

Electrical Sector Solutions

Volume 6: Solid-State Motor Control

EATON

Powering Business Worldwide

Volume 1—Residential and Light Commercial

1

Volume 2—Commercial Distribution

2

Volume 3—Power Distribution and Control Assemblies

3

Volume 4—Circuit Protection

4

Volume 5—Motor Control and Protection

5

Volume 6—Solid-State Motor Control

6

Tab 1—Reduced Voltage Motor Starters V6-T1-1

Tab 2—Adjustable Frequency Drives V6-T2-1

Appendix 1—Eaton Terms & Conditions V6-A1-1

Appendix 2—Catalog Parent Number Index V6-A2-1

Appendix 3—Alphabetical Product Index V6-A3-1



Volume 7—Logic Control, Operator Interface and Connectivity Solutions

7

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Solutions

Eaton takes the complexity out of power systems management with a holistic and strategic approach, leveraging our industry-leading technology, solutions and services. We focus on the following three areas in all we do:

- Reliability—maintain the appropriate level of power continuity without disruption or unexpected downtime
- Efficiency—minimize energy usage, operating costs, equipment footprint and environmental impact
- Safety—identify and mitigate electrical hazards to protect what you value most

Using the Eaton Catalog Library

As we grow, it becomes increasingly difficult to include all products in one or two comprehensive catalogs. Knowing that each user has their specific needs, we have created a library of catalogs for our products that when complete, will contain 15 volumes. Since the volumes will continuously be a work in progress and updated, each volume will stand alone. Refer to our volume directory, MZ08100001E, for a quick glance of where to look for the products you need. The 15 volumes include:

- Volume 1—Residential and Light Commercial (CA08100002E)
- Volume 2—Commercial Distribution (CA08100003E)
- Volume 3—Power Distribution and Control Assemblies (CA08100004E)
- Volume 4—Circuit Protection (CA08100005E)
- Volume 5—Motor Control and Protection (CA08100006E)
- Volume 6—Solid-State Motor Control (CA08100007E)
- Volume 7—Logic Control, Operator Interface and Connectivity Solutions (CA08100008E)
- Volume 8—Sensing Solutions (CA08100010E)
- Volume 9—Original Equipment Manufacturer (CA08100011E)
- Volume 10—Enclosed Control (CA08100012E)
- Volume 11—Vehicle and Commercial Controls (CA08100013E)
- Volume 12—Aftermarket, Renewal Parts and Life Extension Solutions (CA08100014E)
- Volume 13—Counters, Timers and Tachometers (CA08100015E)—Available in electronic format only
- Volume 14—Fuses (CA08100016E)—Available in electronic format only
- Volume 15—Solar Inverters and Electrical Balance of System (CA08100018E)

These volumes are not all-inclusive of every product, but they are meant to be an overview of our product lines. For our full range of product solutions and additional product information, consult Eaton.com/electrical and other catalogs and product guides in our literature library.

These references include:

- The Consulting Application Guide (CA08104001E)
- The Eaton Power Quality Product Guide (COR01FYA)

If you don't have the volume that contains the product or information that you are looking for, not to worry. You can access every volume of the catalog library at Eaton.com/electrical in the Literature Library.

By installing our Automatic Tab Updater (ATU), you can be sure you always have the most recent version of each volume and tab.

Introduction

Icons

Green Leaf



Eaton Green Solutions are products, systems or solutions that represent Eaton benchmarks for environmental performance. The green leaf symbol is our promise that the solution has been reviewed and documented as offering exceptional, industry-leading environmental benefits to customers, consumers and our communities. Though all of Eaton's products and solutions are designed to meet or exceed applicable government standards related to protecting the environment, our products with the Green Leaf designation further provide "exceptional environmental benefit".

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Contact Us

If you need additional help, you can find contact information under the Customer Care heading of Eaton.com/electrical.

Soft Start Controllers



DS7 Soft Starter Controller

1.1 Solid-State Controllers

Product Overview	V6-T1-2
Type S701, Soft Start Controllers	V6-T1-3
Type S701, Soft Start Controllers with Auxiliary Contact	V6-T1-9
Type S701, Soft Start Controllers with Brake	V6-T1-12
Type S511, Semiconductor Reversing Contactors	V6-T1-15
DS7 Soft Start Controllers	V6-T1-19

1.2 Solid-State Starters

Product Overview	V6-T1-43
Type S611, Solid-State Soft Starters	V6-T1-44
Type S801+, Soft Starters	V6-T1-61
Type S811+, Soft Starters with DIM	V6-T1-77

Learn Online Drawings Online



S611 Soft Starters



S811+ Soft Starters



Soft Start Controllers**Product Overview****Type S701**

The S701 device is a reduced voltage soft start controller designed to control acceleration and deceleration of three-phase motors. The S701 provides the user with the ability to adjust initial torque, ramp up and down time, and also select kick start for high inertial loads.

Type S701 with Auxiliary Contact

The S701 device is a reduced voltage soft start controller designed to control acceleration and deceleration of three-phase motors. With the auxiliary contact, it is possible to control an external bypass to reduce heating and increase acceleration and deceleration times.

The unit provides the user with the ability to adjust initial torque, ramp up and down time and also select kick start for high inertia loads.

Semiconductor Reversing Contactor

The S511 device is a semiconductor reversing contactor designed to switch three-phase motors forward and reverse. Unicore electronics and thermal design ensures high switching capacity and long lifetime.

DS7

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 4–32A in four frame sizes.

