both mechanical and electrical stress while maximizing motor performance
- **Improved Safety**—S801 soft starters offer fingerproof deadfront construction, reducing the chance of electrical shock. With the use of 24 Vdc control power, pilot devices and relays can be operated more safely

- **System Cost Savings**—With improved reliability, longer life of system equipment, reduced power draw, space savings and improved safety, you enjoy the benefit of a significant improvement in system uptime and a reduction in system downtime resulting in overall system cost saving
- **Time Savings**—Time savings in using S801 soft starters are achieved through a quick and easy setup procedure, user-friendly operational design, the longer life of system equipment and improved safety
- **Productivity**—Overall, S801 soft starters significantly improve your productivity by saving you time and money. This is demonstrated by longer product life, longer runs between breakdowns and the ease of installation and operation

Standards and Certifications

Enclosed Control

- UL 508
- IEC 947-4-2
- EN 60947.2
- CE marked EMC/LV directives
- CSA-22.2

Schematic Diagram

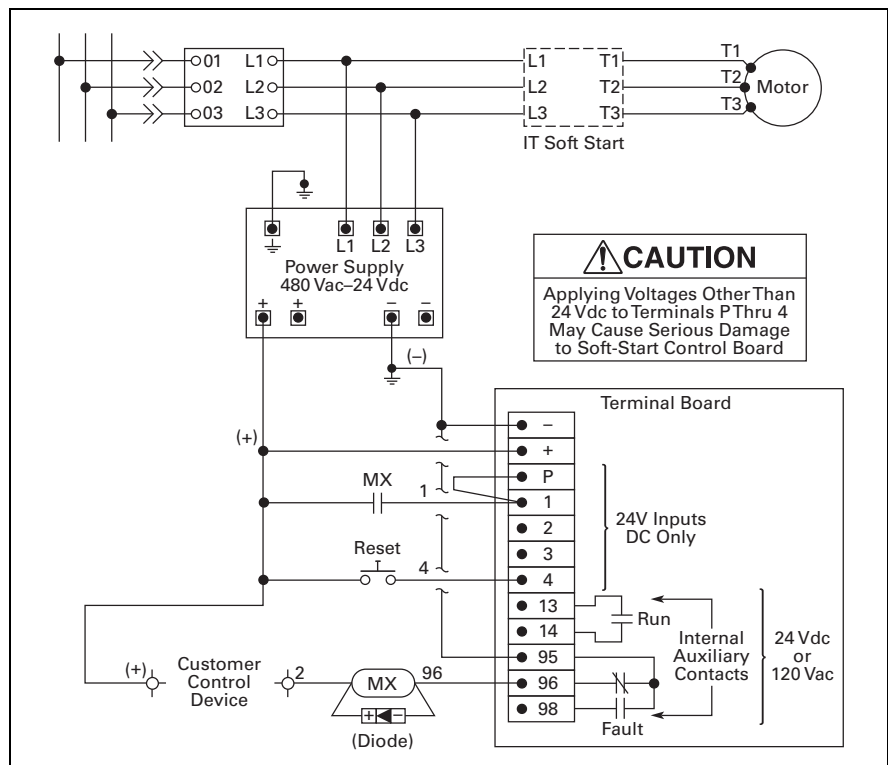


Figure 30.5-1. Wiring Diagram

S801 Solid-State Reduced Voltage Starter

Technical Data and Specifications

Base Ratings

Table 30.5-8 below is the base ratings for the S801 soft starter. The tables included in this catalog are meant to be a selection table for different applications, but to match a unit to your exact application, consult with your local Eaton representative or visit our Web site at www.eaton.com/electrical.

Table 30.5-7. Standard-Duty Ratings

Starting Method	Ramp Current % of FLA	Ramp Time Seconds	Starts per Hour	Ambient Temperature
vs. Soft start	300%	30	3	50°C
vs. Full voltage	500%	10	3	50°C
vs. Wye-delta	350%	20	3	50°C
vs. 80% RVAT	480%	20	2	50°C
vs. 65% RVAT	390%	20	3	50°C
vs. 50% RVAT	300%	20.	4	50°C

Table 30.5-8. Standard-Duty Rating Open Soft Starters

Frame Size	Maximum Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hz)			hp Rating (60 Hz)								
		230	380–400	440	200 V		230 V		460 V		575 V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	37 66	10 18.5	18.5 30	18.5 37	10 20	10 15	10 20	10 20	25 50	20 40	30 60	30 50	S801N37N3S S801N66N3S
R	105 135	30 40	55 63	59 80	30 40	25 30	40 50	30 40	75 100	60 75	100 125	75 100	S801R10N3S S801R13N3S
T	180 240 304	51 75 90	90 110 160	110 147 185	60 75 100	50 60 75	60 75 100	60 75 100	150 200 250	125 150 200	150 200 300	150 200 250	S801T18N3S S801T24N3S S801T30N3S
U	360 420 500	110 129 150	185 220 257	220 257 300	125 150 150	100 125 150	150 175 200	125 150 150	300 350 400	250 300 350	350 450 500	300 350 450	S801U36N3S S801U42N3S S801U50N3S ①②
V	360 420 500 650 720 850 1000	110 129 150 200 220 257 315	185 220 257 355 400 475 560	220 257 300 425 450 500 600	125 150 150 250 — — —	100 125 150 200 — — —	150 175 200 250 300 350 400	125 150 150 200 250 300 350	300 350 400 500 600 700 800	250 300 350 450 500 600 700	350 450 500 600 700 900 1000	300 350 450 500 600 700 800	S801V36N3S S801V42N3S S801V50N3S S801V65N3S S801V72N3S S801V85N3S S801V10N3S

① 15 sec. start, 300% inrush, 40 °C, 1 start every 15 minutes. If these start parameters are exceeded, please refer to 290 mm V-Frame, 500 A starter.

② U-Frame 500 A does not have IEC Certification.

Severe-Duty Ratings

Motor applications and customer needs come in many different varieties. With the standard and severe duty rating tables, we have attempted to provide guidelines on what the S801 soft starter is capable of. If the application falls under these categories, you can use these charts. For other applications, or when a question arises, contact Eaton Corporation to assist you in selecting the proper soft starter.

Table 30.5-9. Severe-Duty Ratings

Starting Method	Ramp Current % of FLA	Ramp Time Seconds	Starts per Hour	Ambient Temperature
vs. Soft start	450%	30	4	50 °C
vs. Full voltage	500%	10	10	50 °C
vs. Wye-delta	350%	65	3	50 °C
vs. 80% RVAT	480%	25	4	50 °C
vs. 65% RVAT	390%	40	4	50 °C
vs. 50% RVAT	300%	60	4	50 °C

Table 30.5-10. Severe-Duty Rating Open Soft Starters

Frame Size	Maximum Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hz)			hp Rating (60 Hz)								
		230	380-400	440	200 V		230 V		460 V		575 V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	22 42	5.5 11	10 18.5	11 22	5 10	5 10	7-1/2 15	5 10	15 30	10 25	20 40	15 30	S801N37N3S S801N66N3S
R	65 80	15 22	30 40	33 45	15 25	15 20	20 30	15 25	50 60	40 50	50 75	50 60	S801R10N3S S801R13N3S
T	115 150 192	33 45 55	59 80 100	63 90 110	30 50 60	30 40 50	40 50 75	30 50 60	75 100 150	75 100 125	100 150 200	100 125 150	S801T18N3S S801T24N3S S801T30N3S
U	240 305 365	75 90 110	110 160 185	147 185 220	75 100 125	60 75 100	75 100 150	75 100 125	200 250 300	150 200 250	200 300 350	200 250 300	S801U36N3S S801U42N3S S801U50N3S ③
V	240 305 365 420 480 525 600	75 90 110 129 147 160 185	110 160 185 220 257 280 315	147 185 220 257 295 335 375	75 100 125 150 150 150 200	60 75 100 125 150 150 150	75 100 150 150 200 200 250	75 100 125 150 150 150 200	200 250 300 350 400 450 500	150 200 250 300 350 500 450	200 300 350 450 500 500 600	200 250 300 350 450 450 500	S801V36N3S S801V42N3S S801V50N3S S801V65N3S S801V72N3S S801V85N3S S801V10N3S

③ U-Frame 500 A unit does not have IEC Certification.

S801 Solid-State Reduced Voltage Starter

Features

- Able to fit in place of existing starters
- Smallest unit on the market today
- Very easy to install, wire and program
- Reduces initial torque on motor and loads
- Able to control the maximum inrush current

Benefits

- Reduced wear on belts, gears, chains, clutches, shafts and bearings
- Allows for controlling the inrush current to the motor and reducing electrical charges due to peak energy demand
- Reduced inrush current leads to more stable power grid and can lower peak demand charges

- Elimination of water-hammer, which can reduce installed cost of pipe hangers and extend existing system life
- Less shock to product on conveyor lines and material handling gear
- 24 Vdc control enhances personnel and equipment safety

Table 30.5-11. Technical Data

Soft Starter (Partial Catalog Number)	S801 N37	S801 N66	S801 R10	S801 R13	S801 T18	S801 T24	S801 T30	S801 U36	S801 U42	S801 U50 ①	S801 V36	S801 V42	S801 V50	S801 V65	S801 V72	S801 V85	S801 V10
Maximum current capacity	37	66	105	135	180	240	304	360	420	500	360	420	500	650	720	850	1000
Dimensions in Inches (mm)																	
Width	2.60 (66.1)		4.38 (111.3)		7.65 (194.3)			7.73 (196.3)			11.04 (280.4)						
Height	7.38 (187.4)		7.92 (201.2)		12.71 (322.8)			12.72 (323.1)			16.57 (420.9)						
Depth	6.63 (168.4)		7.03 (178.6)		6.69 (169.9)			7.08 (179.9)			7.69 (195.3)						
Weight in lb (kg)	5.80 (2.6)		10.50 (4.8)		48.00 (21.8) — with lugs 41.00 (18.6) — without lugs			48.00 (21.8) — with lugs 41.00 (18.6) — without lugs			103.00 (46.0) —with lugs 91.00 (41.4) —without lugs						
General Information																	
Bypass mechanical lifespan	10 M																
Insulating voltage (Ui)	660 V																
Ramp time range	0.5–180 seconds (0.5–360 seconds extended ramp)																
Resistance to vibration	3g																
Resistance to shock	15g																
Electrical Information																	
Operating voltage	200–600 V																
Operating frequency	47–63 Hz																
Overload setting	30%–100%																
Trip class	5, 10, 20 and 30																
Cabling Capacity (IEC 947)																	
Number of conductors	1		1		1 or 2			—		—		—		2, 4 or 6			
Wire sizes	14–2		14–4/0		2/0 to 500 kcmil			—		—		—		2/0 to 500 kcmil			
Type of connectors	Box lug		Box lug		Add-on lug kit			—		—		—		Add-on lug kit			
Control Wiring (12-Pin)																	
Wire sizes in AWG	22–14																
Number of conductors (stranded)	2 (or one AWG 12)																
Torque requirements in lb-in.	3.5																
Solid, stranded or flexible	3.31																
maximum size in mm ²																	
Control Power Requirements																	
Voltage range (24 V ± 10%)	21.6–26.4							—		—		—		21.6–26.4			
Steady state current amperes	1.0							—		—		—		1.4			
Inrush current amperes	10							—		—		—		10			
Ripple	1%							—		—		—		1%			
Relays (1) Class A and C																	
Voltage AC—maximum	240																
Voltage DC—maximum	120																
Amperes—maximum	3																
Environment																	
Temperature—operating	–30 °C to +50 °C (no derating) consult factory for operation >50 °C																
Temperature—storage	–50 °C to +70 °C																
Altitude	<2000 m—consult factory for operation >2000 m																
Humidity	<95% noncondensing																
Operating position	Any																
Pollution degree (IEC 947-1)	3																
Impulse withstand voltage (IEC 947-4-1)	4000 V																

① U-Frame 500 A unit does not have IEC Certification.

S811 Solid-State Reduced Voltage Starter

S811 Solid-State Reduced Voltage Soft Starters



S811 Soft Starter

General Description

The S811 from Eaton offers all the popular features of the S801, but adds enhanced functionality with the new DIM (Digital Interface Module) and communications capabilities.

The S811 reduced voltage soft starter is very compact, multi-functional, easy to install and easy to program. Designed to control the acceleration and deceleration of three-phase motors up to 690 V, the line is available from 11 A through 1000 A.

The S811 is designed to be a complete package combining the SCRs, bypass contactor and overload in one, very compact unit. The S811 is available as a component for panel mounting, in motor control centers or in enclosed control (NEMA Type 1, 3R, 4, 4X, 7/9 and 12).

Application Description

Designed to control the acceleration and deceleration of three-phase motors, the S811 soft starter uses silicon controlled rectifiers (SCRs) to control the voltage to soft start and soft stop the motor. After the motor is started, internal run bypass contactors close, resulting in the motor running directly across-the-line. The built-in solid-state overload protects the motor from overload conditions with sophisticated algorithms that model true motor heating, resulting in better motor protection and fewer nuisance trips. Advanced protective and diagnostic features reduce downtime.

A voltage ramp start or current limit start is available. Kick start is available in either starting mode. The soft stop option allows for a ramp stop time that is longer than the coast to stop time. The pump control option provides a smooth transition for starting and

stopping a motor and eliminating the “water-hammer” effect that can damage pipes, valves and pumps.

The S811 offers an impressive array of advanced protective features. Not only are the protective features selectable, but many offer variable settings allowing the user to fine-tune the starter to meet specific system requirements.

The S811 has an easy to use Digital Interface Module (DIM) that allows the user to configure the device and to read system parameters. The DIM includes an LCD display and keypad to scroll through the various menus. The DIM allows the user to modify control parameters, enable or disable protections, set communication variables, monitor system parameters such as line voltages and currents, and access the fault queue.

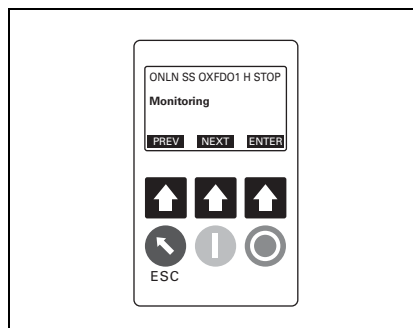


Figure 30.5-2. Digital Interface Module (DIM)

The DIM can be removed from the S811 and remote mounted. Kits are available to door mount the DIM, enabling users to safely configure, commission, monitor and troubleshoot the system at the electrical panel without opening the enclosure door.

The S811 has built-in communications capabilities that enable the soft starter to be connected to a variety of networks, including DeviceNet™, Ethernet, Modbus® and PROFIBUS. Multiple control components can be connected to one Eaton gateway that concentrates data from the devices into a single node. Configuration is simple—a single press of the gateway's Auto Configuration button sets the system up for default operation. This automatically configures the I/O assemblies to the system devices.

The data from these devices are then assembled into a single input and output messages.

The S811 communication parameters can be configured with the DIM or through the network using CH Studio Component Manager.

Advanced communication configuration settings provide the system integrator with powerful tools to facilitate system optimization.

Features and Benefits

- The DIM provides an intuitive, easy-to-use human interface with powerful configuration capabilities to maximize system performance
- Door or device mounted DIM enables users to safely configure, commission, monitor and troubleshoot the system at the electrical panel without opening the enclosure door
- System operating parameters can be monitored enterprise-wide through a communications network. Increase uptime by providing data for process management and preventive diagnostics
- Run bypass mode greatly reduces internal heating created by the greater power dissipation in the SCRs. Bypass contactor directly connects the motor to the line and improves system efficiency by reducing internal power losses
- Internal solid-state overload protection provides accurate current measurement and trip settings. Sophisticated algorithms solve a series of differential equations that model true motor heating and cooling, resulting in superior motor overload protection while minimizing nuisance trips. Advanced selectable protective features safeguard the motor and system against a variety of system faults
- Internal run bypass contactors and overload protection eliminate the need for additional devices, reducing enclosure sizes, minimizing installation and wiring time and reducing overall assembly size and cost
- Wide range of overload FLA settings (31–100% of rated current) and a selectable trip class (5–30) offers users the flexibility to fine-tune the starter to match specific application requirements

S811 Solid-State Reduced Voltage Starter

- Variable ramp times and torque control settings provide unlimited starting configurations, allowing for maximum application flexibility
- Kick-start feature enables soft starting of high friction loads
- Soft stop control for applications where an abrupt stop of the load is not acceptable
- Pump control option with sophisticated pump algorithms on both starting and stopping that minimize the pressure surges that cause water hammer. The pump control option will maximize the life of the pump and piping systems while minimizing the downtime caused by system failure
- Six SCRs control all three motor phases, providing smooth acceleration and deceleration performance
- Soft acceleration and deceleration reduces wear on belts, gears, chains, clutches, shafts and bearings
- Reduce the peak inrush current stress on the power system
- Minimize peak starting torque to diminish mechanical system wear and damage
- 24 Vdc control module enhances personnel and equipment safety.
- Removable, lockable control terminal block reduces maintenance costs. Also provides the opportunity for OEMs to reduce assembly and test costs by using pre-assembled wire harnesses

Protective Features

All protective features can be configured, enabled or disabled with the DIM or through the communications network.

Motor Overload

The S811 includes electronic overload protection as standard. The overload meets applicable requirements for a motor overload protective device. The overload protects the motor from over heat conditions with the use of sophisticated algorithms that model true motor heating, resulting in superior motor protection and fewer nuisance trips.

The S811 calculates a thermal memory value. A 100% value represents the maximum safe temperature of the motor. When the thermal memory value reaches 100%, an overload trip will occur removing power to the motor. Upon trip, the S811 stores the calculated motor heating value and will not allow a motor re-start until the motor has sufficiently cooled. This feature ensures the motor will not be

damaged by repeated overload trip, reset and re-start cycles.

The thermal memory value can be monitored through the DIM or the communications network. The thermal memory value can be of great use in determining an impending overload trip condition. Alarms can be implemented in the process monitoring system warning of an impending trip before a trip occurs halting the process. Costly system downtime can be avoided.

The trip current is adjusted to match the specific application requirements by entering the motor nameplate full load current rating and trip class. The FLA adjustment includes a 3 to 1 adjustment range. The overload trip class is adjustable from class 5 through class 30. The overload is ambient temperature compensated—meaning its trip characteristics will not vary with changes in ambient temperature. The overload protection can be enabled, disabled, or disabled on start.

Short Circuit

The use of a short-circuit protective device in coordination with the S811 is required in branch motor circuits by most electrical codes. Short-circuit coordination ratings with both fuses and Eaton's molded case circuit breakers are available providing customers with design flexibility. The S811 has short circuit coordination ratings as an open component, an enclosed starter, and in a motor control center.

Jam

Excessive current and torque up to locked rotor levels can occur in a jam condition. The condition can result in stress and damage to the motor, load, mechanical system, and the electrical distribution system. Jam protection prevents the stress and damage from a jam during normal run. After the motor is started, a current greater than 300% FLA setting will cause the starter to trip on a jam fault.

Stall

Excessive current and torque up to locked rotor levels can occur in a stall condition. The condition can lead to an overload trip and result in stress and damage to the motor, load, mechanical system, and the electrical distribution system. Stall protection prevents stress and damage to a motor that has not come up to speed, or stalled after the soft start time. The S811 will trip to protect the system in the event that the

motor did not get to the rated speed in the defined soft start period. A current greater than 200% FLA at the end of the soft start period will cause the starter to trip on a stall fault.

Pole Over Temperature

High ambient temperatures, extended ramp times and high duty cycle conditions may cause the S811 power pole conductors to reach a temperature that exceeds their thermal rating. The S811 is equipped with sensors that monitor the temperature of the power poles. Over temperature protection occurs if the device's thermal capacity is exceeded. The soft starter will trip in over temperature conditions, preventing device failure.

The device pole temperature value can be monitored through the DIM or the communications network. This feature can be of use in determining an impending over temperature trip condition. Alarms can be implemented in the process monitoring system warning of an impending trip before a trip occurs, halting the process. Costly system shutdown can be avoided.

Phase Loss

Loss of a phase can cause a significant increase in the current drawn in the remaining two phases. Phase loss can lead to motor damage before an eventual overload trip occurs. Phase loss is typically an indication of a failure in the electrical distribution system. The S811 will detect a phase loss and trip if any phase current drops below a preset value. The phase loss trip level is adjustable from 0% to 100% of the average of the other two phase levels with an adjustable trip delay of 0.1 to 60 seconds.

Phase Imbalance

Phase current or voltage imbalance can cause a significant increase in the current drawn in the remaining two phases. Phase imbalance can lead to motor damage before an eventual overload trip. Phase imbalance is typically an indication of a failure in the electrical distribution system or the motor. The S811 will detect both current and voltage phase imbalances and trip if any phase becomes imbalanced as compared to the average of the other two phases.

The phase current imbalance trip level is adjustable from 0% to 100% of the average of the current in the other two phases with an adjustable trip delay of 0.1 to 60 seconds.

S811 Solid-State Reduced Voltage Starter

The phase voltage imbalance trip level is adjustable from 0% to 100% of the average of the voltage in the other two phases with an adjustable trip delay of 0.1 to 60 seconds.

Reset Mode

The S811 can be set up for automatic or manual reset on trip. The manual reset mode requires the operator to physically press the RESET button located on the soft starter. The overload can be manually reset through the DIM or through the communications network. The overload can also be electrically reset by energizing a 24 Vdc input on the control terminal block.

The automatic reset mode allows the soft starter to be automatically reset as soon as the trip condition is no longer present. With the automatic reset mode, after the fault is no longer present, the motor will be restarted as soon as a valid start signal is present.

Phase Reversal

The S811 can determine if the proper line phase sequence is present by default. The device will trip if the line phase sequence is something other than A-B-C. The S811 can be configured to operate under reversed phase conditions (A-C-B).

Shorted SCR Detection

The S811 monitors the operation of the power poles and will trip under a shorted SCR condition.

Open SCR Detection

The S811 monitors the operation of the power poles and will trip under an open SCR condition.

Low Current

Low current conditions can be a result of a loss of load or a failure in the mechanical system. The S811 has low current protection that will trip if the average rms current falls below a preset value. The low current protection can be programmed as a percent of motor FLA from 0% to 100%.

Low Voltage

Low voltage conditions can result from disturbances in the electrical power distribution system. Low voltage conditions can cause a malfunction and damage to electrical equipment. The S811 has low voltage protection that will trip if the average rms voltage falls below a preset value. The low voltage protection can be programmed as a percent of nominal voltage from 1% to 99% with a trip delay of 0.1 to 60 seconds.

High Voltage

High voltage conditions can result from disturbances in the electrical power distribution system. High voltage conditions can cause malfunctions or failures of electrical equipment. The S811 has high voltage protection that will trip if the average rms voltage is greater than a preset value. The high voltage protection can be programmed as a percent of nominal voltage from 101% to 120% with a trip delay of 0.1 to 60 seconds.

Monitoring Capabilities

The S811 has an impressive array of system monitoring capabilities that allow users to access real time process and diagnostic data. This data can be viewed at the device with the DIM or through a communications network. Data over a communications network can provide valuable insight into the condition of the equipment and processes. Maintenance and production personnel can monitor critical operational and maintenance data from a central control station that can be located far away from the production facility. Process data can be monitored to determine system anomalies that may indicate a need for preventive maintenance or an impending failure. Adjustments made through the communications network can reduce costs by minimizing the time traveling to the location where the motor controls are located. When faults do occur, real time fault data can assist maintenance in troubleshooting and planning repair resources. Remote reset signals can be given to tripped devices without the need for manual intervention by maintenance personnel.

Average Line Current

Provides the average of the three-phase rms line currents in amps, accurate to within 2%. Current data can be used to indicate a need for maintenance. Increased currents in a fixed load application can indicate a reduction in system efficiencies and performance, signifying system maintenance is due.

Average Pole Current

Provides the average of the three-phase rms pole currents in amps, accurate to within 2%. The pole current is the current through the soft starter. The line and pole current will be identical in in-line applications, and will differ in inside-the-delta applications.

Average line current as a % FLA

Provides the average rms line current as a percentage of the S811 FLA setting.

Three-Phase Line Currents

Provides three rms phase line currents in amps, accurate to within 2%. Imbalances or changes in the relative phase current to one another can indicate anomalies in the motor or electrical distribution system.

Three-Phase Pole Currents

Provides three rms phase pole currents in amps, accurate to within 2%. The pole current is the current through the soft starter. The line and pole current will be identical in in-line applications, and will differ in inside-the-delta applications.

Three-Phase Line Voltages

Provides the individual rms three-phase line voltages. Imbalances or changes in the relative phase voltage to one another can indicate anomalies in the motor or electrical distribution system. Voltage can be used to monitor electrical distribution system performance. Warnings, alarms and system actions to low or high voltage conditions can be implemented.

Percent Thermal Memory

Provides the real time calculated thermal memory value. The S811 calculates thermal memory value. A 100% value represents the maximum safe temperature of the motor. When the thermal memory value reaches 100%, an overload trip will occur, removing power to the motor.

The thermal memory value can be of great use in determining an impending overload trip condition. Alarms can be implemented in the process monitoring system warning of an impending trip before a trip occurs, halting the process. Costly system downtime can be avoided.

DC Control Voltage

Monitors level of the 24 Vdc control voltage. Fluctuations in control voltage can cause component malfunction and failure. System control voltage data can be used to implement warnings, alarms and system actions to low or high voltage conditions.

S811 Solid-State Reduced Voltage Starter

Pole Temperature

Increases in pole temperature are caused by increases in ambient temperature, start/stop times and start duty cycles. Changes in pole temperatures represent a change in system operating conditions. Identifying unexpected operating conditions or changes can prompt maintenance and aid in process evaluation activities.

Device Temperature

An increase in device temperature is a strong indication of an increase in ambient temperature. High ambient temperature operation can be identified with the device temperature data. Ambient temperature increases can be due to loss of enclosure cooling fans or blocked venting. High ambient temperatures will reduce the life of all electrical equipment in the enclosure.

Start Count

Start count data can be used to monitor system output, schedule preventative maintenance, identify system anomalies and identify changes in system operation.

Diagnostics**Fault Queue**

Current fault and a fault queue containing the last nine system faults can be read through the DIM or communications network. Fault identification can minimize troubleshooting time and cost. The fault queue can be remotely accessed through a communications network to assist in planning maintenance resources. Thirty different faults can be identified by the S811.

Control Status

The S811 provides data that represents system conditions that can be read through the DIM or the communications network. This data identifies the status of the system and the control commands the system is requesting of the S811. This can be used for advanced troubleshooting and system integration activities.

Breaker Status

The S811 has provisions to read and display circuit breaker status. Eaton communicating cover control or other communicating protective device is required to take advantage of this feature.

User Manual

A comprehensive user manual is available and can be downloaded free of charge from www.eaton.com/electrical by performing a document search for MN03902002E.

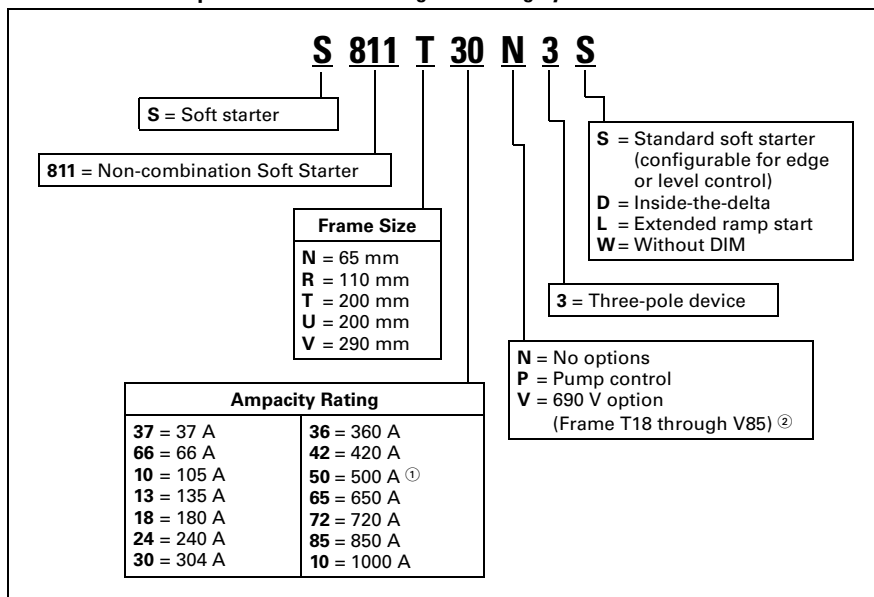
Accessories**Surge Suppressors**

A surge suppressor can mount on either the line or load side of the S811 soft starter. It is designed to clip the line voltage (or load side induced voltage).

**Surge Suppressor****Surge Suppressor Mounted on a 200 mm Device****Table 30.5-12. Surge Suppressors**

Description	Catalog Number
600 V MOV for 65 mm and 110 mm units	EMS38
600 V MOV for 200 mm and 290 mm units	EMS39
690 V MOV for 200 mm and 290 mm units	EMS41

30

Catalog Number Selection**Table 30.5-13. S811 Open Soft Starters Catalog Numbering System**

① U-Frame 500 A unit does not have IEC Certification.

② Not available in U-Frame.

S811 Solid-State Reduced Voltage Starter

Operation

Starting and Stopping Modes

The S811 has a variety of starting and stopping methods to provide superior performance in the most demanding applications. The motor can be started in either Voltage Ramp Start or Current Limit Start mode. Kick Start and Soft Stop are available within both starting modes.

Voltage Ramp Start

Provides a voltage ramp to the motor resulting in a constant torque increase. The most commonly used form of soft start, this start mode allows you to set the initial torque value and the duration of the ramp to full voltage conditions. Bypass contactors close after ramp time.

- Adjustable initial torque 0–85% of locked rotor torque
- Adjustable ramp time 0.5–180 seconds (can be extended with factory modification)

Current Limit Start

Limits the maximum current available to the motor during the start phase. This mode of soft starting is used when it becomes necessary to limit the maximum starting current due to long start times or to protect the motor. This start mode allows you to set the maximum starting current as a percentage of locked rotor current and the duration of the current limit. Bypass contactors close after current limit time.

- Maximum current of 0–85% locked rotor current
- Adjustable ramp time 0.5–180 seconds (can be extended with factory modification)

Kick Start

Selectable feature in both Voltage Ramp Start and Current Limit Start modes. Provides a current and torque “kick” for 0 to 2.0 seconds. This provides greater initial current to develop additional torque to break-away a high friction load.

- 0–85% of locked rotor torque
- 0–2.0 seconds duration

Soft Stop

Allows for a controlled stopping of a load. Used when a stop-time that is greater than the coast-to-stop time is desired. Often used with high friction loads where a sudden stop may cause system or load damage.

- Stop time = 0–60 seconds

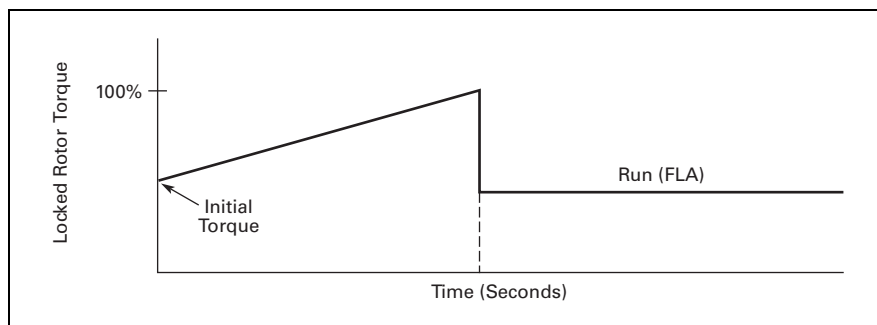


Figure 30.5-3. Starting Characteristics—Ramp Start

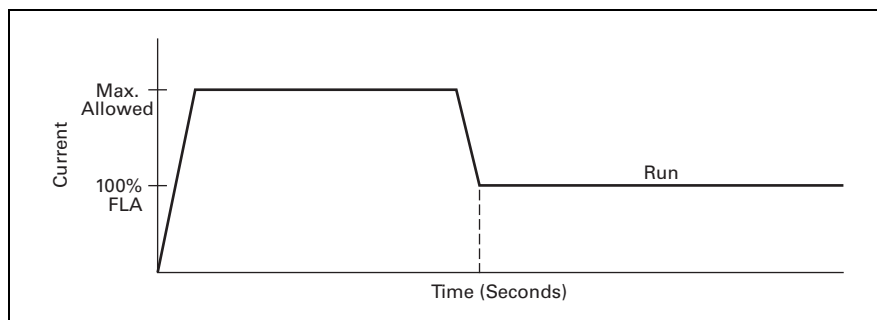


Figure 30.5-4. Starting Characteristics—Current Limit Start

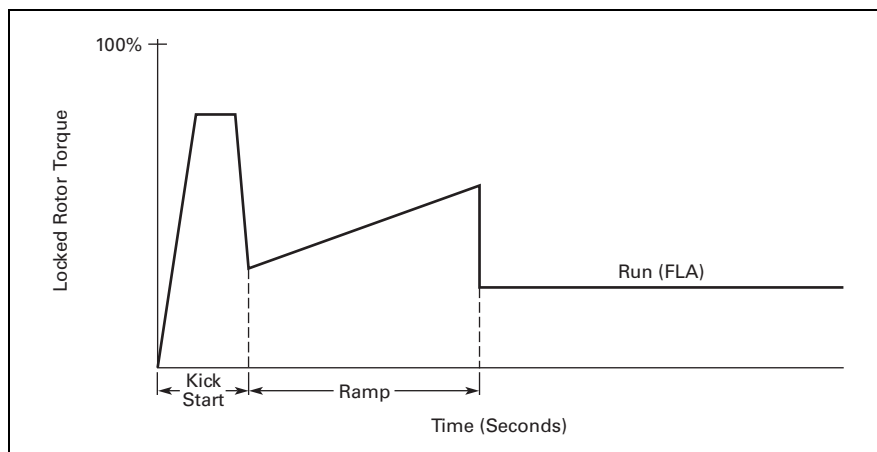


Figure 30.5-5. Starting Characteristics—Kick Start

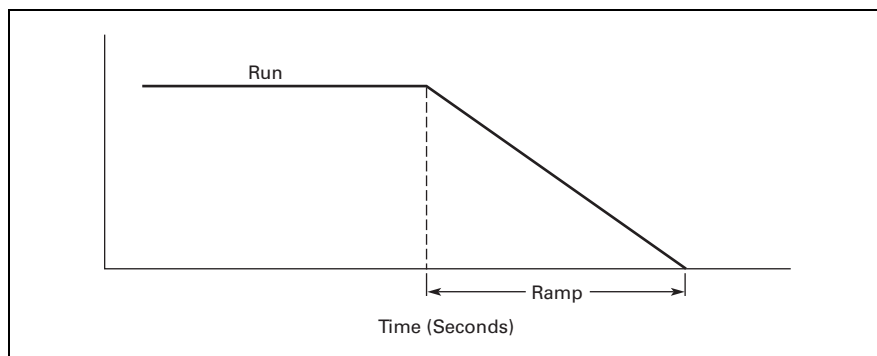


Figure 30.5-6. Starting Characteristics—Soft Stop

S811 Solid-State Reduced Voltage Starter

Product Selection

Motor applications and customer needs come in many different varieties. With the standard and severe duty rating tables, we have attempted to provide guidelines on what the S811 soft

starter is capable of. If the application falls under these categories, you can use these charts. For other applications, or when a question arises, consult with your local Eaton Representative or call our Technical Resource Center at (877) ETN-CARE.

Table 30.5-14. Standard-Duty Ratings

Starting Method	Ramp Current % of FLA	Ramp Time Seconds	Starts per Hour	Ambient Temperature
vs. Soft start	300%	30 sec.	3	50 °C
vs. Full voltage	500%	10 sec.	3	50 °C
vs. Wye-delta	350%	20 sec.	3	50 °C
vs. 80% RVAT	480%	20 sec.	2	50 °C
vs. 65% RVAT	390%	20 sec.	3	50 °C
vs. 50% RVAT	300%	20 sec.	4	50 °C

Table 30.5-15. Product Selection—Standard-Duty Rating Open Soft Starters

Frame Size	Max. Current	Three-Phase Motor												Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)									
		230	380-400	440	200 V		230 V		460 V		575 V			
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF		
N	37 66	10 18.5	18.5 30	18.5 37	10 20	10 15	10 20	10 20	25 50	20 40	30 60	30 50	S811N37N3S S811N66N3S	
R	105 135	30 40	55 63	59 80	30 40	25 30	40 50	30 40	75 100	60 75	100 125	75 100	S811R10N3S S811R13N3S	
T	180 240 304	51 75 90	90 110 160	110 147 185	60 75 100	50 60 75	60 75 100	60 75 100	150 200 250	125 150 200	150 200 300	150 200 250	S811T18N3S S811T24N3S S811T30N3S	
U	360 420 500	110 120 150	185 220 257	220 257 300	125 150 150	100 125 150	150 175 200	125 150 150	300 350 400	250 300 350	350 450 500	300 350 450	S811U36N3S S811U42N3S S811U50N3S ①	
V	360 420 500 650 720 850 1000	110 129 150 200 220 257 315	185 220 257 355 425 450 560	220 257 300 425 450 500 600	125 150 150 250 — — —	100 125 150 200 — — —	150 175 200 250 300 350 400	125 150 150 200 250 300 350	300 350 400 500 600 700 800	250 300 350 450 500 600 700	350 450 500 600 700 900 1000	300 350 450 500 600 700 800	S811V36N3S S811V42N3S S811V50N3S S811V65N3S S811V72N3S S811V85N3S S811V10N3S	

① 500 A rating does not have IEC Certification.

Table 30.5-16. Severe-Duty Ratings

Starting Method	Ramp Current % of FLA	Ramp Time Seconds	Starts per Hour	Ambient Temperature
vs. Soft start	450%	30 sec.	4	50 °C
vs. Full voltage	500%	10 sec.	10	50 °C
vs. Wye-delta	350%	65 sec.	3	50 °C
vs. 80% RVAT	480%	25 sec.	4	50 °C
vs. 65% RVAT	390%	40 sec.	4	50 °C
vs. 50% RVAT	300%	60 sec.	4	50 °C

S811 Solid-State Reduced Voltage Starter
Table 30.5-17. Product Selection—Severe-Duty Rating Open Soft Starters

Frame Size	Maximum Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)								
		230	380–400	440	200 V		230 V		460 V		575 V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	22 42	5.5 11	10 18.5	11 22	5 10	5 10	7-1/2 15	5 10	15 30	10 25	20 40	15 30	S811N37N3S S811N66N3S
R	65 80	15 22	30 40	33 45	15 25	15 20	20 30	15 25	50 60	40 50	50 75	50 60	S811R10N3S S811R13N3S
T	115 150 192	33 45 55	59 80 100	63 90 110	30 50 60	30 40 50	40 50 75	30 50 60	75 100 150	75 100 125	100 150 200	100 125 150	S811T18N3S S811T24N3S S811T30N3S
U	240 305	75 90	110 160	147 185	75 100	60 75	75 100	75 100	200 250	150 200	200 300	200 250	S811U36N3S S811U42N3S
V	240 305 365 420 480 525 600	75 90 110 129 147 160 185	110 160 185 220 257 280 315	147 185 220 257 295 335 375	75 100 125 150 150 150 200	60 75 100 125 150 150 150	75 100 150 150 200 200 250	75 100 125 150 150 150 200	200 250 300 350 400 450 500	150 200 250 300 350 500 600	200 300 350 450 500 500 600	200 250 300 350 450 450 500	S811V36N3S S811V42N3S S811V50N3S S811V65N3S S811V72N3S S811V85N3S S811V10N3S

S811 Solid-State Reduced Voltage Starter

Technical Data and Specifications

Table 30.5-18. Specifications—S811 Soft Starter

Soft Starter (Partial Catalog Number)	S811 N37	S811 N66	S811 R10	S811 R13	S811 T18	S811 T24	S811 T30	S811 U36	S811 U42	S811 U50 ①	S811 V36	S811 V42	S811 V50	S811 V65	S811 V72	S811 V85	S811 V10 ②
Maximum current capacity	37	66	105	135	180	240	304	360	420	500	360	420	500	650	720	850	1000
FLA range	11– 37	20– 66	32– 105	42– 135	56– 180	75– 240	95– 304	112– 360	131 – 420	156 – 500	112 – 360	131– 420	156– 500	203– 650	225– 720	265– 580	320– 1000

Dimensions

Width in inches (mm)	2.66 (67.6)	4.42 (112.2)	7.67 (194.8)	7.73 (196.3)	11.05 (280.6)
Height in inches (mm)	7.38 (187.4)	7.92 (201.2)	12.71 (322.9)	12.72 (323.1)	16.57 (420.8)
Depth in inches (mm)	6.48 (164.5)	6.64 (168.7)	6.39 (162.4)	7.08 (179.9)	7.35 (186.6)
Weight in lb (kg)	5.80 (2.6)	10.50 (4.8)	48.00 (21.8) with lugs 41.00 (18.6) without lugs	48.00 (21.8) with lugs 41.00 (18.6) without lugs	103.00 (46.8) with lugs 91.00 (41.4) without lugs

General Information

Bypass mechanical lifespan	10 million
Insulating voltage Ui	660 V
Ramp time range	0.5–180 seconds (0.5–360 seconds extended ramp)
Resistance to vibration	3g
Resistance to shock	15g

Electrical Information

Operating voltage	200–600 V
Operating frequency	47–63 Hz
Overload setting	30–100%
Trip class	5, 10, 20 and 30

Cabling Capacity (IEC 947)

Number of conductors	One	One	One or two	—	—	—	Two, four or six
Wire sizes	14–2	14–4/0	4 AWG to 500 kcmil	—	—	—	2/0 to 500 kcmil
Type of connectors	Box lug		Add-on lug kit				

Control Wiring (12-Pin)

Wire sizes in AWG	22–14
Number of conductors (stranded)	Two (or one AWG 12)
Torque requirements in lb-in	3.5
Solid, stranded or flexible maximum size in mm ²	3.31

Control Power Requirements

Voltage range (24 V ± 10%)	21.6–26.4						
Steady state current amps	1.0	1.0	1.0	—	—	—	1.4
Inrush current amps	10	10	10	—	—	—	10
Ripple	1%						

Relays (1) Class A and C

Voltage AC—maximum	240
Voltage DC—maximum	120
Amperes—maximum	3

Environment

Temperature—operating	–30 °C to +50 °C (no derating) consult factory for operation > +50 °C
Temperature—storage	–50 °C to +70 °C
Altitude	<2000m—consult factory for operation > 2000m
Humidity	<95% noncondensing
Operating position	Any
Pollution degree IEC 947-1	3
Impulse withstand voltage IEC 947-4-1	6000 V

① U-Frame 500 A unit does not have IEC Certification.

② UR Recognized Product.

S611 Solid-State Reduced Voltage Soft Starter

S611 Solid-State Reduced Voltage Soft Starter



S611 Solid-State Soft Starter

General Description

Eaton revolutionized the reduced voltage control marketplace with its advanced feature set and user-friendly user interface module to enhance system performance and to reduce commissioning times. The S611 adds enhanced functionality with network communications, metering, monitoring and diagnostics capabilities.