Contents**Description****Page**

Soft Start Controllers	V6-T1-3
Type S701, Soft Start Controllers	V6-T1-9
Type S701, Soft Start Controllers with Auxiliary Contact	V6-T1-12
Type S701, Soft Start Controllers with Brake	V6-T1-15
Type S511, Semiconductor Reversing Contactors	V6-T1-19
DS7 Soft Start Controllers	

Type S701, Soft Start Controllers**Contents****Description**

	Page
Type S701, Soft Start Controllers	V6-T1-4
Standards and Certifications	V6-T1-4
Catalog Number Selection	V6-T1-4
Product Selection	V6-T1-4
Technical Data and Specifications	V6-T1-5
Dimensions	V6-T1-8
Type S701, Soft Start Controllers with Auxiliary Contact	V6-T1-9
Type S701, Soft Start Controllers with Brake	V6-T1-12
Type S511, Semiconductor Reversing Contactors	V6-T1-15
DS7 Soft Start Controllers	V6-T1-19

Type S701, Soft Start Controllers**Product Description**

The S701 device is a reduced voltage soft start controller designed to control acceleration and deceleration of three-phase motors. The S701 provides the user with the ability to adjust initial torque, ramp up and down time, and also select kick start for high inertial loads.

Application Description

The S701 line of soft start controllers is specifically designed to be a low cost option for soft starting small (15 hp and down) three-phase motors. The S701 unit controls current on two of three motor phases to control the torque being applied to the motor, allowing for smooth starting of a motor. The S701 is designed to be used with a manual motor starter or a full voltage starter. These devices provide the necessary overload protection for the motor and also provide line isolation for the motor. Short-circuit protection can be provided by fuses or circuit breakers.

Features

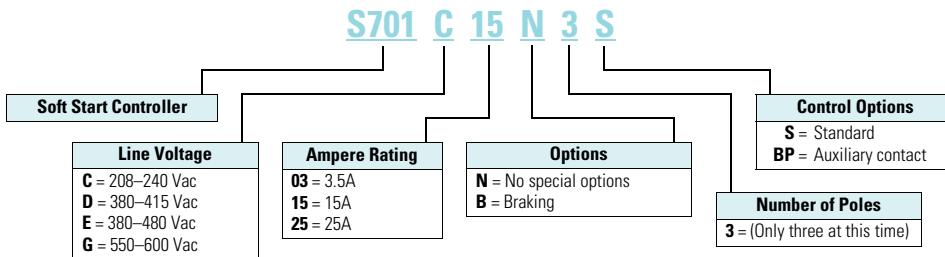
- Rated operational voltage up to 600 Vac
- Control voltage range from 24–480 Vac/Vdc
- Adjustable ramp times (0.5–10 seconds)
- Adjustable initial torque control (0–85%)
- Kick start feature
- Soft stop (0.5–10 seconds)
- Unlimited number of START/STOP operations per hour
- IP20 finger protection
- Fractional to 15 hp motors at 480V (20 hp at 600V)

Benefits

- Reduced wear on belts, gears, chains, clutches, shafts and bearings
- Allows for controlling the inrush current to the motor
- Reduced water-hammer in pumping applications
- Less shock to product on conveyor lines and material handling gear

Standards and Certifications

- IEC 947 compliant
- EN 60947-4-2
- CE marked
- CSA certified
- UL listed (E108212)
- cUL listed

**Catalog Number Selection****S701 Soft Starters****Product Selection**

S701E15N3S Soft Start Controllers



Max. Current	Line Voltage	Control Voltage (Vac/Vdc)	Three-Phase Motor kW Rating (50 Hz)			hp Rating (60 Hz)						Catalog Number	
			230V	380–400V	440V	200V	1.0 SF	1.15 SF	230V	1.0 SF	1.15 SF	460V	
3.5	208–240	24–240	7.5	N/A	N/A	1	1	1	1	N/A	N/A	N/A	S701C03N3S
3.5	380–415	24–300	N/A	1.1	N/A	N/A	N/A	N/A	N/A	1-1/2	1-1/2	N/A	S701D03N3S
3.5	440–480	24–300	N/A	N/A	1.5	N/A	N/A	N/A	N/A	2	2	N/A	S701E03N3S
3.5	500–600	24–300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	S701G03N3S
15	208–240	24–240	4	N/A	N/A	3	3	3	3	N/A	N/A	N/A	S701C15N3S
15	380–480	24–300	N/A	5.5	7.5	N/A	N/A	N/A	N/A	10	7-1/2	N/A	S701E15N3S
15	500–600	24–300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	S701G15N3S
25	208–240	24–240	7.5	N/A	N/A	5	5	7-1/2	5	N/A	N/A	N/A	S701C25N3S
25	380–480	24–300	N/A	11	12.5	N/A	N/A	N/A	N/A	15	15	N/A	S701E25N3S
25	500–600	24–300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	S701G25N3S