The Eaton line of S611 reduced voltage soft starters is multi-functional, easy to install and easy to program. Designed to control the acceleration and deceleration of three-phase motors up to 600 V, the line is available from 26 to 414 A.

The S611 is designed to be a complete package, combining the SCRs, bypass contactor and overload in one compact unit.

Application Description

Designed to control the acceleration and deceleration of three-phase motors, the S611 soft starter uses silicon controlled rectifiers (SCRs) to control the voltage to soft start and soft stop the motor. After the motor is started, internal run bypass contactors close, resulting in the motor running directly across-the-line. The built-in solid-state overload protects the motor from overload conditions with sophisticated algorithms that model true motor heating, resulting in better motor protection and fewer nuisance trips. Advanced protective and diagnostic features reduce downtime.

A voltage ramp start or current limit start is available. Kick start is available in either starting mode. The soft stop option allows for a ramp stop time that is longer than the coast to stop time.

The pump control option provides a smooth transition for starting and stopping a motor and for eliminating the “water-hammer” effect that can damage pipes, valves and pumps.

The S611 offers an impressive array of advanced protective features. Not only are the protective features selectable, but many offer variable settings allowing the user to fine-tune the starter to meet specific system requirements.

The S611 has an easy-to-use user interface module (UI) that allows the user to configure the device and to read system parameters. The UI includes an LED display and a keypad to scroll through the various parameters. The UI allows the user to modify control parameters, enable or disable protections, set communication variables, monitor system parameters such as line voltages and currents, and access the fault queue.

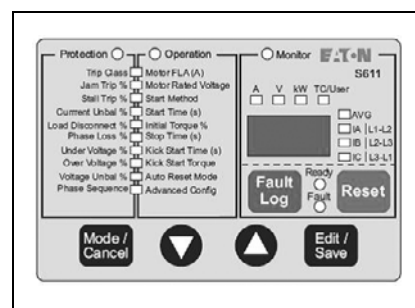


Figure 30.5-7. User Interface

The UI can be removed from the S611 and be remote mounted. Kits are available to door mount the UI, enabling users to safely configure, commission, monitor and troubleshoot the system at the electrical panel without opening the enclosure door. This will help eliminate the possibility of an arc flash incident.

Communications

The S611 has built-in communication capabilities through two communications ports to connect the soft starter to a variety of networks, including Modbus (native), DeviceNet™ and PROFIBUS.

The S611 communication parameters can be configured with the UI. Advanced communication configuration settings provide the system integrator with powerful tools to facilitate system optimization.

S611 Solid-State Reduced Voltage Soft Starter

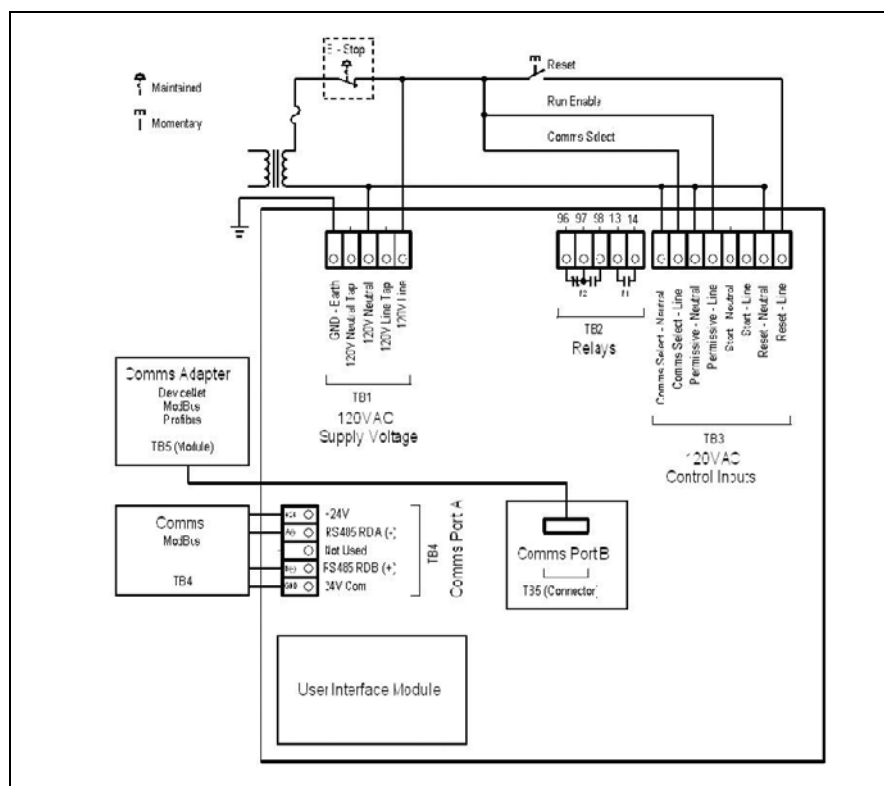


Figure 30.5-8. Control Wiring Diagram

Table 30.5-19. Network Communications Reference

Description	Style Number	Catalog Number
Modbus communication adapter without I/O	3-2372-001A	C441M
Modbus communication adapter with 120 Vac I/O	3-2372-003B	C441N
Modbus communication adapter with 24 Vdc I/O	3-2372-004B	C441P
DeviceNet communication adapter with 120 Vac I/O	3-2372-001B	C441K
DeviceNet communication adapter with 24 Vdc I/O	3-2372-002B	C441L
PROFIBUS communication adapter with 120 Vac I/O	3-2398-001B	C441S
PROFIBUS communication adapter with 24 Vdc I/O	3-2398-002B	C441Q

Features and Benefits

- The UI (user interface module) provides an intuitive, easy-to-use human interface with powerful configuration capabilities to maximize system performance
- Door or device mounted UI enables users to safely configure, commission, monitor and troubleshoot the system at the electrical panel without opening the enclosure door, eliminating the possibility of an arc flash incident
- System operating parameters can be monitored enterprise-wide through a communications network. Increase uptime by providing data for process management and preventive diagnostics

- Run Bypass mode greatly reduces internal heating created by the greater power dissipation in the SCRs. Bypass contactor directly connects the motor to the line and improves system efficiency by reducing internal power losses
- Internal solid-state overload protection provides accurate current measurement and trip settings. Sophisticated algorithms solve a series of differential equations that model true motor heating and cooling, resulting in superior motor overload protection while minimizing nuisance trips. Advanced selectable protective features safeguard the motor and system against a variety of system faults

- Internal run bypass contactors and overload protection eliminate the need for additional devices, reducing enclosure sizes, minimizing installation and wiring time, and reducing overall assembly size and cost
- Wide range of overload FLA settings (50–100% of rated frame current) and a selectable trip class (5–30) offers users the flexibility to fine-tune the starter to match specific application requirements
- Variable ramp times and torque control settings provide unlimited starting configurations, allowing for maximum application flexibility
- Kick-start feature enables soft starting of high friction loads
- Soft stop control for applications where an abrupt stop of the load is not acceptable
- Pump control option with sophisticated pump algorithms on both starting and stopping that minimize the pressure surges that cause water hammer. The pump control option will maximize the life of the pump and piping systems while minimizing the downtime caused by system failure
- Six SCRs control all three motor phases, providing smooth acceleration and deceleration performance
- Soft acceleration and deceleration reduces wear on belts, gears, chains, clutches, shafts and bearings
- Reduce the peak inrush current's stress on the power system
- Minimize peak starting torque to diminish mechanical system wear and damage
- 120 Vac control voltage enhances ease of connections

Protective Features

All protective features can be configured, enabled or disabled with the UI or through the communications network.

S611 Solid-State Reduced Voltage Soft Starter

Motor Overload

The S611 includes electronic overload protection as standard. The overload meets applicable requirements for a motor overload protective device. The overload protects the motor from overheat conditions with the use of sophisticated algorithms that model true motor heating, resulting in superior motor protection and fewer nuisance trips.

The S611 calculates a thermal memory value. A 100% value represents the maximum safe temperature of the motor. When the thermal memory value reaches 100%, an overload trip will occur removing power to the motor. Upon trip, the S611 stores the calculated motor heating value and will not allow a motor re-start until the motor has sufficiently cooled. This feature ensures the motor will not be damaged by repeated overload trip, reset and re-start cycles.

The thermal memory value can be monitored through the UI or the communications network. The thermal memory value can be of great use in determining an impending overload trip condition. Alarms can be implemented in the process monitoring system warning of an impending trip before a trip occurs halting the process. Costly system downtime can be avoided.

The trip current is adjusted to match the specific application requirements by entering the motor nameplate full load current rating and trip class. The FLA adjustment includes a 2 to 1 adjustment range. The overload trip class is adjustable from class 5 through class 30. The overload is ambient temperature compensated—meaning its trip characteristics will not vary with changes in ambient temperature. The overload protection can be enabled, disabled, or disabled on start.

Short Circuit

The use of a short-circuit protective device in coordination with the S611 is required in branch motor circuits by most electrical codes. Short-circuit coordination ratings with both fuses and Eaton molded-case circuit breakers are available providing customers with design flexibility. The S611 has short-circuit coordination ratings as an open component, an enclosed starter, and in a motor control center.

Jam

Excessive current and torque up to locked rotor levels can occur in a jam condition. The condition can result in stress and damage to the motor, load, mechanical system and the electrical distribution system. Jam protection prevents the stress and damage from a jam during normal run. After the motor is started, a current greater than 300% FLA setting will cause the starter to trip on a jam fault.

Stall

Excessive current and torque up to locked rotor levels can occur in a stall condition. The condition can lead to an overload trip and can result in stress and damage to the motor, load, mechanical system and the electrical distribution system. Stall protection prevents stress and damage to a motor that has not come up to speed, or stalled after the soft start time. The S611 will trip to protect the system in the event that the motor did not get to the rated speed in the defined soft start period. A current greater than 200% FLA at the end of the soft start period will cause the starter to trip on a stall fault.

Pole Over Temperature

High ambient temperatures, extended ramp times and high duty cycle conditions may cause the S611 power pole conductors to reach a temperature that exceeds their thermal rating. The S611 is equipped with sensors that monitor the temperature of the power poles. Overtemperature protection occurs if the device's thermal capacity is exceeded. The soft starter will trip in overtemperature conditions, preventing device failure.

The device pole temperature value can be monitored through the UI or the communications network. This feature can be of use in determining an impending overtemperature trip condition. Alarms can be implemented in the process monitoring system warning of an impending trip before a trip occurs, halting the process. Costly system shutdown can be avoided.

Phase Loss

Loss of a phase can cause a significant increase in the current drawn in the remaining two phases. Phase loss can lead to motor damage before an eventual overload trip occurs. Phase loss is typically an indication of a failure in the electrical distribution system. The S611 will detect a phase loss and trip if any phase current drops below a preset value. The phase loss trip level is adjustable from 0% to 100% of the average of the other two phase levels with an adjustable trip delay of 0.1–60 seconds.

Phase Imbalance

Phase current or voltage imbalance can cause a significant increase in the current drawn in the remaining two phases. Phase imbalance can lead to motor damage before an eventual overload trip. Phase imbalance is typically an indication of a failure in the electrical distribution system or the motor. The S611 will detect both current and voltage phase imbalances and trip if any phase becomes imbalanced as compared to the average of the other two phases.

The phase current imbalance trip level is adjustable from 0% to 100% of the average of the current in the other two phases with an adjustable trip delay of 0.1–60 seconds.

The phase voltage imbalance trip level is adjustable from 0% to 100% of the average of the voltage in the other two phases with an adjustable trip delay of 0.1–60 seconds.

Reset Mode

The S611 can be set up for automatic or manual reset on trip. The manual reset mode requires the operator to physically press the RESET button located on the soft starter. The overload can be manually reset through the UI or through the communications network.

The automatic reset mode allows the soft starter to be automatically reset as soon as the trip condition is no longer present. With the automatic reset mode, after the fault is no longer present, the motor will be restarted as soon as a valid start signal is present.

S611 Solid-State Reduced Voltage Soft Starter

Phase Reversal

The S611 can determine if the proper line phase sequence is present by default. The device will trip if the line phase sequence is something other than A-B-C. The S611 can be configured to operate under reversed phase conditions (A-C-B).

Shorted SCR Detection

The S611 monitors the operation of the power poles and will trip under a shorted SCR condition.

Open SCR Detection

The S611 monitors the operation of the power poles and will trip under an open SCR condition.

Low Current

Low current conditions can be a result of a loss of load or a failure in the mechanical system. The S611 has low current protection that will trip if the average rms current falls below a preset value. The low current protection can be programmed as a percent of motor FLA from 0% to 100%.

Low Voltage

Low voltage conditions can result from disturbances in the electrical power distribution system. Low voltage conditions can cause a malfunction and damage to electrical equipment. The S611 has low voltage protection that will trip if the average rms voltage falls below a preset value. The low voltage protection can be programmed as a percent of nominal voltage from 1% to 99% with a trip delay of 0.1–60 seconds.

High Voltage

High voltage conditions can result from disturbances in the electrical power distribution system. High voltage conditions can cause malfunctions or failures of electrical equipment. The S611 has high voltage protection that will trip if the average rms voltage is greater than a preset value. The high voltage protection can be programmed as a percent of nominal voltage from 101% to 120% with a trip delay of 0.1–60 seconds.

Monitoring Capabilities

The S611 has an impressive array of system monitoring capabilities that allow users to access real-time process and diagnostic data. This data can be viewed at the device with the UI or through a communications network. Data over a communications network can provide valuable insight into the condition of the equipment and processes. Maintenance and production personnel can monitor critical operational and maintenance data from a central control station that can be located far away from the production facility. Process data can be monitored to determine system anomalies that may indicate a need for preventive maintenance or an impeding failure.

Adjustments made through the communications network can reduce costs by minimizing the time traveling to the location where the motor controls are located. When faults do occur, real-time fault data can assist maintenance in troubleshooting and planning repair resources. Remote reset signals can be given to tripped devices without the need for manual intervention by maintenance personnel.

Average Line Current

Provides the average of the three phase rms line currents in amperes, accurate to within 2%. Current data can be used to indicate a need for maintenance. Increased currents in a fixed load application can indicate a reduction in system efficiencies and performance, signifying system maintenance is due.

Average Pole Current

Provides the average of the three-phase rms pole currents in amperes, accurate to within 2%. The pole current is the current through the soft starter. The line and pole current will be identical in in-line applications, and will differ in inside-the-delta applications.

Average Line Current as a % FLA

Provides the average rms line current as a percentage of the S611 FLA setting.

Three-Phase Line Currents

Provides three rms phase line currents in amperes, accurate to within 2%. Imbalances or changes in the relative phase current to one another can indicate anomalies in the motor or the electrical distribution system.

Three-Phase Pole Currents

Provides three rms phase pole currents in amperes, accurate to within 2%. The pole current is the current through the soft starter. The line and pole current will be identical in in-line applications.

Three-Phase Line Voltages

Provides the individual rms three-phase line voltages. Imbalances or changes in the relative phase voltage to one another can indicate anomalies in the motor or the electrical distribution system. Voltage can be used to monitor electrical distribution system performance.

Warnings, alarms and system actions to low or high voltage conditions can be implemented.

Percent Thermal Memory

Provides the real-time calculated thermal memory value. The S611 calculates thermal memory value. A 100% value represents the maximum safe temperature of the motor. When the thermal memory value reaches 100%, an overload trip will occur, removing power to the motor.

The thermal memory value can be of great use in determining an impending overload trip condition. Alarms can be implemented in the process monitoring system warning of an impending trip before a trip occurs, halting the process. Costly system downtime can be avoided.

Pole Temperature

Increases in pole temperature are caused by increases in ambient temperature, start/stop times and start duty cycles. Changes in pole temperatures represent a change in system operating conditions. Identifying unexpected operating conditions or changes can prompt maintenance and aid in process evaluation activities.

Power Monitoring

S611 does monitor the power and it can be displayed on the UI.

S611 Solid-State Reduced Voltage Soft Starter

Diagnostics

Fault Queue

Current fault and a fault queue containing the last nine system faults can be read through the UI or the communications network. Fault identification can minimize troubleshooting time and cost, and prevent arc flash incidents. The fault queue can be remotely accessed through a communications network to assist in planning maintenance resources. 30 different faults can be identified by the S611.

Control Status

The S611 provides data that represents system conditions that can be read through the UI or the communications network. This data identifies the status of the system and the control commands the system is requesting of the S611. This can be used for advanced troubleshooting and system integration activities.

Operation

Starting and Stopping Modes

The S611 has a variety of starting and stopping methods to provide superior performance in the most demanding applications. The motor can be started in either Voltage Ramp Start or Current Limit Start mode. Kick Start and Soft Stop are available within both starting modes.

Voltage Ramp Start

Provides a voltage ramp to the motor resulting in a constant torque increase. The most commonly used form of soft start, this start mode allows you to set the initial torque value and the duration of the ramp to full voltage conditions. Bypass contactors close after ramp time.

- Adjustable initial torque 0–85% of locked rotor torque
- Adjustable ramp time 0.5–180 seconds (can be extended with factory modification)

Current Limit Start

Limits the maximum current available to the motor during the start phase. This mode of soft starting is used when it becomes necessary to limit the maximum starting current due to long start times or to protect the motor. This start mode allows you to set the maximum starting current as a percentage of locked rotor current and the duration of the current limit. Bypass contactors close after current limit time.

- Maximum current of 0–85% locked rotor current
- Adjustable ramp time 0.5–180 seconds (can be extended with factory modification)

Kick Start

Selectable feature in both Voltage Ramp Start and Current Limit Start modes. Provides a current and torque “kick” for 0–2.0 seconds. This provides greater initial current to develop additional torque to break-away a high friction load.

- 0–85% of locked rotor torque
- 0–2.0 seconds duration

Soft Stop

Allows for a controlled stopping of a load. Used when a stop-time that is greater than the coast-to-stop time is desired. Often used with high friction loads where a sudden stop may cause system or load damage.

- Stop time = 0–60 seconds

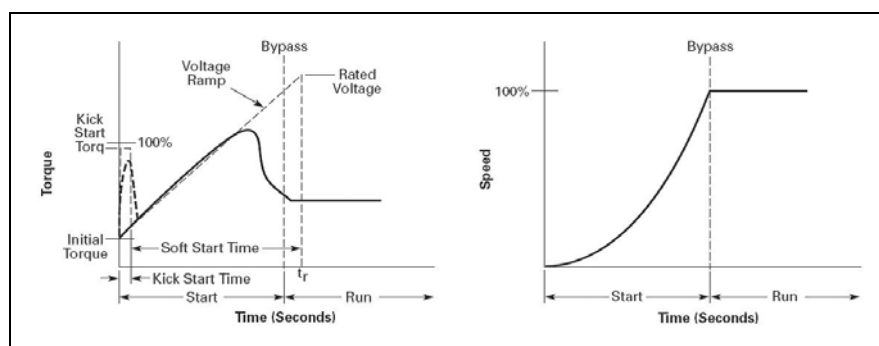


Figure 30.5-9. Ramp Start

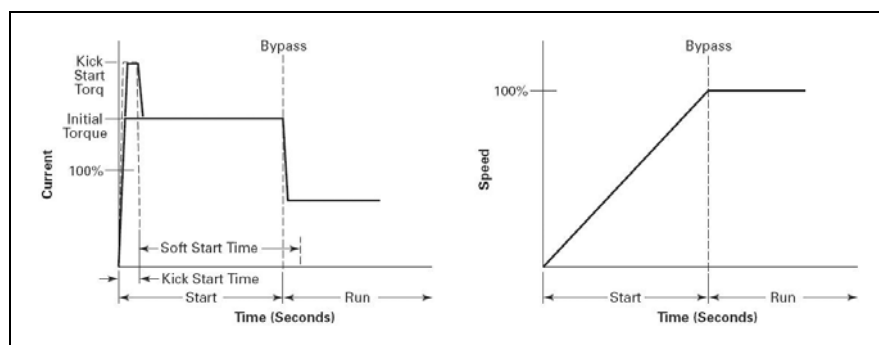


Figure 30.5-10. Current Limit Start

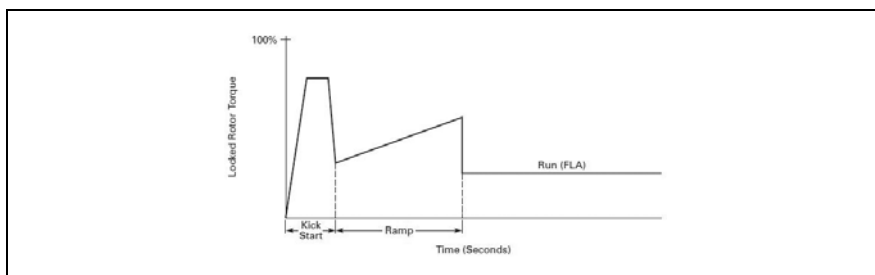


Figure 30.5-11. Kick Start Graphic

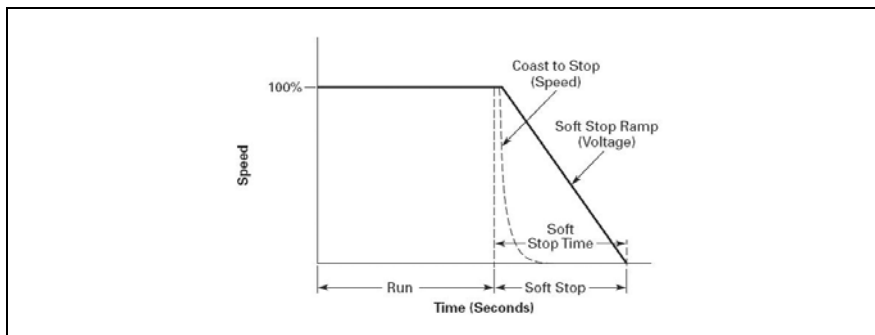


Figure 30.5-12. Stop Ramp Graphic

Edge and Level Sensing Control

Edge or level sensing is selected with the Start Control parameter in the Advanced Configuration Menu. Factory default is level sensing.