Technical Data and Specifications

1

Soft Starters—S701_03N3S

Description	S701C03N3S	S701D03N3S	S701E03N3S	S701G03N3S
Maximum current capacity	3.5	3.5	3.5	3.5
Trip Class				
10A	3.5	3.5	3.5	3.5
10	3.5	3.5	3.5	3.5
20	2.8	2.8	2.8	2.8
30	2.1	2.1	2.1	2.1
Electrical Characteristics				
Line voltage (Vac)	208–240	380–415	440–480	500–600
Operating frequency (Hz)	50/60	50/60	50/60	50/60
Leakage current	5 mA AC max.			
Minimum operational current	50 mA	50 mA	50 mA	50 mA
Control voltage (Vac/Vdc)	24–240	24–300	24–300	24–300
Pickup voltage max.	20.4 Vac/Vdc	20.4 Vac/Vdc	20.4 Vac/Vdc	20.4 Vac/Vdc
Dropout voltage min.	5 Vac/Vdc	5 Vac/Vdc	5 Vac/Vdc	5 Vac/Vdc
Max. control current for no operation	1 mA	1 mA	1 mA	1 mA
Response time max.	70 ms	70 ms	70 ms	70 ms
Control Characteristics				
Ramp time (secs)	0.5–10	0.5–10	0.5–10	0.5–10
Ramp settings (% LRT)	85%	85%	85%	85%
Kick start settings (% LRT)	85%	85%	85%	85%
Soft stop (secs)	0.5–10	0.5–10	0.5–10	0.5–10
Environment Characteristics				
Temperature—operating (no derating)	−30° to 40°C	−30° to 40°C	−30° to 40°C	−30° to 40°C
Current rating 50°C	N/A	N/A	N/A	N/A
Limited duty cycle 50°C	N/A	N/A	N/A	N/A
Current rating 60°C	N/A	N/A	N/A	N/A
Limited duty cycle 60°C	N/A	N/A	N/A	N/A
Temperature—storage	−30° to 80°C	−30° to 80°C	−30° to 80°C	−30° to 80°C
Altitude (meters)—no derating	2000	2000	2000	2000
Humidity	95% noncondensing	95% noncondensing	95% noncondensing	95% noncondensing
Operating position (no derating)	Vertical ±30°	Vertical ±30°	Vertical ±30°	Vertical ±30°
Impulse withstand voltage IEC 947-4-1	4000V	4000V	4000V	4000V
Rated insulation voltage (Ui)	660V	660V	660V	660V
Installation category	III	III	III	III
Vibration	IEC 68-2-6 5g 10–150 Hz			
Power dissipation for intermittent operation	4 W/A x duty cycle			
Power dissipation for continuous operation	4 W/A x duty cycle			
Cooling method	Natural convection	Natural convection	Natural convection	Natural convection
Degree of protection	IP20	IP20	IP20	IP20
Pollution degree	3	3	3	3
Agency approvals	UL, cUL, CE	UL, cUL, CE	UL, cUL, CE	UL, cUL, CE

Soft Starters—S701_15N3S

Description	S701C15N3S	S701E15N3S	S701G15N3S
Maximum current capacity	15	15	15
Trip Class			
10A	15	15	15
10	15	15	15
20	12	12	12
30	10	10	10
Electrical Characteristics			
Line voltage (Vac)	208–240	380–480	500–600
Operating frequency (Hz)	50/60	50/60	50/60
Leakage current	5 mA AC max.	5 mA AC max.	5 mA AC max.
Minimum operational current	50 mA	50 mA	50 mA
Control voltage (Vac/Vdc)	24–240	24–480	24–480
Pickup voltage max.	20.4 Vac/Vdc	20.4 Vac/Vdc	20.4 Vac/Vdc
Dropout voltage min.	5 Vac/Vdc	5 Vac/Vdc	5 Vac/Vdc
Max. control current for no operation	1 mA	1 mA	1 mA
Response time max.	70 ms	70 ms	70 ms
Control Characteristics			
Ramp time (secs)	0.5–10	0.5–10	0.5–10
Ramp settings (% LRT)	85%	85%	85%
Kick start settings (% LRT)	85%	85%	85%
Soft stop (secs)	0.5–10	0.5–10	0.5–10
Environment Characteristics			
Temperature—operating (no derating)	−30° to 40°C	−30° to 40°C	−30° to 40°C
Current rating 50°C	12.5A	12.5A	12.5A
Limited duty cycle 50°C	15A on-time max. 15 min. duty cycle max. 0.8	15A on-time max. 15 min. duty cycle max. 0.8	15A on-time max. 15 min. duty cycle max. 0.8
Current rating 60°C	10A	10A	10A
Limited duty cycle 60°C	15A on-time max. 15 min. duty cycle max. 0.65	15A on-time max. 15 min. duty cycle max. 0.65	15A on-time max. 15 min. duty cycle max. 0.65
Temperature—storage	−30° to 80°C	−30° to 80°C	−30° to 80°C
Altitude (meters)—no derating	2000	2000	2000
Humidity	95% noncondensing	95% noncondensing	95% noncondensing
Operating position (no derating)	Vertical ±30°	Vertical ±30°	Vertical ±30°
Impulse withstand voltage IEC 947-4-1	4000V	4000V	4000V
Rated insulation voltage (Ui)	660V	660V	660V
Installation category	III	III	III
Vibration	IEC 68-2-6 5g 10–150 Hz	IEC 68-2-6 5g 10–150 Hz	IEC 68-2-6 5g 10–150 Hz
Power dissipation for intermittent operation	2 W/A x duty cycle	2 W/A x duty cycle	2 W/A x duty cycle
Power dissipation for continuous operation	2 W/A	2 W/A	2 W/A
Cooling method	Natural convection	Natural convection	Natural convection
Degree of protection	IP20	IP20	IP20
Pollution degree	3	3	3
Agency approvals	UL, CSA, CE	UL, CSA, CE	UL, CSA, CE

Soft Starters—S701_25N3S

Description	S701C25N3S	S701E25N3S	S701G25N3S
Maximum current capacity	25	25	25
Trip Class			
10A	25	25	25
10	25	25	25
20	20	20	20
30	15	15	15
Electrical Characteristics			
Line voltage (Vac)	208–240	380–480	500–600
Operating frequency (Hz)	50/60	50/60	50/60
Leakage current	5 mA AC max.	5 mA AC max.	5 mA AC max.
Minimum operational current	50 mA	50 mA	50 mA
Control voltage (Vac/Vdc)	24–240	24–300	24–300
Pickup voltage max.	20.4 Vac/Vdc	20.4 Vac/Vdc	20.4 Vac/Vdc
Dropout voltage min.	5 Vac/Vdc	5 Vac/Vdc	5 Vac/Vdc
Max. control current for no operation	1 mA	1 mA	1 mA
Response time max.	70 ms	70 ms	70 ms
Control Characteristics			
Ramp time (secs)	0.5–10	0.5–10	0.5–10
Ramp settings (% LRT)	85%	85%	85%
Kick start settings (% LRT)	85%	85%	85%
Soft stop (secs)	0.5–10	0.5–10	0.5–10
Environment Characteristics			
Temperature—operating (no derating)	−30° to 40°C	−30° to 40°C	−30° to 40°C
Current rating 50°C	20A	20A	20A
Limited duty cycle 50°C	25A on-time max. 15 min. duty cycle max. 0.8	25A on-time max. 15 min. duty cycle max. 0.8	25A on-time max. 15 min. duty cycle max. 0.8
Current rating 60°C	17A	17A	17A
Limited duty cycle 60°C	25A on-time max. 15 min. duty cycle max. 0.65	25A on-time max. 15 min. duty cycle max. 0.65	25A on-time max. 15 min. duty cycle max. 0.65
Temperature—storage	−30° to 80°C	−30° to 80°C	−30° to 80°C
Altitude (meters)—no derating	2000	2000	2000
Humidity	95% noncondensing	95% noncondensing	95% noncondensing
Operating position (no derating)	Vertical ±30°	Vertical ±30°	Vertical ±30°
Impulse withstand voltage IEC 947-4-1	4000V	4000V	4000V
Rated insulation voltage (Ui)	660V	660V	660V
Installation category	III	III	III
Vibration	IEC 68-2-6 5g 10–150 Hz	IEC 68-2-6 5g 10–150 Hz	IEC 68-2-6 5g 10–150 Hz
Power dissipation for intermittent operation	2 W/A x duty cycle	2 W/A x duty cycle	2 W/A x duty cycle
Power dissipation for continuous operation	2 W/A	2 W/A	2 W/A
Cooling method	Natural convection	Natural convection	Natural convection
Degree of protection	IP20	IP20	IP20
Pollution degree	3	3	3
Agency approvals	UL, CSA, CE	UL, CSA, CE	UL, CSA, CE

Dimensions

Approximate Dimensions in Inches (mm)

Soft Starters—S701...N3S

Catalog Number	W	H	D	Weight in Lbs (kg)
S701C03N3S	0.89 (22.5)	3.94 (100)	5.01 (127)	0.6 (270)
S701D03N3S	0.89 (22.5)	3.94 (100)	5.01 (127)	0.6 (270)
S701E03N3S	0.89 (22.5)	3.94 (100)	5.01 (127)	0.6 (270)
S701G03N3S	0.89 (22.5)	3.94 (100)	5.01 (127)	0.6 (270)
S701C15N3S	1.77 (45)	3.94 (100)	5.04 (128)	1.52 (690)
S701E15N3S	1.77 (45)	3.94 (100)	5.04 (128)	1.52 (690)
S701G15N3S	1.77 (45)	3.94 (100)	5.04 (128)	1.52 (690)
S701C25N3S	3.54 (90)	3.94 (100)	5.04 (128)	2.53 (1150)
S701E25N3S	3.54 (90)	3.94 (100)	5.04 (128)	2.53 (1150)
S701G25N3S	3.54 (90)	3.94 (100)	5.04 (128.)	2.53 (1150)

Type S701, Soft Start Controllers with Auxiliary Contact**Contents****Description**

	Page
Type S701, Soft Start Controllers	V6-T1-3
Type S701, Soft Start Controllers with Auxiliary Contact	
Product Selection	V6-T1-10
Technical Data and Specifications	V6-T1-10
Dimensions	V6-T1-11
Type S701, Soft Start Controllers with Brake	V6-T1-12
Type S511, Semiconductor Reversing Contactors	V6-T1-15
DS7 Soft Start Controllers	V6-T1-19

Type S701, Soft Start Controllers with Auxiliary Contact**Product Description**

The S701 device is a reduced voltage soft start controller designed to control acceleration and deceleration of three-phase motors. With the auxiliary contact, it is possible to control an external bypass to reduce heating and increase acceleration and deceleration times.

The unit provides the user with the ability to adjust initial torque, ramp up and down time and also select kick start for high inertia loads.

Application Description

The S701 line of soft start controllers is specifically designed to be a low cost option for soft starting small (15 hp and down) three-phase motors. The auxiliary contact is designed to work in conjunction with an across-the-line contactor. The purpose of the contactor is to provide a parallel current path once the soft starter has brought the motor up to speed. Once the soft start controller reaches end of ramp, the auxiliary contact will close and send a signal to close the bypass contactor, thus providing a low impedance path for the current to the motor. The S701 unit controls current on two of three motor phases to control the torque being applied to the motor, allowing for smooth starting of a motor. The S701 is designed to be used with a manual motor protector or a full voltage starter. These devices provide the necessary overload protection for the motor and also provide line isolation for the motor. Short-circuit protection can be provided by fuses or circuit breakers.