Edge Sensing

Edge sensing requires 120 Vac power be momentarily applied to the Start terminal (with the Permissive terminal 120 Vac) to initiate a start under all conditions. After a stop or fault occurs, the 120 Vac must be removed, then reapplied to pin 1 before another start can occur. This control configuration should be used when restarting of the motor after a fault or stop must be supervised manually or as a part of a control scheme. The cycling of 120 Vac power to the Permissive terminal before starting is required regardless of the position of the auto reset parameter.

Level Sensing

Level sensing will enable a motor to restart after a fault is cleared without cycling 120 Vac to the Permissive terminal as long as:

- Permissive terminal is supplied with 120 Vac
- The auto reset parameter is set to enabled
- All faults have cleared or have been reset

This control configuration should be used where it is desirable to restart a motor after a fault without additional manual or automatic control. An example of this condition would be on a remote pumping station where it is desirable to automatically restart a pump after a power outage without operator intervention.

If the auto reset feature is used, CAUTION must be exercised to ensure that any restart occurs in a safe manner.

S611 Solid-State Reduced Voltage Soft Starter

Product Selection

Motor applications and customer needs come in many different varieties. The standard and severe-duty rating tables provide guidelines

on what the soft starter is capable of. If the application falls under these categories, use these charts. For other applications, or when a question

arises, consult a local Eaton Representative or call the Eaton Technical Resource Center.

Table 30.5-20. S611 Horsepower Ratings—300% FLA at 15 Seconds at 50°C

Maximum Current Amperes	60 Hz								Catalog Number
	200 V		230 V		460 V		575–600 V		
	1.0 SF	1.15 SV	1.0 SF	1.15 SV	1.0 SF	1.15 SV	1.0 SF	1.15 SV	
52	15	10	15	15	40	30	50	40	S611A052N3S S611A065N3S S611A077N3S
65	20	15	20	20	50	40	60	50	
77	20	20	25	20	60	50	75	60	
99	30	25	30	30	75	60	100	75	S611B099N3S S611B125N3S S611C156N3S
125	40	30	40	40	100	75	125	100	
156	50	40	60	50	125	100	150	125	
180	60	50	60	60	150	125	150	150	S611C180N3S S611D242N3S S611E302N3S
242	75	60	75	75	200	150	250	200	
302	100	75	100	100	250	200	350	250	
361	125	100	150	125	300	250	350	300	S611E361N3S S611F414N3S
414	150	125	N/A	150	350	250	450	350	

Options

Pump Control

For pump control option, change the 9th digit in the Catalog Number to P.

Table 30.5-21. S611 Horsepower Ratings—Pump Control Option

Maximum Current Amperes	60 Hz								Catalog Number
	200 V		230		460 V		575–600 V		
	1.0 SF	1.15 SV	1.0 SF	1.15 SV	1.0 SF	1.15 SV	1.0 SF	1.15 SV	
52	15	10	15	15	40	30	50	40	S611A052P3S S611A065P3S S611A077P3S
65	20	15	20	20	50	40	60	50	
77	20	20	25	20	60	50	75	60	
99	30	25	30	30	75	60	100	75	S611B099P3S S611B125P3S S611C156P3S
125	40	30	40	40	100	75	125	100	
156	50	40	60	50	125	100	150	125	
180	60	50	60	60	150	125	150	150	S611C180P3S S611D242P3S S611E302P3S
242	75	60	75	75	200	150	250	200	
302	100	75	100	100	250	200	350	250	
361	125	100	150	125	300	250	350	300	S611E361P3S S611F414P3S
414	150	125	N/A	150	350	250	450	350	

Standards and Certifications

- IEC 60947-4-2
- UL listed
- CSA certified (3211 06)

S611 Solid-State Reduced Voltage Soft Starter

Technical Data and Specifications

Table 30.5-22. Specifications—S611 Solid-State Soft Starter

Soft Starter (Partial Catalog Number)	S611A052	S611A065	S611A072	S611B099	S611B125	S611C156	S611C180	S611D242	S611E302	S611E361	S611F414
Maximum current capacity	52	65	77	99	125	156	180	242	302	361	414
FLA range	26–52	32.5–65	38.5–77	48–99	62.5–125	78–156	90–180	120–242	151–302	180.5–361	207–414

Dimensions—Inches (mm)

Width	11.58 (294.1)	11.58 (294.1)	11.58 (294.1)	11.58 (294.1)	11.58 (294.1)	11.58 (294.1)	11.58 (294.1)	11.58 (294.1)	17.56 (446.0)	17.56 (446.0)	17.56 (446.0)
Height	19.45 (494.0)	19.45 (494.0)	19.45 (494.0)	19.45 (494.0)	19.45 (494.0)	20.83 (529.1)	20.83 (529.1)	20.83 (529.1)	31.15 (791.2)	31.15 (791.2)	31.15 (791.2)
Depth	7.46 (189.5)	7.46 (189.5)	7.46 (189.5)	7.46 (189.5)	7.46 (189.5)	8.37 (212.6)	8.37 (212.6)	8.37 (212.6)	9.54 (242.3)	9.54 (242.3)	9.54 (242.3)
Weight in lb (kg)	24 (11)	24 (11)	24 (11)	24 (11)	24 (11)	33 (15)	38 (15)	38 (15)	86 (39)	86 (39)	102 (46)

General Information

Bypass mechanical lifespan	10 million
Insulating voltage	660 V
Ramp time range	0.5–180 seconds
Resistance to vibration	1g
Resistance to shock	Meets ITSA standards

Electrical Information

Operating voltage	130–600 V
Operating frequency	47–63 Hz
Overload setting (frame)	50–100% FLA
Trip class	5, 10, 20 and 30

Cabling Capacity (IEC 947)

Number of conductors	One	One	One	One	One	One	One	One	Two	Two	Two
Wire sizes	14–2/0	14–2/0	14–2/0	14–2/0	2–600 kcmil	2–600 kcmil	2–600 kcmil	2–600 kcmil	2–600 kcmil	2–600 kcmil	2–600 kcmil
Type of connectors	Lug										

Control Wiring

Wire sizes in AWG	22–12
Number of conductors	Two (or one 12–14 AWG)
Torque requirements	3.5 lb-in
Maximum size	12 AWG

Control Power Requirements

Voltage range (24 V \pm 10%)	108–132										
Steady-state current amperes	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.75	0.75	0.75	—
Inrush current amperes	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	—
Ripple	1%										

Relays (1) Class A and C

Voltage AC—maximum	120
Voltage DC—maximum	24
Amperes—maximum	3

Environment

Temperature—operating	–20 °C to +50 °C
Temperature—storage	–40 °C to +85 °C
Altitude	<2000 m, derate 0.5% per 100 m >2000 m
Humidity	<95% noncondensing
Operating position	Vertical, line side up
Pollution degree IEC 947-1	3
Impulse withstand voltage IEC 947-4-1	6000V

DS6 Soft Start Controllers

DS6 Soft Start Controllers



DS6 Soft Start Controllers

General Description

Eaton's DS6 line of reduced voltage solid-state soft start controllers is very compact, multi-functional, easy to install and easy to commission. Designed to control the acceleration and deceleration of three-phase motors, the device is available for current ranges from 40 to 180 A.

Application Description

With its small size, it can easily fit in place of existing soft starters, wye-delta starters, or across-the-line NEMA and IEC starters. This feature allows easy upgrades to existing systems. The product is designed to be wired in the three-phase line feeding the three motor input leads as is done for normal across-the-line starting. The starter uses silicon controlled rectifiers (SCRs) to ramp the voltage to the motor, providing smooth acceleration and deceleration of the load. After the motor is started, the internal run bypass contactor closes, resulting in the motor running directly across-the-line. Internal run bypass significantly reduces the heat generated as compared to non-bypass starters. The soft stop option allows for a ramp stop time that may be longer than the coast-to-stop time. An external over-load protection is needed.

Operation

Voltage Ramp Start

This start method provides a voltage ramp to the motor, resulting in a constant torque increase. This most commonly used form of soft start mode allows you to set the initial voltage value and the duration of the ramp to full voltage conditions.

Bypass contactor(s) close after ramp time has elapsed.

- Adjustable initial voltage 30–92% of full voltage
- Adjustable ramp time 1–30 seconds

Soft Stop

Allows for a controlled stopping of load. Used when a stop-time that is greater than the coast-to-stop time is desired. Often used with high friction loads where a sudden stop may cause system or product damage. Setting the soft stop time to a value of 0 turns off this feature.

- Soft stop time = 0–30 seconds

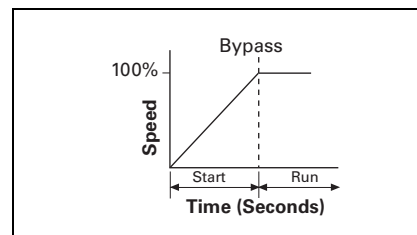


Figure 30.5-13. Start Ramp

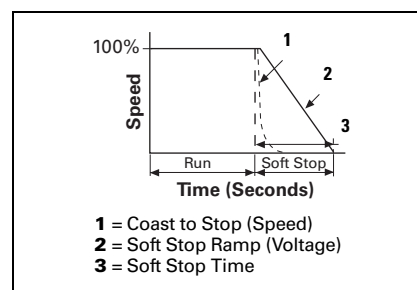


Figure 30.5-14. Stop Ramp

Features and Benefits

- Run Bypass mode greatly reduces internal heating created by the power dissipation across the SCRs. The bypass contactor directly connects the motor to the line and improves system efficiency by reducing internal power losses
- Less heat minimizes enclosure size and cooling requirements, and maximizes the life of all devices in the enclosure
- LED displays device status and provides fault indication
- Variable ramp times and voltage control (torque control) settings provide unlimited starting configurations, allowing for maximum application flexibility
- Soft stop control suits applications where an abrupt stop of the load is not acceptable. Soft acceleration and deceleration reduces wear on belts, gears, chains, clutches, shafts and bearings
- Minimizes the peak inrush current's stress on the power system
- Manages peak starting torque to diminish mechanical system wear and damage
- 24 Vdc control module enhances personnel and equipment safety

Protective Features

- There are two auxiliary relays—
 - First relay is a TOR relay that closes when the TOR is achieved (internal bypass relays close)
 - The second relay is a RUN relay that closes when the RUN signal is initiated and opens when RUN signal is removed. It remains closed during stop ramp time, if set to a value greater than 0. The RUN relay will also open if a fault occurs
- Mains connection—The mains connection is monitored for an open condition and/or undervoltage
- Motor connection—The motor connection is monitored for an open condition
- SCR faults—SCR performance is monitored during the ramp cycle for proper operation
- Heat sink over/under temperature—High ambient temperatures, extended ramp times and high duty cycle conditions may cause the DS6 to exceed its thermal rating. When temperature goes under -5°C , unit will trip as well. The DS6 is equipped with sensors that monitor the temperature of the device. The soft starter will trip in over/under temperature conditions, preventing device failure
- Bypass relay—The DS6 can detect if the bypass relay fails to close after the ramp start or opens while the motor is running. The DS6 will trip on a bypass dropout fault if either of these conditions occur. The device does not start when bypass relay is closed and start signal is applied
- 24 Vdc low voltage—If the control voltage falls below 20 Vdc at any time during operation, the unit will fault

Standards and Certifications

- IEC 60947-4-2
- EN 60947-4-2
- UL listed (E251034)
- CSA certified
- CE marked
- C-Tick

Additional Information

- Instruction Leaflet IL03901001E

DS6 Soft Start Controllers

Product Selection

DS6 Soft Start Horsepower Ratings

Please refer to Application Note AP03900001E for additional information on proper size selection.

**Table 30.5-23. DS6 Soft Start Controllers—Horsepower Ratings—
10 Second Ramp, 1 Start per Hour, 300% Current Limit at 40 °C**

Rated Current Amperes	Motor Power (hp)			Maximum Allowable Breaker Size ①	Maximum Allowable Fuse Size ①	Recommended XTOB Overload	Recommended C440 Overload	Catalog Number
	200 V	230 V	460 V					
40	10	10	30	HFD3150L	150 A Class RK5	XTOB040DC1 ②	C440A1A045SAX	DS6-34DSX041NO-N
52	15	20	40	HFD3200L	200 A Class RK5	XTOB057DC1 ②	C440B1A100SAX	DS6-34DSX055NO-N
65	20	25	50	HJD3250	200 A Class RK5	XTOB065DC1 ②	C440B1A100SAX	DS6-34DSX068NO-N
77	25	30	60	HKD3300	300 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX081NO-N
96	30	30	75	HKD3350	350 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX099NO-N
124	40	50	100	HKD3400	500 A Class RK5	XTOB125GC1S	C440A1A005SAX ④	DS6-34DSX134NO-N
156	50	60	125	HLD3450	500 A Class RK5	XTOB160LC1 ③	C440A1A005SAX ④	DS6-34DSX161NO-N
180	60	75	150	HLD3500	500 A Class RK5	XTOB220LC1 ③	C440A1A005SAX ④	DS6-34DSX196NO-N

① Maximum values may be higher than allowed per NEC 430.52 and UL 508A 31.1.

② XTOBXDIND panel mounting adapter must be used with this overload.

③ XTOBXTLL line and load lugs must be used with this overload.

④ ZEB-XCT300 current transformer must be used with this overload.

Table 30.5-24. 10 Second Ramp, 1 Start per Hour, 400% Current Limit at 40 °C

Rated Current Amperes	Motor Power (hp)			Maximum Allowable Breaker Size ⑤	Maximum Allowable Fuse Size ⑤	Recommended XTOB Overload	Recommended C440 Overload	Catalog Number
	200 V	230 V	460 V					
27	7.5	10	20	HFD3150L	150 A Class RK5	XTOB040DC1	C440A1A045SAX	DS6-34DSX041NO-N
34	10	10	30	HFD3200L	200 A Class RK5	XTOB040DC1	C440A1A045SAX	DS6-34DSX055NO-N
40	15	15	30	HJD3250	200 A Class RK5	XTOB057DC1 ⑥	C440A1A045SAX	DS6-34DSX068NO-N
52	15	20	40	HKD3300	300 A Class RK5	XTOB057DC1 ⑥	C440B1A100SAX	DS6-34DSX081NO-N
65	20	25	50	HKD3350	350 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX099NO-N
80	30	30	75	HKD3350	500 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX134NO-N
96	30	40	75	HLD3450	500 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX161NO-N
124	40	50	100	HLD3500	500 A Class RK5	XTOB150GC1S	C440A1A005SAX ⑦	DS6-34DSX196NO-N

⑤ Maximum values may be higher than allowed per NEC 430.52 and UL 508A 31.1.

⑥ XTOBXDIND panel mounting adapter must be used with this overload.

⑦ ZEB-XCT300 current transformer must be used with this overload.

DS6 Soft Start Controllers

DS6 Soft Start kW Ratings

Please refer to Application Note AP03900001E for additional information on proper size selection.

Table 30.5-25. DS6 Soft Start Controllers—kW Ratings According to IEC 60947-4-2—
10 Second Ramp, 1 Start per Hour, 300% Current Limit at 40 °C

Rated Current Amperes	Motor Power (kW)		Maximum Allowable Breaker Size ①	Maximum Allowable Fuse Size ①	Recommended XTOB Overload	Recommended C440 Overload	Catalog Number
	230 V	400 V					
41	11	22	HFD3150L	150 A Class RK5	XTOB057DC1 ②	C440A1A045SAX	DS6-34DSX041N0-N
55	15	30	HFD3200L	200 A Class RK5	XTOB057DC1 ②	C440B1A100SAX	DS6-34DSX055N0-N
68	15	37	HJD3250	200 A Class RK5	XTOB070GC1 ②	C440B1A100SAX	DS6-34DSX068N0-N
81	22	45	HKD3300	300 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX081N0-N
99	30	55	HKD3350	350 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX099N0-N
134	30	75	HKD3400	500 A Class RK5	XTOB150GC1S	C440A1A005SAX ④	DS6-34DSX134N0-N
160	45	90	HLD3450	500 A Class RK5	XTOB160LC1 ③	C440A1A005SAX ④	DS6-34DSX161N0-N
196	55	110	HLD3500	500 A Class RK5	XTOB220LC1 ③	C440A1A005SAX ④	DS6-34DSX196N0-N

① Maximum values may be higher than allowed per NEC 430.52 and UL 508A 31.1.

② XTOBXDIND panel mounting adapter must be used with this overload.

③ XTOBXTLL line and load lugs must be used with this overload.

④ ZEB-XCT300 current transformer must be used with this overload.

Table 30.5-26. 10 Second Ramp, 1 Start per Hour, 400% Current Limit at 40 °C

Rated Current Amperes	Motor Power (kW)		Maximum Allowable Breaker Size ⑤	Maximum Allowable Fuse Size ⑤	Recommended XTOB Overload	Recommended C440 Overload	Catalog Number
	230 V	400 V					
28.8	7.5	11	HFD3150L	150 A Class RK5	XTOB040DC1	C440A1A045SAX	DS6-34DSX041N0-N
37.5	11	18.5	HFD3200L	200 A Class RK5	XTOB040DC1	C440A1A045SAX	DS6-34DSX055N0-N
46	11	22	HJD3250	200 A Class RK5	XTOB057DC1 ⑥	C440B1A100SAX	DS6-34DSX068N0-N
56	15	30	HKD3300	300 A Class RK5	XTOB065DC1 ⑥	C440B1A100SAX	DS6-34DSX081N0-N
68	18.5	37	HKD3350	350 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX099N0-N
90	22	45	HKD3350	500 A Class RK5	XTOB100GC1S	C440B1A100SAX	DS6-34DSX134N0-N
106	30	55	HLD3450	500 A Class RK5	XTOB160LC1 ⑦	C440A1A005SAX ⑧	DS6-34DSX161N0-N
134	37	75	HLD3500	500 A Class RK5	XTOB160LC1 ⑦	C440A1A005SAX ⑧	DS6-34DSX196N0-N

⑤ Maximum values may be higher than allowed per NEC 430.52 and UL 508A 31.1.

⑥ XTOBXDIND panel mounting adapter must be used with this overload.

⑦ XTOBXTLL line and load lugs must be used with this overload.

⑧ ZEB-XCT300 current transformer must be used with this overload.

Considerations

1. Either XTOB, C306 or C440 series or equivalent overload protection devices may be selected.
2. Contactor is optional for normal applications. It is recommended for mains isolation.

Power Supply

Eaton's PSG and ELC power supplies are recommended as a compact and low-cost source for 24 Vdc power. The light-weight, DIN rail mounted devices have a wide input voltage range, and robust screw terminals make these power supplies easy to install and use. These power supplies are available in 1A and 2A models.

Table 30.5-27. Power Supply Selection

Description	Catalog Number
85–264 V input and 24 V output	ELC-PS01
380–480 V input and 24 V output	PSS25F
100–240 Vac input and 24 Vdc output	PSG60E
380–480 Vac input and 24 Vdc output	PSG60F

DS6 Soft Start Controllers
Technical Data and Specifications
Table 30.5-28. DS6 Soft Start Controllers

Description	Unit	DS6-34DSX041N0-N	DS6-34DSX055N0-N	DS6-34DSX068N0-N	DS6-34DSX081N0-N
General					
Standards	—	IEC/EN 60947-4-2	IEC/EN 60947-4-2	IEC/EN 60947-4-2	IEC/EN 60947-4-2
Certifications	—	UL/CE/C-Tick/CSA	UL/CE/C-Tick/CSA	UL/CE/C-Tick/CSA	UL/CE/C-Tick/CSA
Ambient temperature (operation)	°C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C
Ambient temperature (storage)	°C	–25 °C to +55 °C	–25 °C to +55 °C	–25 °C to +55 °C	–25 °C to +55 °C
Altitude	—	0–1000 m, above 1000 m derate linearly by 1% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 1% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 1% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 1% of rated current per 100 m to a maximum of 2000 m
Installation	—	Vertical	Vertical	Vertical	Vertical
Protection degree	—	IP20	IP20	IP20	IP20
Protection against contact	—	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)
Overvoltage category/pollution degree	—	II/2	II/2	II/2	II/2
Shock resistance	—	8g/11 ms	8g/11 ms	8g/11 ms	8g/11 ms
Vibration resistance according to EN 60721-3-2	—	2M2	2M2	2M2	2M2
Dimensions in inches (mm) (W x H x D)	—	3.66 x 6.89 x 5.47 (93.0 x 175.0 x 138.9)	3.66 x 6.89 x 5.47 (93.0 x 175.0 x 138.9)	3.66 x 6.89 x 5.47 (93.0 x 175.0 x 138.9)	3.66 x 6.89 x 5.47 (93.0 x 175.0 x 138.9)
Weight in lb (kg)	—	4.00 (1.8)	4.00 (1.8)	4.00 (1.8)	4.00 (1.8)
Main Circuit					
Rated operation voltage	V	200–460 Vac	200–460 Vac	200–460 Vac	200–460 Vac
Mains frequency	Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Rated impulse withstand voltage	$U_{imp} 1.2/50 \mu s$	4 kV	4 kV	4 kV	4 kV
Rated operation current	I_e	40	52	65	77
Motor Power Ratings					
200 V	hp	10	15	20	25
230 V	hp	10	20	25	30
460 V	hp	30	40	50	60
230 V	kW	11	15	15	22
400 V	kW	22	30	37	45
Overload cycle according to EN 60947-4-2	—	40 A: AC53a; 3–5; 75–10	52 A: AC53a; 3–5; 75–10	65 A: AC53a; 3–5; 75–10	77 A: AC53a; 3–5; 75–10

DS6 Soft Start Controllers

Table 30.5-28. DS6 Soft Start Controllers (Continued)

Description	Unit	DS6-34DSX041N0-N	DS6-34DSX055N0-N	DS6-34DSX068N0-N	DS6-34DSX081N0-N
Wire Specifications					
Power terminals (box terminals) Single conductor Terminal torque	AWG lb-in	12–2/0 53–80	12–2/0 53–80	12–2/0 53–80	12–2/0 53–80
Control signals Single conductor Terminal torque	AWG lb-in	16 min. 3.5	16 min. 3.5	16 min. 3.5	16 min. 3.5
Power Section					
Rated impulse withstand voltage	U_{imp} 1.2/ 50 μ s	4 kV	4 kV	4 kV	4 kV
Control Commands					
Supply voltage control board Nominal voltage Nominal current ramp, TOR Current peak (closing shorting contactors)	U_s Vdc mA	+24 Vdc +10%/–15% 65 600 mA/50 ms	+24 Vdc +10%/–15% 65 600 mA/50 ms	+24 Vdc +10%/–15% 65 600 mA/50 ms	+24 Vdc +10%/–15% 65 600 mA/50 ms
Voltage to the control terminals (rated control voltage) DC driven	—	+24 Vdc +10%/–15%	+24 Vdc +10%/–15%	+24 Vdc +10%/–15%	+24 Vdc +10%/–15%
Input current at 24 Vdc	mA	14	14	14	14
Relay Outputs					
Number of relays	—	2 (TOR, ready)	2 (TOR, ready)	2 (TOR, ready)	2 (TOR, ready)
Maximum voltage	V	250 Vac, 60 Vdc	250 Vac, 60 Vdc	250 Vac, 60 Vdc	250 Vac, 60 Vdc
Maximum current	A	3 A, resistive	3 A, resistive	3 A, resistive	3 A, resistive
Soft Start Functions					
Ramp times Start ramp Stop ramp	s s	1–30 0–30	1–30 0–30	1–30 0–30	1–30 0–30
Initial voltage % line voltage	—	30–92%	30–92%	30–92%	30–92%

DS6 Soft Start Controllers
Table 30.5-28. DS6 Soft Start Controllers (Continued)

Description	Unit	DS6-34DSX099N0-N	DS6-34DSX134N0-N	DS6-34DSX161N0-N	DS6-34DSX196N0-N
General					
Standards	—	IEC/EN 60947-4-2	IEC/EN 60947-4-2	IEC/EN 60947-4-2	IEC/EN 60947-4-2
Certifications/markings	—	UL/CE/C-Tick/CSA	UL/CE/C-Tick/CSA	UL/CE/C-Tick/CSA	UL/CE/C-Tick/CSA
Ambient temperature (operation)	°C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C
Ambient temperature (storage)	°C	–25 °C to +55 °C	–25 °C to +55 °C	–25 °C to +55 °C	–25 °C to +55 °C
Altitude	—	0–1000 m, above 1000 m derate linearly by 1% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 1% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 1% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 1% of rated current per 100 m to a maximum of 2000 m
Installation	—	Vertical	Vertical	Vertical	Vertical
Protection degree	—	IP20	IP20	IP20	IP20
Protection against contact	—	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)
Overvoltage category/pollution degree	—	II/2	II/2	II/2	II/2
Shock resistance	—	8g/11 ms	8g/11 ms	8g/11 ms	8g/11 ms
Vibration resistance according to EN 60721-3-2	—	2M2	2M2	2M2	2M2
Dimensions in inches (mm) (W x H x D)	—	3.66 x 6.89 x 5.47 (93.0 x 175.0 x 138.9)	4.25 x 8.46 x 7.01 (108.0 x 214.9 x 178.1)	4.25 x 8.46 x 7.01 (108.0 x 214.9 x 178.1)	4.25 x 8.46 x 7.01 (108.0 x 214.9 x 178.1)
Weight in lb (kg)	—	4.00 (1.8)	8.16 (3.7)	8.16 (3.7)	8.16 (3.7)
Main Circuit					
Rated operation voltage	V	200–460 Vac	200–460 Vac	200–460 Vac	200–460 Vac
Mains frequency	Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Rated impulse withstand voltage	U_{imp} 1.2/50 μ s	4 kV	4 kV	4 kV	4 kV
Rated operation current	I_e	96	124	156	180
Motor Power Ratings					
200 V	hp	30	40	50	60
230 V	hp	30	50	60	75
460 V	hp	75	100	125	150
230 V	kW	30	30	45	55
400 V	kW	55	75	90	110
Overload cycle according to EN 60947-4-2	—	96A: AC53a; 3–5; 75–10	124A: AC53a; 3–5; 75–10	156A: AC53a; 3–5; 75–10	180A: AC53a; 3–5; 75–10

DS6 Soft Start Controllers

Table 30.5-28. DS6 Soft Start Controllers (Continued)

Description	Unit	DS6-34DSX099N0-N	DS6-34DSX134N0-N	DS6-34DSX161N0-N	DS6-34DSX196N0-N
Wire Specifications					
Power terminals (box terminals) Single conductor Terminal torque	AWG lb-in	12–2/0 53–80	12 AWG–350 kcmil 44–123	12 AWG–350 kcmil 44–123	12 AWG–350 kcmil 44–123
Control signals Single conductor Terminal torque	AWG lb-in	16 min. 3.5	16 min. 3.5	16 min. 3.5	16 min. 3.5
Power Section					
Rated impulse withstand voltage	U_{imp} 1.2/ 50 μ s	4 kV	4 kV	4 kV	4 kV
Control Commands					
Supply voltage control board Nominal voltage Nominal current ramp, TOR Current peak (closing shorting contactors)	U_s Vdc mA	+24 Vdc +10%/–15% 65 600 mA/50 ms	+24 Vdc +10%/–15% 65 600 mA/50 ms	+24 Vdc +10%/–15% 65 600 mA/50 ms	+24 Vdc +10%/–15% 65 600 mA/50 ms
Voltage to the control terminals (rated control voltage) DC driven	—	+24 Vdc +10%/–15%	+24 Vdc +10%/–15%	+24 Vdc +10%/–15%	+24 Vdc +10%/–15%
Input current at 24 Vdc	mA	14	14	14	14
Relay Outputs					
Number of relays	—	2 (TOR, ready)	2 (TOR, ready)	2 (TOR, ready)	2 (TOR, ready)
Maximum voltage	V	250 Vac, 60 Vdc	250 Vac, 60 Vdc	250 Vac, 60 Vdc	250 Vac, 60 Vdc
Maximum current	A	3 A, resistive	3 A, resistive	3 A, resistive	3 A, resistive
Soft Start Functions					
Ramp times Start ramp Stop ramp	s s	1–30 0–30	1–30 0–30	1–30 0–30	1–30 0–30
Initial voltage % line voltage	—	30–92%	30–92%	30–92%	30–92%

Dimensions—Approximate Dimensions in Inches (mm)

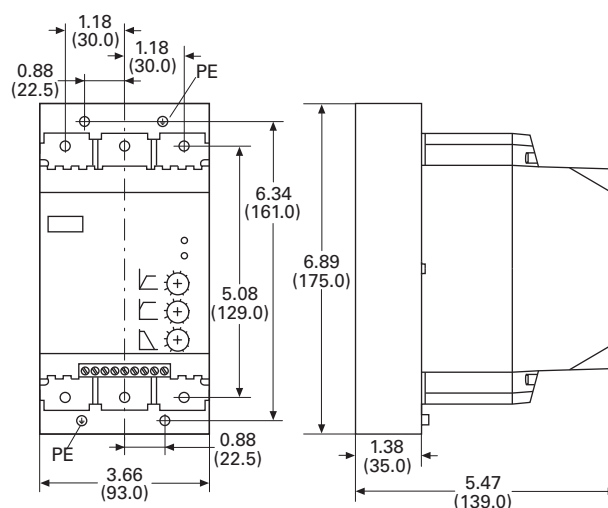


Figure 30.5-15. 25–75 hp Models

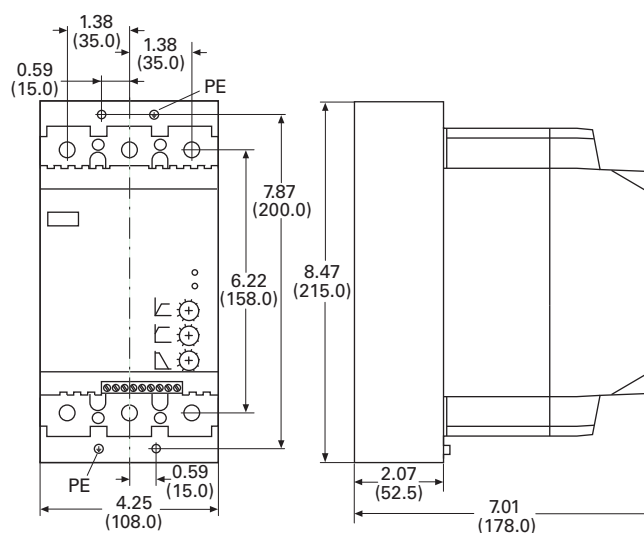


Figure 30.5-16. 100–150 hp Models

DS7 Soft Start Controllers



DS7 Soft Start Controllers

General Description

Eaton's DS7 line of reduced voltage solid-state soft start controllers is very compact, multi-functional, easy to install and easy to commission. Designed to control the acceleration and deceleration of three-phase motors, the device is available for current ranges from 4–32 A in four frame sizes.

Application Description

With its small size, it can easily fit in place of existing soft starters, wye-delta starters, or across-the-line NEMA® and IEC starters. This feature allows easy upgrades to existing systems. The product is designed to be wired in the three-phase line feeding the three motor input leads as is done for normal across-the-line starting. The starter uses silicon controlled rectifiers (SCRs) to ramp the voltage to the motor, providing smooth acceleration and deceleration of the load. After the motor is started, the internal run bypass relay closes, resulting in the motor running directly across-the-line. Internal run bypass significantly reduces the heat generated as compared to non-bypass starters. The soft stop option allows for a ramp stop time that may be longer than the coast-to-stop time. An external overload protection relay is needed.

Operation

Voltage Ramp Start

This start method provides a voltage ramp to the motor, resulting in a constant torque increase. This most commonly used form of soft start mode allows you to set the initial voltage value and the duration of the ramp to full voltage conditions.

- Adjustable initial voltage 30–92% of full voltage (120/230 Vac control voltage)
- Adjustable initial voltage 30–100% of full voltage (24 Vac/Vdc control voltage)
- Adjustable ramp time 1–30 seconds
- Bypass relays close at the end the ramp time (TOR)

Soft Stop

Allows for a controlled stopping of load. Used when a stop-time that is greater than the coast-to-stop time is desired. Often used with high friction loads where a sudden stop may cause system or product damage. Setting the soft stop time to a value of 0 turns off this feature.

- Soft stop time = 0–30 seconds

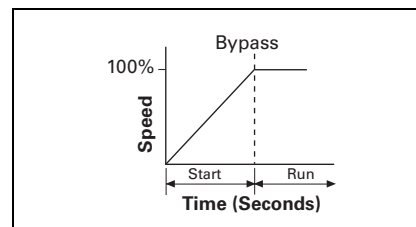


Figure 30.5-17. Start Ramp

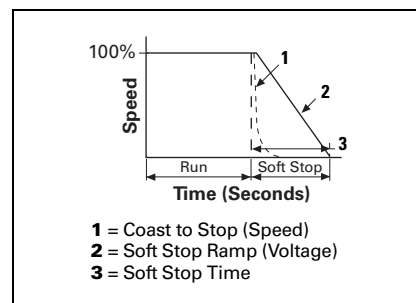


Figure 30.5-18. Stop Ramp

Auxiliary Contacts

Auxiliary contacts are provided to indicate soft start controller status.

Frame Size 1 (4A to 12A)—One Relay

The auxiliary relay indicates when the soft starter is at Top-of-Ramp (TOR).

Frame Size 2 (16A to 32A)—Two Relays

One auxiliary relay indicates when the soft starter is at Top-of-Ramp (TOR).

One auxiliary relay indicates that a RUN command is present, including start ramp, bypass and stop ramp times.

DS7 Soft Start Controllers

Features and Benefits

- Run bypass mode greatly reduces internal heating created by the power dissipation across the SCRs. The bypass relay directly connects the motor to the line and improves system efficiency by reducing internal power losses
- Less heat minimizes enclosure size and cooling requirements, and maximizes the life of all devices in the enclosure
- LED displays device status and provides fault indication
- Variable ramp times and voltage control (torque control) settings provide unlimited starting configurations, allowing for maximum application flexibility
- Soft stop control suits applications where an abrupt stop of the load is not acceptable. Soft acceleration and deceleration reduces wear on belts, gears, chains, clutches, shafts and bearings
- Minimizes the peak inrush current's stress on the power system. Peak starting torque can be managed to diminish mechanical system wear and damage
- 24 Vac/Vdc control voltage enhances personnel and equipment safety. 120/230 Vac control voltage is also available
- Auxiliary relays indicate status of the soft start controllers
 - The TOR relay is active until motor stop command is received and/or the soft start controller detects a fault condition
 - RUN relay is active during the start ramp, bypass and stop ramp

Protective Features

- Mains connection—The mains connection is monitored for a phase loss and/or undervoltage during ramp up
- Motor connection—The motor connection is monitored for an open condition during the ramp
- SCR faults—SCR performance is monitored during the ramp cycle for proper operation
- Heat sink over/under temperature—High ambient temperatures, extended ramp times and high duty cycle conditions may cause the DS7 to exceed its thermal rating. When temperature goes under -5°C , unit will trip as well. The DS7 is equipped with sensors that monitor the temperature of the device. The soft starter will trip in over/under temperature conditions, preventing device failure
- Warning is indicated for an over-temperature condition for the next start
- Bypass relay
 - The DS7 can detect if the bypass relay fails to close after the ramp start or opens while the motor is running
 - The DS7 will also detect a condition whereas the bypass relay is closed when the RUN command is given
 - The DS7 will trip on a bypass dropout fault if either of these conditions occur

Standards and Certifications

- IEC 60947-4-2
- EN 60947-4-2
- UL listed
- CSA certified
- CE marked
- C-Tick

Additional Information

- Instruction Leaflet IL03901001E

DS7 Soft Start Controllers

Product Selection

DS7 Soft Start Horsepower Ratings

Please refer to Application Note AP03901006E for additional information on proper size selection.

Table 30.5-29. DS7 Soft Start Controllers—Horsepower Ratings—10 Second Ramp, One Start per Hour, 300% Current Limit at 40 °C ①

Rated Current Amperes	Motor Power (hp)			Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended XTOB Overload (Direct Connect) ②	Recommended XTOE Overload ②	MMP ②	Connection Kit to MMP	Catalog Number
	200 V	230 V	480 V							
3.7	0.75	0.75	2	HFD3015	15A Class RK5	XTOB004BC1	XTOE005BCS	XTPR004BC1	XTPAXTPCB	DS7-340SX004NO-N ④ DS7-342SX004NO-N ⑤
6.9	1.5	2	3	HFD3015	15A Class RK5	XTOB006BC1 ③	XTOE020BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX007NO-N ④ DS7-342SX007NO-N ⑤
7.8	2	2	5	HFD3020	20A Class RK5	XTOB010BC1	XTOE020BCS	XTPR010BC1	XTPAXTPCB	DS7-340SX009NO-N ④ DS7-342SX009NO-N ⑤
11	3	3	7.5	HFD3030	20A Class RK5	XTOB012BC1	XTOE020BCS	XTPR012BC1	XTPAXTPCB	DS7-340SX012NO-N ④ DS7-342SX012NO-N ⑤
15.2	3	5	10	HFD3035	25A Class RK5	XTOB016CC1	XTOE020CCS	XTPR016BC1	XTPAXTPCC	DS7-340SX016NO-N ④ DS7-342SX016NO-N ⑤
22	5	7.5	15	HFD3060	40A Class RK5	XTOB024CC1	XTOE045CCS	XTPR025BC1	XTPAXTPCC	DS7-340SX024NO-N ④ DS7-342SX024NO-N ⑤
32	7.5	10	20	HFD3070	50A Class RK5	XTOB032CC1	XTOE045CCS	XTPR032BC1	XTPAXTPCC	DS7-340SX032NO-N ④ DS7-342SX032NO-N ⑤

① Actual motor FLAs vary. Verify these devices cover the motor specific FLA.

② Selections are based on motor FLA value at 480 V.

③ Not to be used with 230 V.

④ 24 Vac/Vdc device.

⑤ 120/230 Vac device.

Table 30.5-30. DS7 Soft Start Controllers—Horsepower Ratings—10 Second Ramp, One Start per Hour, 400% Current Limit at 40 °C ⑥

Rated Current Amperes	Motor Power (hp)			Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended XTOB Overload (Direct Connect) ⑦	Recommended XTOE Overload ⑦	MMP ⑦	Connection Kit to MMP	Catalog Number
	200 V	230 V	480 V							
3	0.5	0.5	1.5	HFD3015	15A Class RK5	XTOB004BC1	XTOE005BCS	XTPR004BC1	XTPAXTPCB	DS7-340SX004NO-N ⑨ DS7-342SX004NO-N ⑩
4.8	1	1	3	HFD3015	15A Class RK5	XTOB006BC1 ⑧	XTOE020BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX007NO-N ⑨ DS7-342SX007NO-N ⑩
6.9	1.5	2	3	HFD3020	20A Class RK5	XTOB006BC1	XTOE020BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX009NO-N ⑨ DS7-342SX009NO-N ⑩
9	2	2	5	HFD3030	20A Class RK5	XTOB010BC1	XTOE020BCS	XTPR010BC1	XTPAXTPCB	DS7-340SX012NO-N ⑨ DS7-342SX012NO-N ⑩
11	3	3	7.5	HFD3035	25A Class RK5	XTOB016CC1	XTOE020CCS	XTPR016BC1	XTPAXTPCC	DS7-340SX016NO-N ⑨ DS7-342SX016NO-N ⑩
17.5	5	5	10	HFD3060	40A Class RK5	XTOB016CC1	XTOE045CCS	XTPR016BC1	XTPAXTPCC	DS7-340SX024NO-N ⑨ DS7-342SX024NO-N ⑩
22	5	7.5	15	HFD3070	50A Class RK5	XTOB024CC1	XTOE045CCS	XTPR025BC1	XTPAXTPCC	DS7-340SX032NO-N ⑨ DS7-342SX032NO-N ⑩

⑥ Actual motor FLAs vary. Verify these devices cover the motor specific FLA.

⑦ Selections are based on motor FLA value at 480 V.

⑧ Not to be used with 230 V.

⑨ 24 Vac/Vdc device.

⑩ 120/230 Vac device.

DS7 Soft Start Controllers

DS7 Soft Start kW Ratings

Please refer to Application Note AP03901006E for additional information on proper size selection.

**Table 30.5-31. DS7 Soft Start Controllers—kW Ratings According to IEC 60947-4-2—
10 Second Ramp, One Start per Hour, 300% Current Limit at 40 °C ①**

Rated Current Amperes	Motor Power (kW)		Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended XTOB Overload (Direct Connect) ②	Recommended XTOE Overload ②	MMP ②	Connection Kit to MMP	Catalog Number
	230 V	400 V							
3.8	0.75	1.5	HFD3015	15A Class RK5	XTOB004BC1	XTOE005BCS	XTPR004BC1	XTPAXTPCB	DS7-340SX004NO-N ④ DS7-342SX004NO-N ⑤
7	1.5	3	HFD3015	15A Class RK5	XTOB006BC1 ③	XTOE020BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX007NO-N ④ DS7-342SX007NO-N ⑤
9	2.2	4	HFD3020	20A Class RK5	XTOB010BC1	XTOE020BCS	XTPR010BC1	XTPAXTPCB	DS7-340SX009NO-N ④ DS7-342SX009NO-N ⑤
12	3	5.5	HFD3030	20A Class RK5	XTOB012BC1	XTOE020BCS	XTPR012BC1	XTPAXTPCB	DS7-340SX012NO-N ④ DS7-342SX012NO-N ⑤
16	4	7.5	HFD3035	25A Class RK5	XTOB016CC1	XTOE020CCS	XTPR016BC1	XTPAXTPCC	DS7-340SX016NO-N ④ DS7-342SX016NO-N ⑤
24	5.5	11	HFD3060	40A Class RK5	XTOB024CC1	XTOE045CCS	XTPR025BC1	XTPAXTPCC	DS7-340SX024NO-N ④ DS7-342SX024NO-N ⑤
32	7.5	15	HFD3070	50A Class RK5	XTOB032CC1	XTOE045CCS	XTPR032BC1	XTPAXTPCC	DS7-340SX032NO-N ④ DS7-342SX032NO-N ⑤

① Actual motor FLAs vary. Verify these devices cover the motor specific FLA.

② Selections are based on motor FLA value at 480 V.

③ Not to be used with 230 V.

④ 24 Vac/Vdc device.

⑤ 120/230 Vac device.