Features

- Rated operational voltage up to 600 Vac
- Control voltage range from 24–300 Vac/Vdc
- Adjustable ramp times (0.5–20 seconds)
- Adjustable initial torque control (0–85%)
- Kick start feature (0–85% adjustment)
- Kick start for 200 ms
- Soft stop (0.5–20 seconds)
- IP20 finger protection
- Available up to 30A (with Bypass installed)
- Auxiliary contact for up-to-speed indication

Benefits

- Reduced wear on belts, gears, chains, clutches, shafts and bearings
- Bypass option allows for greater current capacity in the unit
- Bypass option helps to reduce heat in the enclosure
- Allows for controlling the inrush current to the motor
- Reduced water-hammer in pumping applications
- Less shock to product on conveyor lines and material handling gear

Standards and Certifications

- IEC 947 compliant
- EN 60947-4-2
- CE marked
- UL listed (E108212)
- cUL listed



Product SelectionFor S701 catalog number selection, see **Page V6-T1-4**.

Soft Start Controllers with Auxiliary Contact															
S701	Max. Current	Line Voltage	Control Voltage (Vac/Vdc)	Three-Phase Motor			hp Rating								Catalog Number
				230V	380–400V	440V	200V	230V	460V	575V	1.0 SF	1.15 SF	1.0 SF	1.15 SF	
Ratings without Bypass															
25	208–240	24–240	5.5	N/A	N/A	N/A	5	5	7-1/2	5	N/A	N/A	N/A	N/A	S701C25N3BP
25	380–480	24–300	N/A	12.5	12.5	N/A	N/A	N/A	N/A	15	15	N/A	N/A	N/A	S701E25N3BP
25	500–600	24–300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	20	N/A	S701G25N3BP
Ratings with Bypass															
30	208–240	24–240	7.5	N/A	N/A	N/A	7-1/2	7-1/2	10	7-1/2	N/A	N/A	N/A	N/A	S701C25N3BP
30	380–480	24–300	N/A	15	15	N/A	N/A	N/A	N/A	20	15	N/A	N/A	N/A	S701E25N3BP
30	500–600	24–300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	25	20	N/A	S701G25N3BP

Technical Data and Specifications**Soft Starters with Auxiliary Contact—S701_25N3BP**

Description	S701C25N3BP	S701E25N3BP	S701G25N3BP
Maximum current capacity with bypass (without bypass)	30 (25)	30 (25)	30 (25)
Trip Class			
10A	30 (25)	30 (25)	30 (25)
10	30 (25)	30 (25)	30 (25)
20	24 (20)	24 (20)	24 (20)
30	19.5 (15)	19.5 (15)	19.5 (15)
Electrical Characteristics			
Line voltage (Vac)	208–240	380–480	500–600
Operating frequency (Hz)	50/60	50/60	50/60
Leakage current	5 mA AC max.	5 mA AC max.	5 mA AC max.
Minimum operational current	50 mA	50 mA	50 mA
Control voltage (Vac/Vdc)	24–240	24–300	24–300
Pickup voltage max.	20.4 Vac/Vdc	20.4 Vac/Vdc	20.4 Vac/Vdc
Dropout voltage min.	5 Vac/Vdc	5 Vac/Vdc	5 Vac/Vdc
Max. control current for no operation	1 mA	1 mA	1 mA
Response time max.	70 ms	70 ms	70 ms

Soft Starters with Auxiliary Contact—S701_25N3BP, continued

Description	S701C25N3BP	S701E25N3BP	S701G25N3BP
Control Characteristics			
Ramp time (secs)	0.5–20	0.5–20	0.5–20
Ramp settings (% LRT)	85%	85%	85%
Kick start settings (% LRT)	85%	85%	85%
Soft stop (secs)	0.5–20	0.5–20	0.5–20
Environmental Characteristics			
Temperature—operating (no derating)	−30° to 40°C	−30° to 40°C	−30° to 40°C
Current rating 50°C	20A	20A	20A
Limited duty cycle 50°C	25A on-time max. 15 min. duty cycle max. 0.8	25A on-time max. 15 min. duty cycle max. 0.8	25A on-time max. 15 min. duty cycle max. 0.8
Current rating 60°C	17A	17A	17A
Limited duty cycle 60°C	25A on-time max. 15 min. duty cycle max. 0.65	25A on-time max. 15 min. duty cycle max. 0.65	25A on-time max. 15 min. duty cycle max. 0.65
Temperature—storage	−30° to 80°C	−30° to 80°C	−30° to 80°C
Altitude (meters)—no derating	2000	2000	2000
Humidity	95% noncondensing	95% noncondensing	95% noncondensing
Operating position (no derating)	Vertical ±30°	Vertical ±30°	Vertical ±30°
Impulse withstand voltage IEC 947-4-1	4000V	4000V	4000V
Rated insulation voltage (Ui)	660V	660V	660V
Installation category	III	III	III
Vibration	IEC 68-2-6 5g 10–150 Hz	IEC 68-2-6 5g 10–150 Hz	IEC 68-2-6 5g 10–150 Hz
Power dissipation for continuous operation	2 W/A without bypass	2 W/A without bypass	2 W/A without bypass
Power dissipation with semiconductor bypassed	5 W/A max. with bypass	5 W/A max. with bypass	5 W/A max. with bypass
Cooling method	Natural convection	Natural convection	Natural convection
Degree of protection	IP20	IP20	IP20
Pollution degree	3	3	3
Agency approvals	UL, cUL, CE	UL, cUL, CE	UL, cUL, CE

Dimensions

Approximate Dimensions in Inches (mm)

Soft Starters with Auxiliary Contact—S701_25N3BP

Catalog Number	W	H	D	Weight in Lbs (kg)
S701C25N3BP	3.54 (89.9)	3.94 (100.1)	5.04 (128.0)	2.53 (1150)
S701E25N3BP	3.54 (89.9)	3.94 (100.1)	5.04 (128.0)	2.53 (1150)
S701G25N3BP	3.54 (89.9)	3.94 (100.1)	5.04 (128.0)	2.53 (1150)

Type S701, Soft Start Controllers with Brake**Contents****Description**

	Page
Type S701, Soft Start Controllers	V6-T1-3
Type S701, Soft Start Controllers with Auxiliary Contact	V6-T1-9
Type S701, Soft Start Controllers with Brake	
Product Selection	V6-T1-13
Technical Data and Specifications	V6-T1-13
Dimensions	V6-T1-14
Type S511, Semiconductor Reversing Contactors	V6-T1-15
DS7 Soft Start Controllers	V6-T1-19

Type S701, Soft Start Controllers with Brake**Product Description**

The S701 soft start controller with DC injection brake is designed to control acceleration and deceleration of three-phase motors. Brake current is adjustable from 0–50A DC. The ramp-up feature is adjustable from 0.5–10 seconds. Torque adjustment is adjustable with or without break loose (kick start) function.