**Table 30.5-32. DS7 Soft Start Controllers—kW Ratings According to IEC 60947-4-2—
10 Second Ramp, One Start per Hour, 400% Current Limit at 40 °C ⑥**

Rated Current Amperes	Motor Power (kW)		Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended XTOB Overload (Direct Connect) ⑦	Recommended XTOE Overload ⑦	MMP ⑦	Connection Kit to MMP	Catalog Number
	230 V	400 V							
2.5	0.33	1	HFD3015	15A Class RK5	XTOB004BC1	XTOE005BCS	XTPR004BC1	XTPAXTPCB	DS7-340SX004NO-N ⑨ DS7-342SX004NO-N ⑩
3.8	0.75	1.5	HFD3015	15A Class RK5	XTOB006BC1 ⑧	XTOE020BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX007NO-N ⑨ DS7-342SX007NO-N ⑩
7	1.5	3	HFD3020	20A Class RK5	XTOB006BC1	XTOE020BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX009NO-N ⑨ DS7-342SX009NO-N ⑩
9	2.2	4	HFD3030	20A Class RK5	XTOB010BC1	XTOE020BCS	XTPR010BC1	XTPAXTPCB	DS7-340SX012NO-N ⑨ DS7-342SX012NO-N ⑩
12	3	5.5	HFD3035	25A Class RK5	XTOB016CC1	XTOE020CCS	XTPR016BC1	XTPAXTPCC	DS7-340SX016NO-N ⑨ DS7-342SX016NO-N ⑩
16	4	7.5	HFD3060	40A Class RK5	XTOB016CC1	XTOE045CCS	XTPR016BC1	XTPAXTPCC	DS7-340SX024NO-N ⑨ DS7-342SX024NO-N ⑩
24	5.5	11	HFD3070	50A Class RK5	XTOB024CC1	XTOE045CCS	XTPR025BC1	XTPAXTPCC	DS7-340SX032NO-N ⑨ DS7-342SX032NO-N ⑩

⑥ Actual motor FLAs vary. Verify these devices cover the motor specific FLA.

⑦ Selections are based on motor FLA value at 480 V.

⑧ Not to be used with 230 V.

⑨ 24 Vac/Vdc device.

⑩ 120/230 Vac device.

Considerations

1. Either XTOB or XTOE or equivalent overload protection devices may be selected. In addition, manual motor protectors—MMP series can also be considered.
2. Isolation contactor is required for mains isolation.

24 Vdc Control Power

Eaton's ELC power supplies are recommended as a compact and low-cost source for 24 Vdc power. The light-weight, DIN rail mounted devices have a wide input voltage range and robust screw terminals make these power supplies easy to install and use. These power supplies are available in 1A and 2A models.

AC Control Power

24, 120 or 230 Vac may be used for control power in accordance with the model requirements.

Table 30.5-33. DC Power Supply Selection

Description	Catalog Number
85–264 V input and 24 V output 380–480 V input and 24 V output	ELC-PS01 PSS25F

DS7 Soft Start Controllers

Technical Data and Specifications

Table 30.5-34. DS7 Soft Start Controllers

Rated Control Circuit					
Voltage 24 Vac/Vdc Voltage 110/230 Vac	Unit	DS7-340SX004NO-N DS7-342SX004NO-N	DS7-340SX007NO-N DS7-342SX007NO-N	DS7-340SX009NO-N DS7-342SX009NO-N	DS7-340SX012NO-N DS7-342SX012NO-N
General					
Standards	—	IEC/EN 60947-4-2; GB14048.6; UL508; CSA-C22.2 No 0-M91; CSA-C22.2 No 14-05 CE marking	IEC/EN 60947-4-2; GB14048.6; UL508; CSA-C22.2 No 0-M91; CSA-C22.2 No 14-05 CE marking	IEC/EN 60947-4-2; GB14048.6; UL508; CSA-C22.2 No 0-M91; CSA-C22.2 No 14-05 CE marking	IEC/EN 60947-4-2; GB14048.6; UL508; CSA-C22.2 No 0-M91; CSA-C22.2 No 14-05 CE marking
Certifications/markings	—	UL/CE/CSA/C-Tick	UL/CE/CSA/C-Tick	UL/CE/CSA/C-Tick	UL/CE/CSA/C-Tick
Ambient temperature (operation)	°C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celsius to 60 °C
Ambient temperature (storage)	°C	–25 °C to +55 °C	–25 °C to +55 °C	–25 °C to +55 °C	–25 °C to +55 °C
Altitude	—	0–1000 m, above 1000 m derate linearly by 2.5% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 2.5% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 2.5% of rated current per 100 m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 2.5% of rated current per 100 m to a maximum of 2000 m
Installation	—	Vertical	Vertical	Vertical	Vertical
Protection class	—	IP20	IP20	IP20	IP20
Protection class applies to the front and operator control and display elements. Protection type from all sides is IP00.	—	With optional covers from the NZM range, protection type IP40 from all sides can be achieved	With optional covers from the NZM range, protection type IP40 from all sides can be achieved	With optional covers from the NZM range, protection type IP40 from all sides can be achieved	With optional covers from the NZM range, protection type IP40 from all sides can be achieved
Busbar tag shroud	—	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)
Overvoltage category/ pollution degree	—	II/2	II/2	II/2	II/2
Shock resistance	—	8g/11 ms	8g/11 ms	8g/11 ms	8g/11 ms
Vibration resistance according to EN 60721-3-2	—	2M2	2M2	2M2	2M2
Mean heat dissipation at rated duty cycle	W	0.2	0.35	0.35	0.6
Radio interference	—	B	B	B	B
Dimensions (W x H x D)	mm	45 x 130 x 95	45 x 130 x 95	45 x 130 x 95	45 x 130 x 95
	in	1.77 x 5.12 x 3.74	1.77 x 5.12 x 3.74	1.77 x 5.12 x 3.74	1.77 x 5.12 x 3.74
Weight	kg	0.35	0.35	0.35	0.35
	lb	0.77	0.77	0.77	0.77
Main Circuit					
Rated operational voltage	V	230–460 Vac	230–460 Vac	230–460 Vac	230–460 Vac
Mains frequency	Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Rated operation current AC 53	I _e	4	7	9	12
Motor Power Ratings					
200 V	hp	0.75	1.5	2	3
230 V	hp	0.75	2	2	5
480 V	hp	2	3	5	10
230 V	kW	0.75	1.5	2.2	3
400V	kW	1.5	3	4	5.5
Overload cycle according to EN 60947-4-2	—	4 A: AC53a; 3-5; 75-10	7 A: AC53a; 3-5; 75-10	9 A: AC53a; 3-5; 75-10	12 A: AC53a; 3-5; 75-10

DS7 Soft Start Controllers
Table 30.5-34. DS7 Soft Start Controllers (Continued)

Rated Control Circuit					
Voltage 24 Vac/Vdc Voltage 110/230 Vac	Unit	DS7-340SX004NO-N DS7-342SX004NO-N	DS7-340SX007NO-N DS7-342SX007NO-N	DS7-340SX009NO-N DS7-342SX009NO-N	DS7-340SX012NO-N DS7-342SX012NO-N
Wire Specifications					
Power terminals Single conductor—solid or stranded Terminal torque	AWG lb-in	18–10 11	18–10 11	18–10 11	18–10 11
Control signals Single conductor—solid or stranded Terminal torque	AWG lb-in	18–10 11	18–10 11	18–10 11	18–10 11
Power Section					
Rated impulse withstand voltage	U _{imp} 1.2/ 50 μs	4 kV	4 kV	4 kV	4 kV
Rated insulation voltage	—	500	500	500	500
Control Commands—Vac/Vdc					
Supply voltage control board U _s nominal	Vdc	20.4–26.4	20.4–26.4	20.4–26.4	20.4–26.4
Current consumption at 24 Vac/Vdc	mA	1.6	1.6	1.6	1.6
Pickup voltage	—	+17.3 to +27	+17.3 to +27	+17.3 to +27	+17.3 to +27
Dropout voltage	—	+3 to 0	+3 to 0	+3 to 0	+3 to 0
Relay Outputs					
Number of relays	—	1 (TOR)	1 (TOR)	1 (TOR)	1 (TOR)
Maximum voltage	Vac	250	250	250	250
Maximum current	A	1 A	1 A	1 A	1 A
Soft Start Functions					
Ramp times Start ramp Stop ramp	s s	1–30 0–30	1–30 0–30	1–30 0–30	1–30 0–30
Initial voltage % line voltage	—	30–100%	30–100%	30–100%	30–100%
Control Commands—Vac					
Supply voltage control board U _s nominal	Vac	102–253	102–253	102–253	102–253
Current consumption at 24 Vac/Vdc	mA	4	4	4	4
Pickup voltage	Vac	102–230	102–230	102–230	102–230
Dropout voltage	Vac	0–28	0–28	0–28	0–28
Relay Outputs					
Number of relays	—	1 (TOR)	1 (TOR)	1 (TOR)	1 (TOR)
Maximum voltage	Vac	250	250	250	250
Maximum current	A	3 A	3 A	3 A	3 A
Soft Start Functions					
Ramp times Start ramp Stop ramp	s s	1–30 0–30	1–30 0–30	1–30 0–30	1–30 0–30
Initial voltage % line voltage	—	30–92%	30–92%	30–92%	30–92%

DS7 Soft Start Controllers

Table 30.5-34. DS7 Soft Start Controllers (Continued)

Rated Control Circuit				
Voltage 24 Vac/Vdc Voltage 110/230 Vac	Unit	DS7-340SX016NO-N DS7-342SX016NO-N	DS7-340SX024NO-N DS7-342SX024NO-N	DS7-340SX032NO-N DS7-342SX032NO-N
General				
Standards	—	IEC/EN 60947-4-2; GB14048.6; UL508; CSA-C22.2 No 0-M91; CSA-C22.2 No 14-05 CE marking	IEC/EN 60947-4-2; GB14048.6; UL508; CSA-C22.2 No 0-M91; CSA-C22.2 No 14-05 CE marking	IEC/EN 60947-4-2; GB14048.6; UL508; CSA-C22.2 No 0-M91; CSA-C22.2 No 14-05 CE marking
Certifications/markings	—	UL/CE/CSA/C-Tick	UL/CE/CSA/C-Tick	UL/CE/CSA/C-Tick
Ambient temperature (operation)	°C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celcius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celcius to 60 °C	0 to 40 °C, above 40 °C derate linearly by 1% of rated current per Celcius to 60 °C
Ambient temperature (storage)	°C	–25 °C to +55 °C	–25 °C to +55 °C	–25 °C to +55 °C
Altitude	—	0–1000 m, above 1000 m derate linearly by 2.5% of rated current per 10 0m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 2.5% of rated current per 10 0m to a maximum of 2000 m	0–1000 m, above 1000 m derate linearly by 2.5% of rated current per 10 0m to a maximum of 2000 m
Installation	—	Vertical	Vertical	Vertical
Protection class	—	IP20	IP20	IP20
Protection class applies to the front and operator control and display elements. Protection type from all sides is IP00.	—	With optional covers from the NZM range, protection type IP40 from all sides can be achieved	With optional covers from the NZM range, protection type IP40 from all sides can be achieved	With optional covers from the NZM range, protection type IP40 from all sides can be achieved
Busbar tag shroud	—	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)
Overvoltage category/pollution degree	—	II/2	II/2	II/2
Shock resistance	—	8g/11 ms	8g/11 ms	8g/11 ms
Vibration resistance according to EN 60721-3-2	—	2M2	2M2	2M2
Mean heat dissipation at rated duty cycle	W	0.8	1.1	1.5
Radio interference	—	B	B	B
Dimensions (W x H x D)	mm	45 x 150 x 118	45 x 150 x 118	45 x 150 x 118
	in	1.77 x 5.12 x 3.74	1.77 x 5.12 x 3.74	1.77 x 5.12 x 3.74
Weight	kg	0.4	0.4	0.4
	lb	0.88	0.88	0.88
Main Circuit				
Rated operational voltage	V	230–460 Vac	230–460 Vac	230–460 Vac
Mains frequency	Hz	50/60 Hz	50/60 Hz	50/60 Hz
Rated operation current AC 53	I _e	16	24	32
Motor Power Ratings				
200 V	hp	3	5	10
230 V	hp	5	7.5	10
480 V	hp	10	15	25
230 V	kW	4	5.5	7.5
400 V	kW	7.5	11	15
Overload cycle according to EN 60947-4-2	—	16 A: AC53a; 3-5; 75-10	24 A: AC53a; 3-5; 75-10	32 A: AC53a; 3-5; 75-10

DS7 Soft Start Controllers

Table 30.5-34. DS7 Soft Start Controllers (Continued)

Rated Control Circuit				
Voltage 24 Vac/Vdc Voltage 110/230 Vac	Unit	DS7-340SX016NO-N DS7-342SX016NO-N	DS7-340SX024NO-N DS7-342SX024NO-N	DS7-340SX032NO-N DS7-342SX032NO-N
Wire Specifications				
Power terminals Single conductor—solid or stranded Terminal torque	AWG lb-in	18–6 11	18–6 11	18–6 11
Control Signals Single conductor—solid or stranded Terminal torque	AWG lb-in	18–10 11	18–10 11	18–10 11
Power Section				
Rated impulse withstand voltage	U _{imp} 1.2/ 50 μ s	4 kV	4 kV	4 kV
Rated insulation voltage	—	500	500	500
Control Commands—Vac/Vdc				
Supply voltage control board U _s nominal	Vdc	20.4–26.4	20.4–26.4	20.4–26.4
Current consumption at 24 Vac/Vdc	mA	1.6	1.6	1.6
Pickup voltage	—	+17.3 to +27	+17.3 to +27	+17.3 to +27
Dropout voltage	—	+3 to 0	+3 to 0	+3 to 0
Relay Outputs				
Number of relays	—	2 (TOR, Ready)	2 (TOR, Ready)	2 (TOR, Ready)
Maximum voltage	Vac	250	250	250
Maximum current	A	1 A	1 A	1 A
Soft Start Functions				
Ramp times Start ramp Stop ramp	s s	1–30 0–30	1–30 0–30	1–30 0–30
Initial voltage % line voltage	—	30–100%	30–100%	30–100%
Control Commands—Vac				
Supply voltage control board U _s nominal	Vac	102–253	102–253	102–253
Current consumption at 102–253 Vac	mA	4	4	4
Pickup voltage	Vac	102–230	102–230	102–230
Dropout voltage	Vac	0–28	0–28	0–28
Relay Outputs				
Number of relays	—	2 (TOR, Run)	2 (TOR, Run)	2 (TOR, Run)
Maximum voltage	Vac	250	250	250
Maximum current	A	3 A	3 A	3 A
Soft Start Functions				
Ramp times Start ramp Stop ramp	s s	1–30 0–30	1–30 0–30	1–30 0–30
Initial voltage % line voltage	—	30–92%	30–92%	30–92%

DS7 Soft Start Controllers

Dimensions—Approximate Dimensions in Inches (mm)

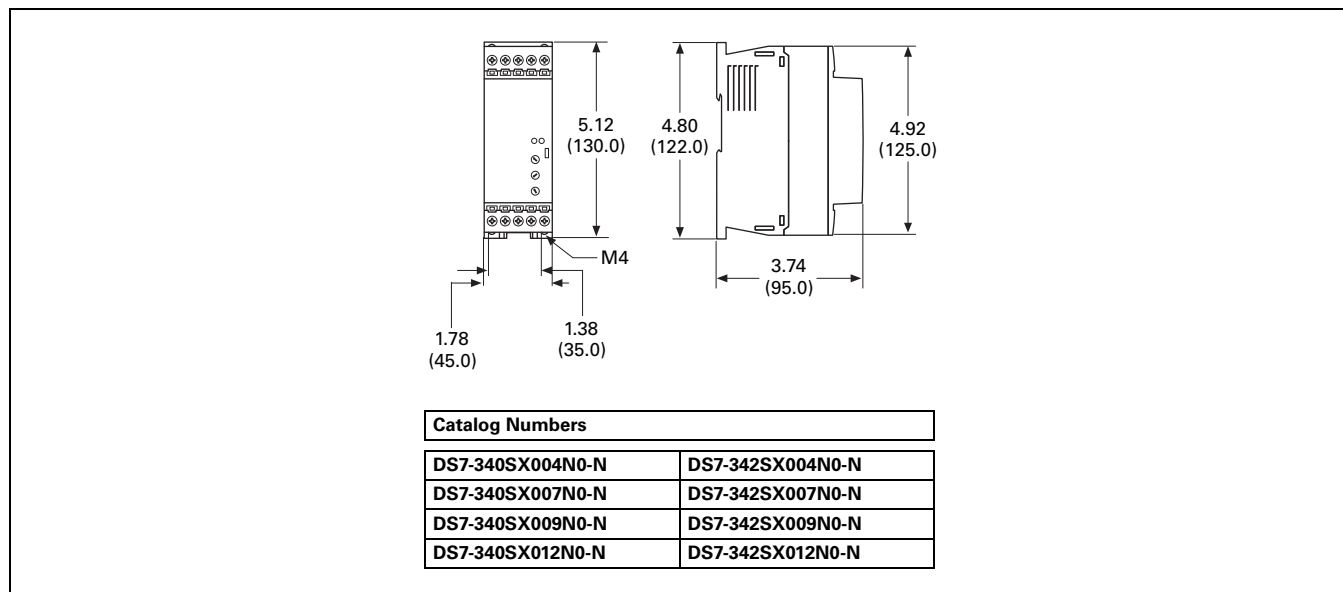


Figure 30.5-19. Frame Size 1

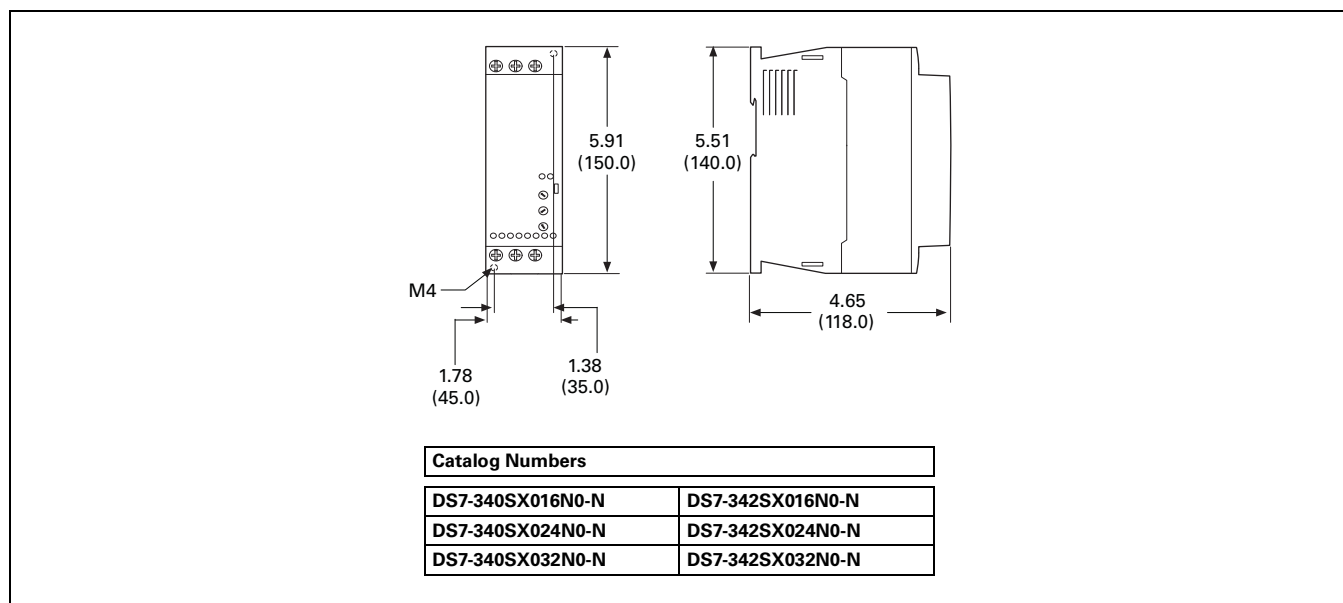


Figure 30.5-20. Frame Size 2

PSG Series DC Power Supplies

PSG Series DC Power Supplies



PSG Series

General Description

Eaton's PSG Series of power supplies is designed to be a high-performance, high-quality line of products covering a majority of 24 Vdc control applications. With global certifications, compact size and an impressive operating temperature range, the PSG Series fits a wide variety of applications at a competitive price.

Eight models are offered, from 2.5 A up to 20 A with both single- and three-phase input voltage models available.

Application Description

The PSG Series is a line of general-purpose power supplies for use in a wide variety of industrial control applications. Applications include communication networks, sensors, PLCs and many other electrical systems.

Each model is equipped with a rugged metal housing, heavy-duty screw terminals and a variety of protection features, making the PSG one of the most versatile industrial power supply lines on the market.