Application Description

The S701 line of soft start controllers is specifically designed to be a low cost option for soft starting small (15 hp and down) three-phase motors. The braking option is a DC injection system, allowing for fast stopping of a three-phase motor. The S701 unit controls current on two of the three phases to control the torque being applied to the motor, allowing for smooth starting of a motor. The S701 is designed to be used with a manual motor starter or a full voltage starter. These devices provide the necessary overload protection for the motor and also provide line isolation for the motor. Short-circuit protection can be provided by fuses or circuit breakers.

Features

- Rated operational voltage up to 480 Vac
- Control voltage range from 24–300 Vac/Vdc
- Adjustable ramp times (0.5–20 seconds)
- Adjustable initial torque control (0–85%)
- Kick start feature (0–85% adjustment)
- Kick start for 200 ms
- IP20 finger protection
- Braking control adjustable from 0–50A DC
- Slow speed: 7.5% or 10% of nominal speed

Benefits

- Reduced wear on bolts, gears, chains, clutches, shafts and bearings
- Braking option allows for quick stopping of loads
- Brake control can help eliminate expensive mechanical brakes
- Allows for controlling the inrush current to the motor
- Reduced water-hammer in pumping applications
- Less shock to product on conveyor lines and material handling gear

Standards and Certifications

- IEC 947 compliant
- EN 60947-4-2
- CE marked
- UL listed (E108212)
- cUL listed



Product SelectionFor S701 catalog number selection, see **Page V6-T1-4**.

S701E25B3S

Soft Start Controllers with Brake

Max. Current	Line Voltage	Control Voltage (Vac/Vdc)	Three-Phase Motor kW Rating (50 Hz)			hp Rating				Catalog Number
			230V	380–400V	440V	200V 1.0 SF	1.15 SF	230V 1.0 SF	1.15 SF	
25	208–240	24–240	5.5	N/A	N/A	5	5	7-1/2	5	N/A N/A S701C25B3S
25	380–480	24–300	N/A	12.5	12.5	N/A	N/A	N/A	15	15 S701E25B3S

Technical Data and Specifications**Soft Starters with Brake—S701_25B3S**

Description	S701C25B3S	S701E25B3S
Maximum current capacity	25	25
Trip Class		
10A	25	25
10	25	25
20	20	20
30	15	15
Electrical Characteristics		
Line voltage (Vac)	208–240	380–480
Operating frequency (Hz)	50/60	50/60
Leakage current	5 mA AC max.	5 mA AC max.
Minimum operational current	1A	1A
Control voltage (Vac/Vdc)	24–240	24–300
Pickup voltage max.	20.4 Vac/Vdc	20.4 Vac/Vdc
Dropout voltage min.	5 Vac/Vdc	5 Vac/Vdc
Max. control current for no operation	1 mA	1 mA
Response time max.	100 ms	100 ms
Control Characteristics		
Ramp time (secs)	0.5–10	0.5–10
Ramp settings (% LRT)	85%	85%
Kick start settings (% LRT)	85%	85%
Soft stop (secs)	0.5–10	0.5–10
Brake current	0–50 Vdc	0–50 Vdc

Soft Starters with Brake—S701_25B3S, continued

Description	S701C25B3S	S701E25B3S
Environmental Characteristics		
Temperature—operating	–30° to 40°C	–30° to 40°C
Current rating 50°C	20A	20A
Limited duty cycle 50°C	25A on-time max. 15 min. duty cycle max. 0.8	25A on-time max. 15 min. duty cycle max. 0.8
Current rating 60°C	17A	17A
Limited duty cycle 60°C	25A on-time max. 15 min. duty cycle max. 0.65	25A on-time max. 15 min. duty cycle max. 0.65
Temperature—storage	–30° to 80°C	–30° to 80°C
Altitude (meters)—no derating	2000	2000
Humidity	95% noncondensing	95% noncondensing
Operating position	Vertical ± 0°	Vertical ± 0°
Impulse withstand voltage IEC 947-4-1	4000V	4000V
Rated insulation voltage (Ui)	660V	660V
Installation category	III	III
Vibration	IEC 68-2-6 5g 10–150 Hz	IEC 68-2-6 5g 10–150 Hz
Power dissipation for intermittent operation	2 W/A x duty cycle	2 W/A x duty cycle
Power dissipation for continuous operation	2 W/A	2 W/A
Cooling method	Natural convection	Natural convection
Degree of protection	IP20	IP20
Pollution degree	3	3
Agency approvals	UL, cUL, CE	UL, cUL, CE

Dimensions

Approximate Dimensions in Inches (mm)

Soft Starters with Brake—S701_25B3S

Catalog Number	W	H	D	Weight in Lbs (kg)
S701C25B3S	3.54 (89.9)	3.94 (100.1)	5.04 (128.0)	2.53 (1150)
S701E25B3S	3.54 (89.9)	3.94 (100.1)	5.04 (128.0)	2.53 (1150)

Contents

	Page
Type S701, Soft Start Controllers	V6-T1-3
Type S701, Soft Start Controllers with Auxiliary Contact	V6-T1-9
Type S701, Soft Start Controllers with Brake	V6-T1-12
Type S511, Semiconductor Reversing Contactors	
Product Selection	V6-T1-16
Technical Data and Specifications	V6-T1-16
Dimensions	V6-T1-17
DS7 Soft Start Controllers	V6-T1-19

Type S511, Semiconductor Reversing Contactors

Product Description

The S511 device is a semiconductor reversing contactor designed to switch three-phase motors forward and reverse. Unicore electronics and thermal design ensures high switching capacity and long lifetime.

Application Description

The S511 line of solid-state reversing contactors is specifically designed for high speed operations or when long contactor life is required. The reversing contactors are intended for small motor applications (5 hp and below). The S511 unit can be used in a variety of applications including fans, pumps, conveyors, doors, hoists, cranes, etc. It is designed to be used with a manual motor starter or a full voltage starter. These devices provide the necessary overload protection for the motor and also provide line isolation for the motor. Short-circuit protection can be provided by fuses or circuit breakers.

Features

- Rated operational voltage up to 480 Vac
- Control voltage ranges of 5–24 Vdc and 24–240 Vac/Vdc
- Unlimited number of START/STOP operations per hour
- IP20 finger protection
- AC-3 current rating of 10A
- AC-4 current rating of 8A

Benefits

- Extremely high switching rates possible
- Very long life expectancy and no contacts or movable parts to replace
- Compact design (45 mm wide) leads to significant panel savings

Standards and Certifications

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



Listed

Product Selection**Reversing Solid-State Contactors**

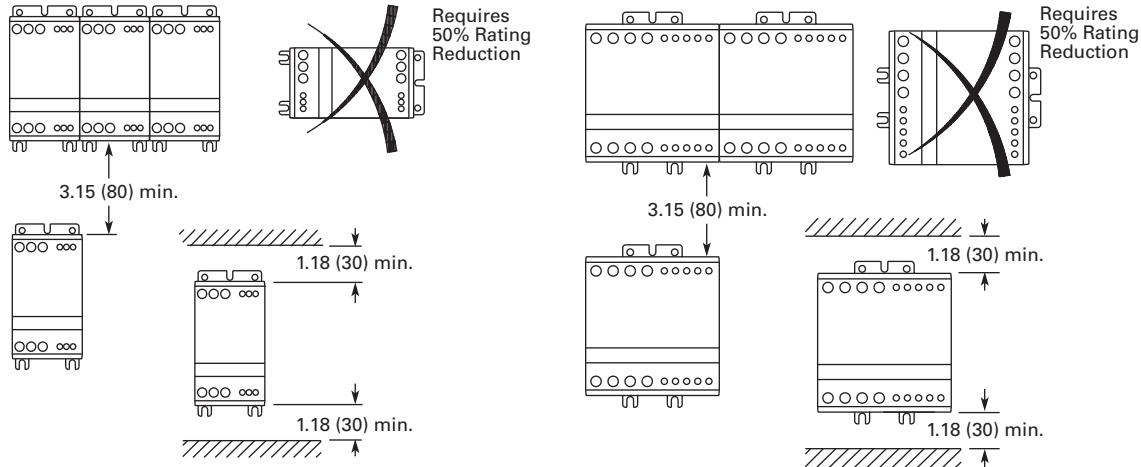
Max. Current	Line Voltage	Control Voltage	Three-Phase Motor			hp Rating						Catalog Number	
			kW Rating (50 Hz)			200V			230V				
			230V	380–400V	440V	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF		
10	208–480	5–24 Vdc	2.2	4	4	2	2	3	2	5	5	S511E10N3D	
10	208–480	24–240 Vac/Vdc	2.2	4	4	2	2	3	2	5	5	S511E10N3S	

Technical Data and Specifications**Semiconductor Reversing Contactors—S511E10N3_**

Description	S511E10N3D	S511E10N3S
Maximum current capacity	10	10
Trip Class		
10A	10	10
10	10	10
20	8	8
30	6.5	6.5
Electrical Characteristics		
Line Voltage (Vac)	208–480	208–480
Operating frequency (Hz)	50/60	50/60
Control voltage	5–24 Vdc	24–240 Vac/Vdc
Pickup voltage max.	4.25 Vdc	20.4 Vac/Vdc
Dropout voltage min.	1.5 Vdc	7.2 Vac/Vdc
Max. control voltage	26.4 Vdc	253 Vac/Vdc
Response time max.	1/2 cycle	1 cycle
Interlock time max.	80 ms	150 ms
Control Characteristics		
Operation current AC-3	10	10
Operation current AC-4	8	8
Duty cycle	Continuous operation	Continuous operation
Leakage current	1 mA AC max.	1 mA AC max.
Minimum operation current	10 mA AC	10 mA AC
Environmental Characteristics		
Temperature—operating	0° to 60°C	0° to 60°C
Temperature—storage	–20° to 80°C	–20° to 80°C
Altitude (meters)	2000	2000
Humidity	95% noncondensing	95% noncondensing
Operating position	Vertical ±30°	Vertical ±30°
Impulse withstand voltage IEC 947-4-1	4000V	4000V
Rated insulation voltage (Ui)	660V	660V
Installation category	III	III
Vibration	IEC 68-2-6 5g 10–150 Hz	IEC 68-2-6 5g 10–150 Hz
Power dissipation for intermittent operation	2.2 W/A x duty cycle	2.2 W/A x duty cycle
Power dissipation for continuous operation	2.2 W/A	2.2 W/A
Cooling method	Natural convection	Natural convection
Degree of protection	IP20	IP20
Pollution degree	3	3
Agency approvals	UL, CSA, CE	UL, CSA, CE

Mounting Instructions

IMPORTANT: The controller is designed for vertical mounting in free air. If the controller is mounted horizontally, the load current must be reduced to 50% of rated current.