Features, Benefits and Functions

- Universal input voltages: 85–264 Vac for single-phase units, 320–575 Vac for three-phase units
- Rugged aluminum housing stands up to harsh environments
- Current surge (power boost) of 1.5 times nominal current for 1 second allows branch protection and powering of high pickup loads
- Wide operating temperature range: –20° C to +75 °C (derating above 50 °C)
- Adjustable DC voltage output
- LED indicating light for DC OK simplifies troubleshooting
- Compact size, with common depth and height across all models, allows for common panel depths and family consistency
- MTBF up to 800,000 hours ensures uptime and reliability
- Heavy-duty screw terminals with finger-safe protective cover allow use of ring-lug terminals
- All-metal DIN rail mounting hardware
- Class 1, Division 2 hazardous location rated

Standards and Certifications

- UL/cUL listed—UL 508 (industrial control equipment)
- cURus—UL 60950-1
- IEC
- EN
- German safety
- CSA certified (contact Eaton for certification dates and status)
- CE marked
- RoHS compliant

Product Selection

Table 30.5-35. Power Supply—Single-Phase

Description	Catalog Number
85–264 Vac input, 24 Vdc/2.5 A output	PSG60E
85–264 Vac input, 24 Vdc/5 A output	PSG120E
85–264 Vac input, 24 Vdc/10 A output	PSG240E
85–264 Vac input, 24 Vdc/20 A output	PSG480E

Table 30.5-36. Power Supply—Three-Phase

Description	Catalog Number
320–575 Vac input, 24 Vdc/2.5 A output	PSG60F
320–575 Vac input, 24 Vdc/5 A output	PSG120F
320–575 Vac input, 24 Vdc/10 A output	PSG240F
320–575 Vac input, 24 Vdc/20 A output	PSG480F

Technical Data and Specifications

Table 30.5-37. PSG Series DC Power Supplies

Capacity	PSG60E 60W	PSG120E 120W	PSG240E 240W	PSG480E 480W	PSG60F 60W	PSG120F 120W	PSG240F 240W	PSG480F 480W
Input								
Nominal voltage	100–240 Vac	100–240 Vac	100–240 Vac	100–240 Vac	3 x 400–500 Vac	3 x 400–500 Vac	3 x 400–500 Vac	3 x 400–500 Vac
Voltage range	②	②	②	②	③	③	③	③
Frequency	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)	47–63 Hz (0 Hz at DC input)
Nominal current ①	1.1 A	1.4 A	2.9 A	5.7 A	0.3 A	0.5 A	0.8 A	1.6 A
Inrush current limitation ①	30 A	<80 A	N/A	N/A	<30 A	<30 A	<40 A	<50 A
Mains buffering at nominal load (typ.) ①	>20 ms	>35 ms	>20 ms	>20 ms	>30 ms	>35 ms	>35 ms	>20 ms
Turn-on time	<2.5 sec	<1 sec	<1 sec	<1 sec	<2 sec	<1 sec	<1 sec	<1 sec
Internal fuse	T3.15 AH/250 V	T3.15 AH/250 V	T6.3AH/250 V	F10H/250 V	3.15AH/500 V	3.15AH/500 V	3.15AH/500 V	3.15AH/500V
External fusing	6 A, 10 A or 16 A	6 A, 10 A or 16 A	10 A or 16 A	10 A or 16 A	3 x circuit breakers 6 A, 10 A or 16 A	3 x circuit breakers 6 A, 10 A or 16 A	3 x circuit breakers 6 A, 10 A or 16 A	3 x circuit breakers 6 A, 10 A or 16 A
Leakage current	<1 mA	<1 mA	<3.5 mA	<1 mA	<3.5 mA	<3.5 mA	<3.5 mA	<3.5 mA

Output

Nominal output voltage	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%	24 Vdc ± 2%
Adjustment range	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc	22–28 Vdc
Nominal current	2.5 A	5 A	10 A	20 A	2.5 A	5 A	10 A	20 A
Startup with capacitive loads	Max. 8000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF	Max. 10,000 µF
Max. power dissipation idling nominal load approx.	10 W	22.5 W	42.5 W	72 W	9 W	18 W	36 W	72 W
Efficiency (at 400 Vac and nominal values)	>85% typ	>84% typ	>84% typ	>86% typ	>86% at 3 x 400 Vac; >85% at 3 x 500 Vac	>86% at 3 x 400 Vac; >85% at 3 x 500 Vac	>86% at 3 x 400 Vac; >85% at 3 x 500 Vac	>86% at 3 x 400 Vac; >85% at 3 x 500 Vac
Current surge (at 24 Vdc)	3.75 A	7.5 A	15 A	30 A	3.75 A	7.5 A	15 A	30 A
Current surge time/cycle	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)	1 sec. (at 10-sec. intervals)
Residual ripple/peak switching (20 MHz)	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp	<50 mV/ <240 mVpp
Parallel operation	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode	With O-ring Diode

Galvanic Isolation

Input/output	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)	4 kVAC (type test)/3 kVAC (routine test)
Input/ground	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)	1.5 kVAC (type test)/1.5 kVAC (routine test)
Output/ground	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)	1.5 kVAC (type test)/500 Vac (routine test)

① Ratings for single-phase models are at 115 Vac; three-phase models are at 400 Vac.

② 85–264 Vac (DC input range 120–375 Vdc).

③ 320–575 Vac (DC input range 450–800 Vdc).

PSG Series DC Power Supplies

Table 30.5-37. PSG Series DC Power Supplies (Continued)

Capacity	PSG60E 60W	PSG120E 120W	PSG240E 240W	PSG480E 480W	PSG60F 60W	PSG120F 120W	PSG240F 240W	PSG480F 480W
General/Physical Data								
Housing material	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)	Aluminum (Al5052)
Signals	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK	Green LED for DC OK
MTBF	>800,000 hrs	>800,000 hrs	>300,000 hrs	>300,000 hrs	>500,000 hrs	>500,000 hrs	>300,000 hrs	>300,000 hrs
Dimensions (L)	121 mm	121 mm	121 mm	121 mm	121 mm	121 mm	121 mm	121 mm
Dimensions (W)	32 mm	50 mm	85 mm	160 mm	70 mm	70 mm	85 mm	160 mm
Dimensions (H)	120 mm	115 mm	118.5 mm	115 mm	118.5 mm	118.5 mm	120.5 mm	115 mm
Weight (kg)	0.37	0.54	1.04	1.8	0.56	0.72	0.77	1.71
Operating temperature	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)	–20°C to +75°C (>50°C derating)
Storage temperature	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C
Operating humidity	<95% RH, non-condensing	<95% RH, non-condensing	<95% RH, non-condensing	<95% RH, non-condensing	<95% RH, non-condensing	<95% RH, non-condensing	<95% RH, non-condensing	<95% RH, non-condensing
Vibration (operating)	①	①	①	①	①	①	①	①
Pollution degree	2	2	2	2	2	2	2	2
Climatic class	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721	3K3 according to EN 60721

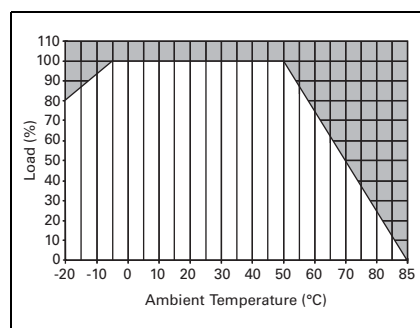
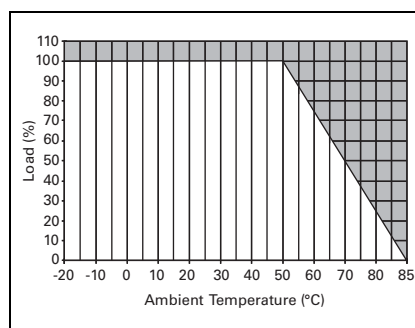
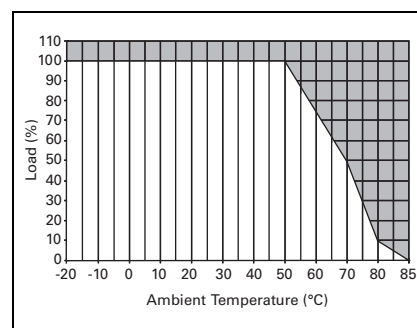
Safety and Protection

Transient surge voltage	Varistor	Varistor	Varistor	Varistor	Varistor	Varistor	Varistor	Varistor
Surge voltage protection against internal surge	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Safety class	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection	Class I with ground connection
Shock	②	②	②	②	②	②	②	②

① 10 to 150 Hz, 0.35 mm acc. 50 m/s/s, single amplitude (5G max.) for 90 min. in each X, Y, Z direction, in acc. with IEC 68-2-6.

② 30G (300 m/s/s) in all directions according to IEC 68-2-27.

Power Derating Curves


**Figure 30.5-21. Vertical Mounting Position
PSG60E**

**Figure 30.5-22. Vertical Mounting Position
PSG60F, PSG120E, PSG120F, PSG480E,
PSG480F**

**Figure 30.5-23. Vertical Mounting Position
PSG240E, PSG240F**

Dimensions—Approximate Dimensions in mm

Note: Dimensions are for reference only.

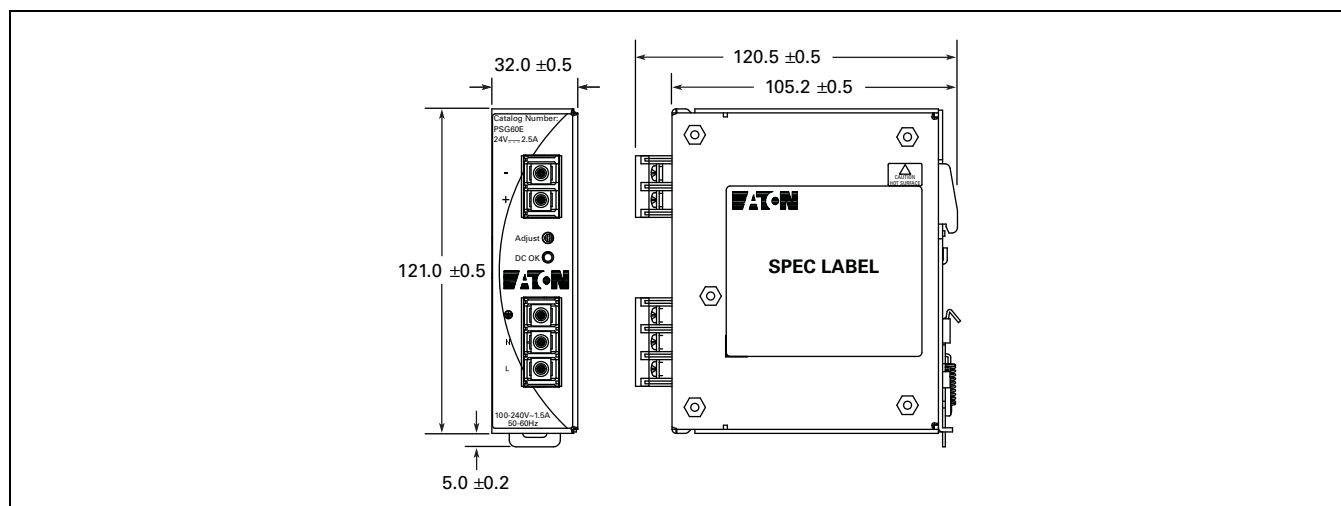


Figure 30.5-24. PSG60E

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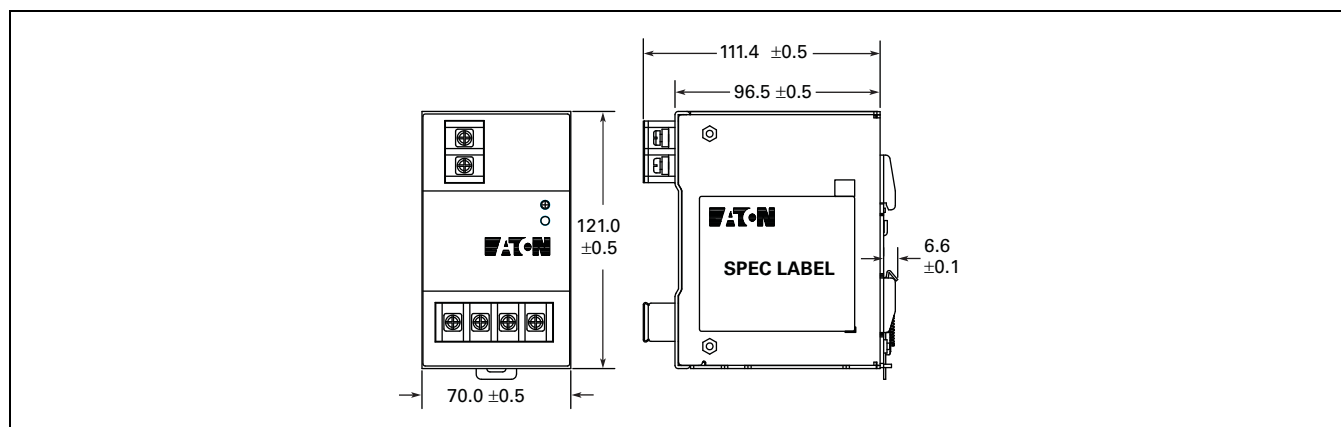


Figure 30.5-25. PSG60F

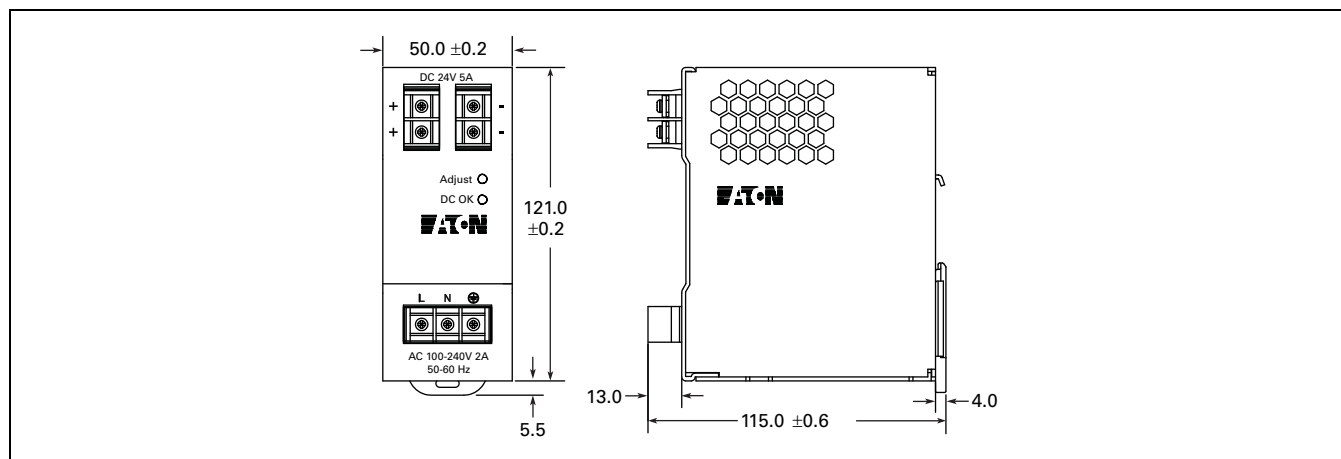


Figure 30.5-26. PSG120E

PSG Series DC Power Supplies

Dimensions—Approximate Dimensions in mm (Continued)

Note: Dimensions are for reference only.

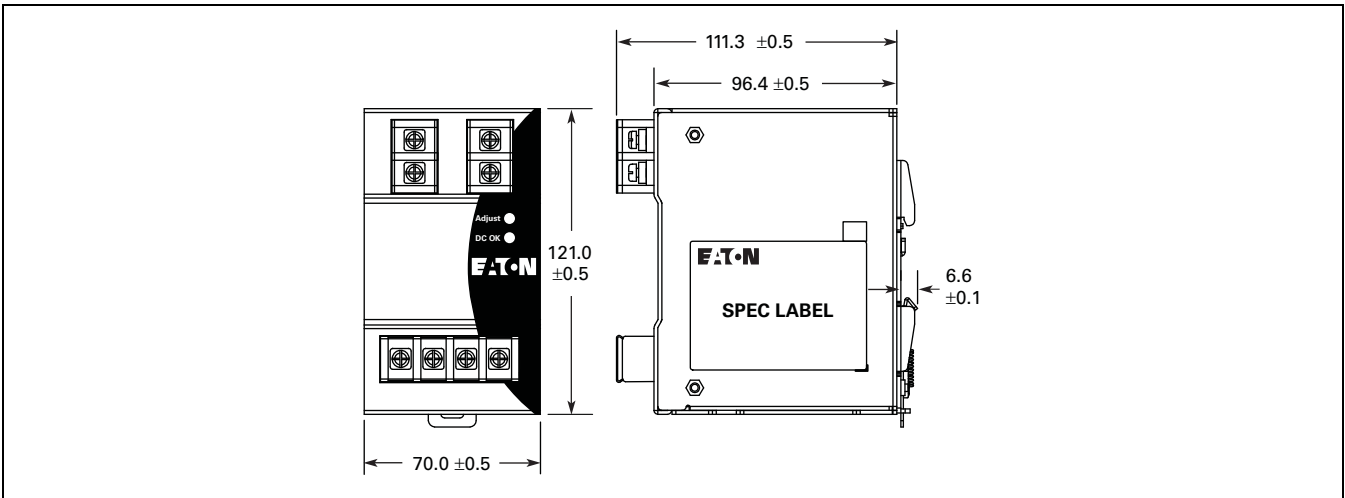


Figure 30.5-27. PSG120F

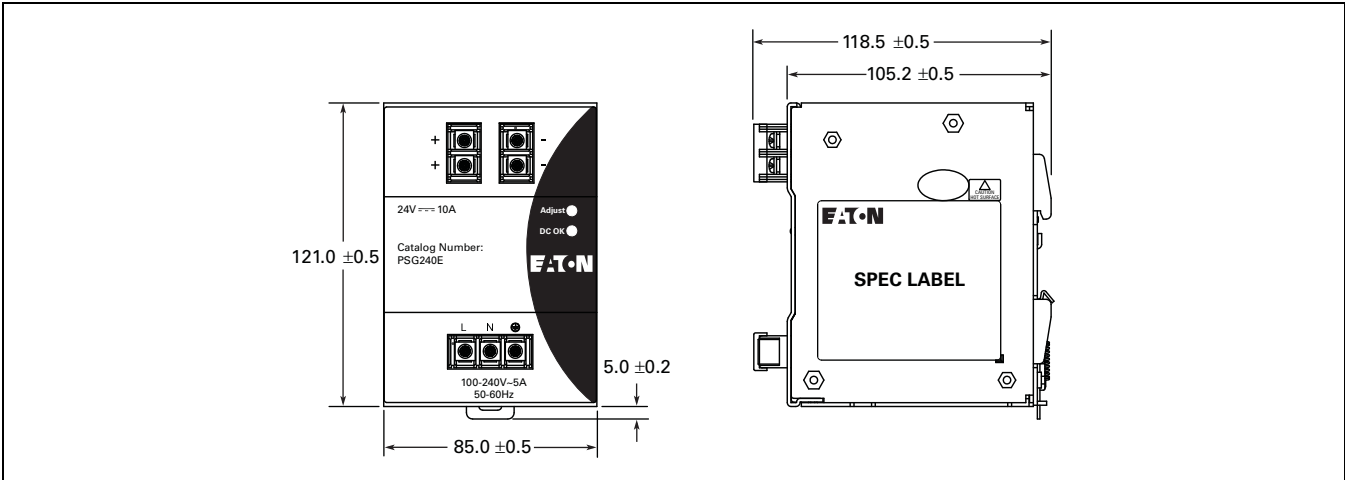


Figure 30.5-28. PSG240E

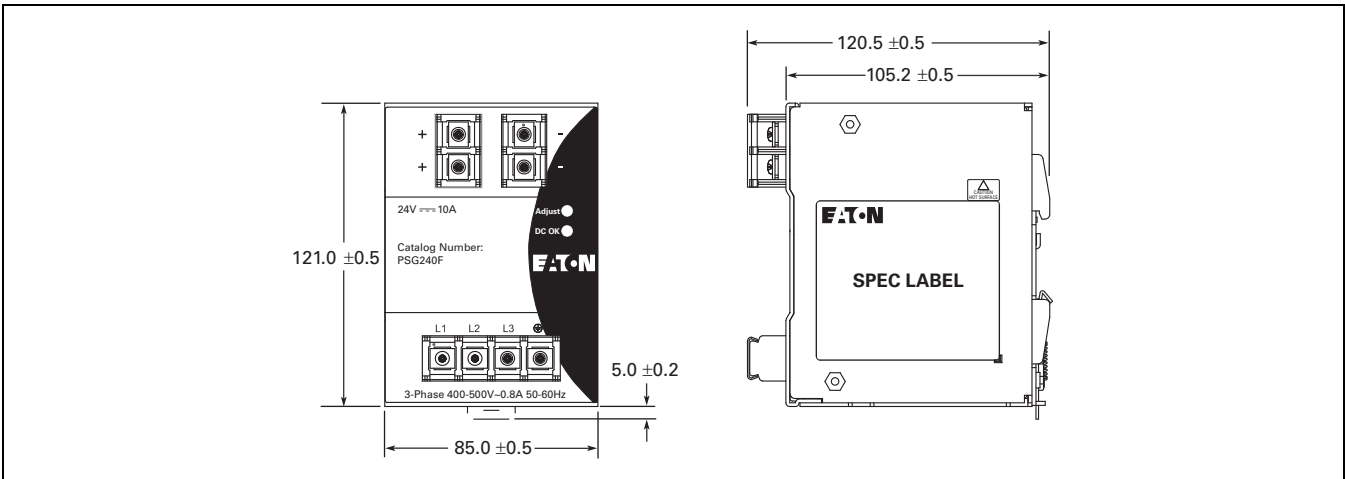


Figure 30.5-29. PSG240F

Dimensions—Approximate Dimensions in mm (Continued)

Note: Dimensions are for reference only.

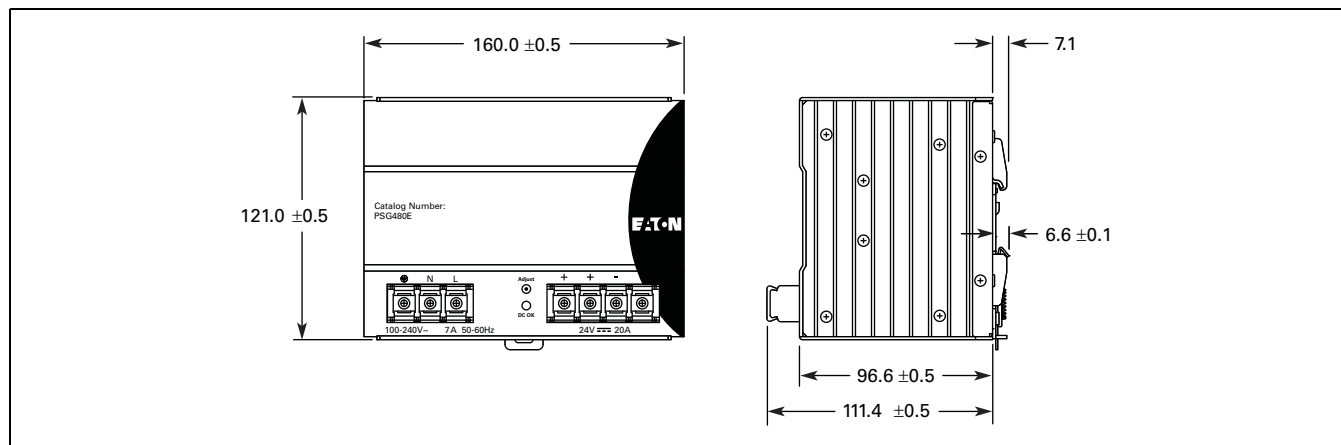


Figure 30.5-30. PSG480E

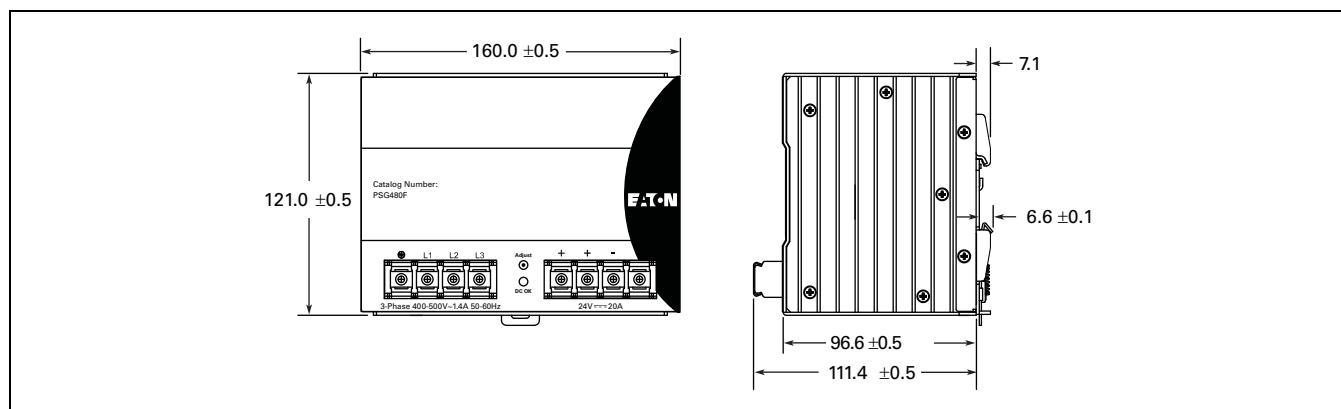


Figure 30.5-31. PSG480F

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General Information
**General Information—
Technical Reference**
Enclosure Types

Enclosures provide mechanical and electrical protection for operator and equipment. Brief descriptions of the various types of Eaton's enclosures offered by Eaton are given below. See NEMA Standards Publication No. 250 for more comprehensive descriptions, definitions and/or test criteria.


Type 1
Type 1 (Conforms to IP40)—for Indoor Use

Suitable for most applications where unusual service conditions do not exist and where a measure of protection from accidental contact with enclosed equipment is required. Designed to meet tests for rod entry and rust resistance. Enclosure is sheet steel, treated to resist corrosion. Depending on the size, knockouts are provided on the top, bottom and sometimes on the side.


Type 3R
Type 3R (Conforms to IP52)—for Outdoor Use

Primarily intended for applications where falling rain, sleet or external ice formations are present. Gasketed cover. Designed to meet tests for rain, rod entry, external icing and rust resistance. Enclosure is sheet steel, treated to resist corrosion. Depending on the size, a blank cover plate is attached to the top (for a conduit hub) and knockouts are provided on the bottom.

Cover-mounted pilot device holes are provided and covered with hole plugs.

Type 4 (Conforms to IP65)—for Indoor or Outdoor Use

Provide measure of protection from splashing water, hose-directed water and wind blown dust or rain. Constructed of sheet steel with gasketed cover.

Designed to meet tests for hose-down, external icing and corrosion protection. When conduit connections are specified, enclosure has two watertight hubs (power) installed top and bottom or one control hub installed in bottom—depending on size.

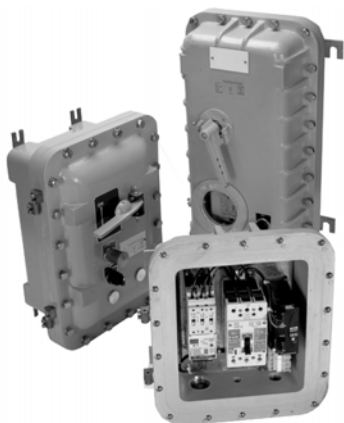
Cover-mounted pilot device holes are provided and covered with hole plugs.


Type 4X
Type 4X (Conforms to IP65)—for Indoor or Outdoor Use

Provide measure of protection from splashing water, hose-directed water, wind blown dust, rain and corrosion. Constructed of stainless steel with gasketed cover. Designed to meet same tests as Type 4 except enclosure must pass a 200-hour salt spray corrosion resistance test.

Provided as 304-grade stainless steel as standard. Select 316-grade option for improved corrosion resistance.

General Information



Type 7 & 9 Bolted

Type 7/9—for Hazardous Gas Locations

For use in Class I, Group B, C or D; Class II, Groups E, F and Class III indoor locations as defined in the National Electrical Code. Type 7/9 enclosures must withstand the pressure generated by explosion of internally trapped gases and be able to contain the explosion so that gases in the surrounding atmosphere are not ignited. Under normal operation, the surface temperature of the enclosure must be below the point where it could ignite explosive gases present in the surrounding atmosphere. Designed to meet explosion, temperature and hydrostatic design tests.



Type 12

Type 12—(Conforms to IP62)—for Indoor Use

Provide a degree of protection from dripping liquids (non-corrosive), falling dirt and dust. Designed to meet tests for drip, dust and rust resistance. Constructed of sheet steel. Hole plugs cover pilot device holes. There are no knockouts, hub cover plates or hubs installed.

Many Eaton Type 12 enclosures are suitable for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations as defined in the National Electrical Code.

Type 12—Safety Interlock

The Type 12 enclosure can be ordered with a safety interlock on the door that can be padlocked off. A vault-type door latch system is used. A tapered plate holds the gasketed door tight against the case edge to provide a positive seal. The special door interlock consists of the door handle and a screwdriver operated cover defeater.

The cover defeater and the disconnect interlock defeater are both recessed screwdriver operated devices which cannot be manipulated with other types of tools.

Table 30.6-1. IEC IP Index of Protection Ratings

1st Number	Description	2nd Number	Description
0	No protection	0	No protection
1	Protection against solid objects greater than 50 mm	1	Protection against vertically falling drops of water
2	Protection against solid objects greater than 12 mm	2	Protection against dripping water when tilted up to 15 degrees
3	Protection against solid objects greater than 2.5 mm	3	Protection against spraying water
4	Protection against solid objects greater than 1 mm	4	Protection against splashing water
5	Total protection against dust—limited ingress (dust protected)	5	Protection against water jets
6	Total protection against dust (dust-tight)	6	Protection against heavy seas
—	—	7	Protection against the effects of immersion
—	—	8	Protection against submersion

Table 30.6-2. NEMA Standard to IP Equivalence

Type	IP
1	40
3R	52
4	65
4X	65
12	62

General Information

Table 30.6-3. Enclosure Selection and Reference Chart—Box Dimensions in Inches (mm)

Box Designation	NEMA Enclosure Type	Width	Height	Depth
1	1	5.62 (142.7)	9.51 (241.6)	4.81 (122.2)
2	1	7.73 (196.3)	12.60 (320.0)	5.84 (148.3)
3	1	12.65 (321.3)	13.85 (351.8)	6.40 (162.6)
4	1	11.66 (296.2)	25.99 (660.1)	8.03 (204.0)
5	12, 3R, 4X	9.84 (250.0)	13.31 (338.1)	6.70 (170.2)
6	12, 3R, 4X	12.01 (305.1)	14.39 (365.5)	6.70 (170.2)
6A	12, 3R, 4X	12.01 (305.1)	14.39 (365.5)	8.44 (214.4)
7	12, 3R, 4X	12.26 (311.4)	14.37 (365.0)	6.70 (170.2)
7A	12, 3R, 4X	16.26 (413.0)	14.37 (365.0)	10.90 (276.9)
8	12, 3R, 4X	14.25 (362.0)	12.10 (307.3)	8.47 (215.1)
9	1, 12, 3R 4X	25.50 (647.7)	29.10 (739.1)	8.41 (213.6)
10	1, 12, 3R 4X	20.00 (508.0)	47.85 (1215.4)	10.48 (266.2)
A	1	10.50 (266.7)	27.06 (687.3)	6.66 (169.2)
A	12, 3R, 4X	10.50 (266.7)	28.98 (736.1)	6.66 (169.2)
A1	1	10.50 (266.7)	27.06 (687.3)	8.49 (215.6)
A1	12, 3R, 4X	10.50 (266.7)	28.98 (736.1)	8.49 (215.6)
B	1	15.50 (393.7)	23.06 (585.7)	6.66 (169.2)
B	12, 3R, 4X	15.50 (393.7)	24.98 (634.5)	6.66 (169.2)
B1	1	15.50 (393.7)	23.06 (585.7)	10.90 (276.9)
B1	12, 3R, 4X	15.50 (393.7)	24.98 (634.5)	10.90 (276.9)
C	1	20.50 (520.7)	30.50 (774.7)	8.44 (214.4)
C	12, 3R, 4X	20.50 (520.7)	32.36 (822.0)	8.44 (214.4)
D	1	29.50 (749.3)	35.00 (889.0)	8.75 (222.3)
D	12, 3R, 4X	29.50 (749.3)	38.10 (967.7)	8.75 (222.3)
E	1, 12, 3R, 4X	28.00 (711.2)	61.75 (1568.5)	10.68 (271.3)
F1E	1, 12, 3R, 4X	37.00 (940.0)	74.75 (1898.7)	19.25 (489.0)
F2E	1, 12, 3R, 4X	42.00 (1066.8)	92.90 (2360.0)	19.25 (489.0)
P1	1	8.50 (215.9)	32.98 (837.7)	6.66 (169.2)
P3	1	18.86 (479.0)	38.40 (975.4)	8.47 (215.1)
P5	1	21.00 (533.4)	48.40 (1229.4)	8.97 (227.8)
P7	1	28.80 (731.5)	60.58 (1538.7)	19.28 (489.7)
I	1, 12	8.62 (219.0)	27.06 (687.3)	6.66 (169.2)
J	1, 12, 3R	8.00 (203.2)	16.50 (419.1)	17.23 (437.6)
K	1, 12, 3R	8.00 (203.2)	19.50 (495.3)	7.23 (183.6)
L	1, 12, 3R	15.87 (403.1)	16.50 (419.1)	7.23 (183.6)
M	1, 12	15.87 (403.1)	24.50 (622.3)	7.23 (183.6)

Note: See Eaton's Enclosed Control guide or Web site for further details on enclosures.

Table 30.6-4. Noncombination Solid-State Reduced Voltage
Box Dimensions

Ampere Rating	SSRV	Non-combination Box No. ①	Ampere Rating	SSRV	Non-combination Box No. ①
0.8–27	S752	6A ②	304	S801/S811	G1
37	S801/S811	7A	360	S801/S811	G1
50	S752	6A ②	420	S801/S811	10
66	S801/S811	7A	500	S801/S811	10
105	S801/S811	7A	650	S801/S811	10
135	S801/S811	B1	720	S801/S811	10
180	S801/S811	C	850	S801/S811	10
240	S801/S811	G1	1000	S801/S811	10

① Enclosure space will also accommodate for a DC Power Supply, two four-pole relays, a CPT and terminal blocks. Also includes space for a DNA module or MOV.

② Same as footnote ①, but CPT is not included. Upsize to 7A enclosure to include space for a CPT and a full voltage bypass contactor.

Table 30.6-5. Combination Solid-State Reduced Voltage Box Dimensions

Ampere Rating	SSRV	Comb. with Fuses Box No. ③	Comb. with HMCP Box No. ③	Ampere Rating	SSRV	Comb. with Fuses Box No. ③	Comb. with HMCP Box No. ③
0.8–27	S752	B1 ④	A1 ⑤	304	S801/S811	F1E	E
37	S801/S811	B1	A1 ⑤	360	S801/S811	F1E	E
50	S752	C	A1 ⑤	420	S801/S811	F1E	E
66	S801/S811	C	A1	500	S801/S811	F1E	E
105	S801/S811	D	B1	650	S801/S811	F1E	F1E
135	S801/S811	D	C	720	S801/S811	F1E	F1E
180	S801/S811	E	E	850	S801/S811	F1E	F1E
240	S801/S811	F1E	E	1000	S801/S811	F1E	F1E

③ Enclosure space will also accommodate for a DC Power Supply, two four-pole relays, a CPT and terminal blocks. Also includes space for a DNA module or MOV.

④ Enclosure may be reduced to an A1, with all space for all items as in footnote ③, excluding relays and CPTs.

⑤ Same as footnote ③, but CPT is not included. Upsize to B1 enclosure to include space for a CPT and a full voltage bypass contactor.

Note: For enclosure box dimensions, refer to table above.

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Group Control Multi-Pak

Group Control Multi-Pak



Multi-Pak Four Compartment Enclosure
*Showing Variety of Possible Equipment
Module Combinations Available*

Application Description

Eaton's Multi-Pak Group Control is designed to save time, space, and expense in installing motor control devices—whether for residential, commercial, or industrial buildings. The modular assembly allows versatile, on-the-job arrangement of Sizes 1 through 4 combination starters with ambient compensated relays, incoming or feeder circuit breakers or fusible disconnect switches, pushbuttons, control transformers, timers, relays, and fuses. The enclosures and separate, pre-wired modules are field-stocked and can be ordered individually, permitting field tailoring to suit the application.

Benefits

- Enclosures and pre-wired equipment modules are individually available from stock. Each shipping carton contains complete mounting and installation instructions
- Cuts installation time by 25 percent. The pre-wired modules can be installed easily, using only a screwdriver, at the job site

- Saves space over individually mounted control
- Can be wall or rack mounted
- Has flexible panel space for auxiliary control items. Barriers can be removed to provide oversized compartments
- Eliminates square duct or cable entrance box
- Simplifies wiring
- Permits quick, easy additions and rearrangements
- UL listed—E69852, Guide NITW

Enclosure Features

The Type 1 enclosures are partitioned into either four or six compartments, to hold combination starter modules, incoming or feeder circuit breakers, fusible switches, or other auxiliary devices. The barriers can be removed to provide oversized spaces. Each enclosure holds up to four Size 1 or 2 full-voltage, non-reversing combination starter modules; up to two Size 3 or 4 starter modules, or a combination of both size ranges.

The compartments have hinged doors, interlocked to prevent opening when the breaker switch is in the ON position. The disconnect operating mechanism can be padlocked in the OFF position.

The Multi-Pak enclosure adapts easily to installation requirements. Multiple units can be arranged to suit the space available—horizontally on a single line or two-high. Knockouts are provided at the top, bottom and sides of the enclosures for conduit connection. Conduit can be installed and cables pulled as dictated by the construction schedule. Combination starter modules and incoming or feeder devices can be installed days, months or years later.

In addition to the barrier compartments, the enclosure contains two wiring troughs. The top section is a wireway fitted with three power terminal straps, each having terminals for extension to adjoining enclosures and to all four compartments. The incoming line and extension terminals are suitable for either copper or aluminum conductors, from No. 6 to 350 kcmil. At the bottom of the enclosure is another wiring trough for interconnecting wiring and outgoing cables.

Hinging of the front doors provides for easy access to each module. The doors are also gasketed with a fire-retardant material. Knockouts are provided on the doors for the mounting of pushbuttons and indicating lights.

The enclosure and wireway cover plates come in ASA-70 light gray enamel. An identification card retainer is mounted on each compartment door. A dust- and weather-resistant enclosure to house the Type 1 enclosure is also available.



Typical Six Compartment Multi-Pak
After Assembly

Combination Starter Modules

Eaton's starter modules consist of a Class A200 magnetic line-starter, prewired with a motor circuit protector or a fusible DS disconnect switch on a panel. Full-voltage non-reversing and reversing, combination starters are available. An external reset button is mounted on the starter module door. With its versatile, modular design, the Multi-Pak starter permits a variety of motor control groupings. One module can contain many different arrangements of devices, such as combination linestarter with control transformers, and/or relays, or two feeder circuit breakers, or fusible switches.

The contactor design comprises a glass polyester case with silver-cadmium oxide alloy contacts, straight-through wiring, out-front terminals, molded coils, stainless steel kickout springs, U-type magnet, and a shock absorber baseplate.

The circuit breakers, equipped with adjustable magnetic trip elements, protect against short circuits. Standard three-pole, inverse-time, and ambient compensated thermal overload relays protect against overload.

Fusible switches are equipped to accept either 250 V or 600 V Class H, K, and R cartridges fuses, with capacities as listed by Underwriters Laboratories for overcurrent protection.

ON-OFF operating mechanisms are molded from an ABS fire-resistant material.

Components of each module have individual printed labels identifying size, voltage, ampere rating and so on. The labels also contain a schematic drawing reference number covering the wiring of the component contained in the module.

Technical Data

Dimensions and Wiring Arrangements

Four compartment enclosures are 32.00 inches (812.8 mm) wide, 26.00 inches (660.4 mm) high, and 7.00 inches (177.8 mm) deep with provisions for four-bolt wall mounting. Six compartment enclosures are an additional 16.00 (406.4) inches wide. Enclosures may be grouped together by nipping through knockouts provided.

Load and control conduits may enter at the top or bottom. Starter wiring diagram and overload heater installation instructions are attached to each starter door.

Dust and weather-resistant enclosures for four or six module units are available. These enclosures are 34.00 inches (863.6 mm) or 50.00 inches (1270.0 mm) wide, 31.00 inches (787.4 mm) high, and 11.75 inches (298.5 mm) deep.

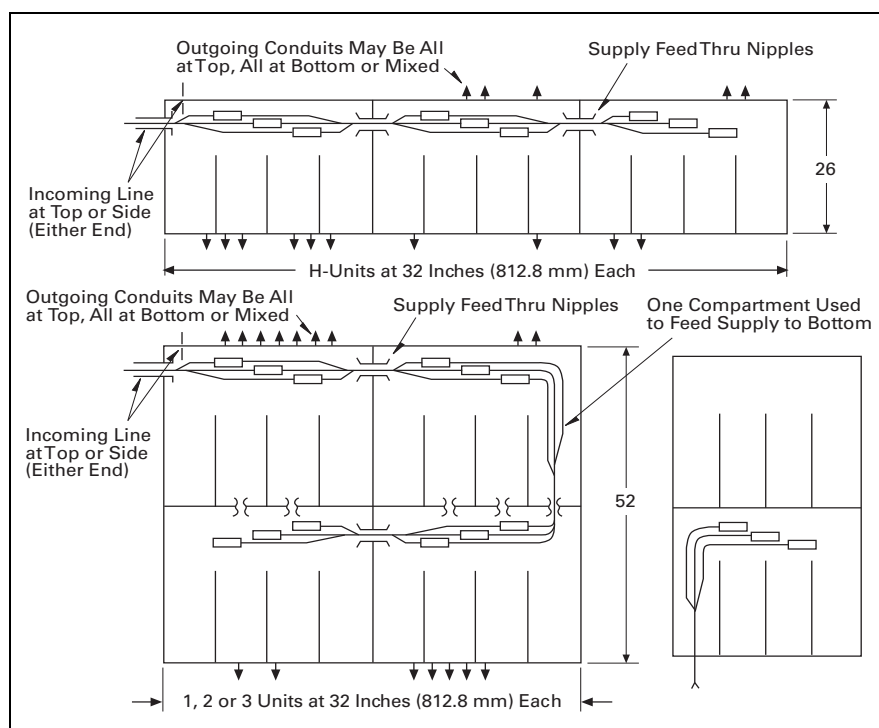


Figure 30.7-1. Wiring Arrangements

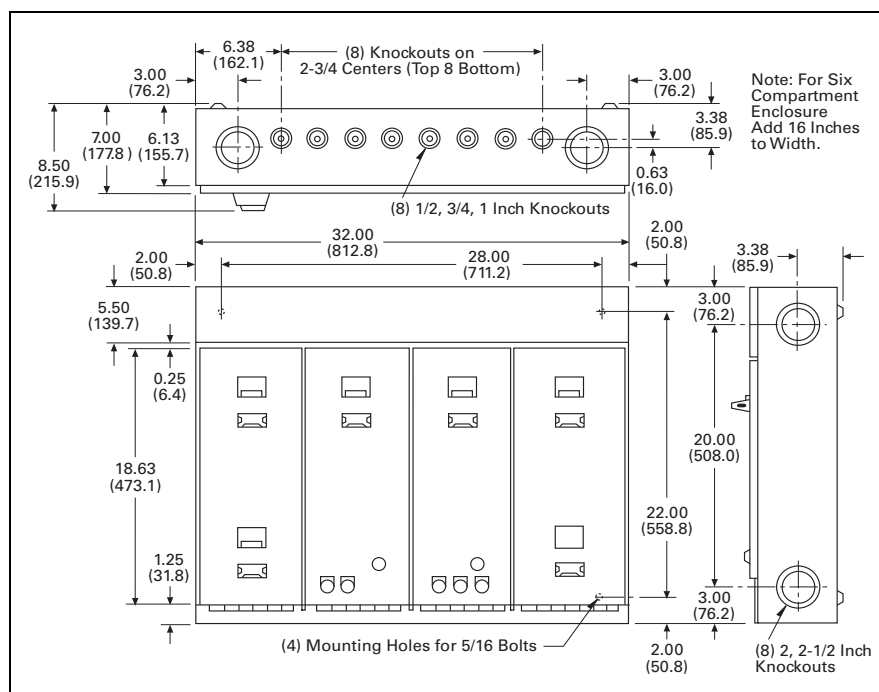


Figure 30.7-2. Type 1 Enclosures—Dimensions in Inches (mm)