Recommended Mounting Distances**Dimensions**

Approximate Dimensions in Inches (mm)

Semiconductor Reversing Contactors—S511E10N3_

Catalog Number	W	H	D	Weight in Lbs (kg)
S511E10N3D	1.77 (45.0)	3.94 (100.1)	5.04 (128.0)	1.52 (690)
S511E10N3S	1.77 (45.0)	3.94 (100.1)	5.04 (128.0)	1.52 (690)

Also refer to dimension drawings on **Page V6-T1-18**.

Cable Requirements and Sizing

75°C	AWG (mm ²)	AWG (mm ²)
	18–12 (0.75–4)	20–16 (0.5–1.5)
	2–18 (2 x 1)	2 x 20–18 (2 x 0.5–0.75)
	18–10 (0.75–4)	20–16 (0.5–1.5)
	2 x 18–14 (2 x 0.75–2.5)	2 x 20–16 (2 x 0.5–1.5)
	18–10 (0.75–4)	20–16 (0.5–1.5)
	2 x 18–16 (0.75–6)	2 x 20–16 (2 x 0.5–1.5)
	Posidrive 1 4.4 in-lb. max. 0.5 Nm max.)	N/A
	4 mm 4.4 in-lb max. (0.5 Nm max.)	3 mm 3.5 in-lb max. (0.4 Nm max.)

1.1

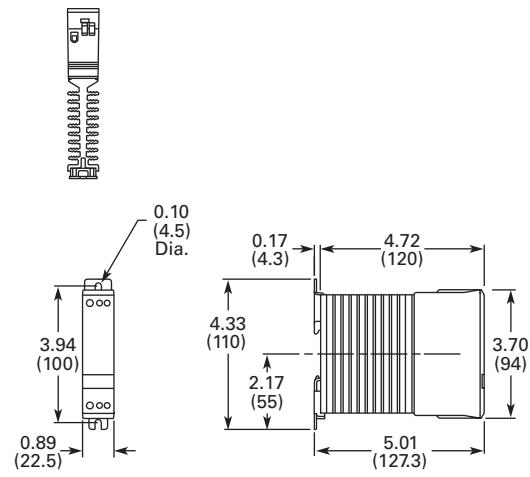
Reduced Voltage Motor Starters

Solid-State Controllers

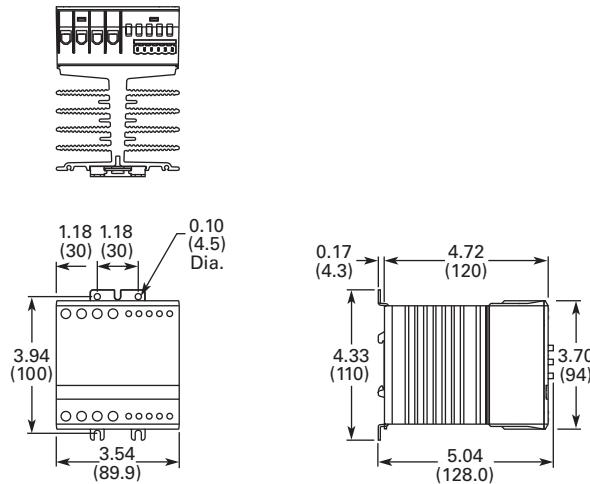
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Approximate Dimensions in Inches (mm)

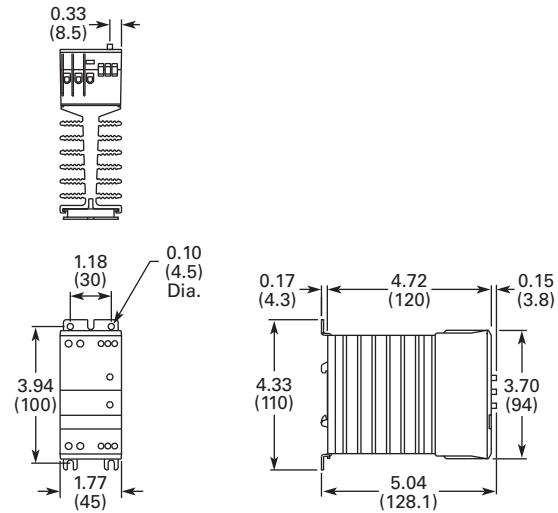
22.5 mm Frame



90 mm Frame



45 mm Frame



DS7 Soft Start Controllers**Contents****Description**

	Page
Type S701, Soft Start Controllers	V6-T1-3
Type S701, Soft Start Controllers with Auxiliary Contact	V6-T1-9
Type S701, Soft Start Controllers with Brake	V6-T1-12
Type S511, Semiconductor Reversing Contactors	V6-T1-15
DS7 Soft Start Controllers	
Features and Benefits	V6-T1-21
Standards and Certifications	V6-T1-21
Instructional Leaflets	V6-T1-21
Catalog Number Selection	V6-T1-22
Product Selection	V6-T1-23
Accessories	V6-T1-32
Technical Data and Specifications	V6-T1-33
Dimensions	V6-T1-41

DS7 Soft Start Controllers**Product Description**

The DS7 is available in standard and SmartWire-DT configurations.

Standard (Non SmartWire-DT)

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 to 180 FLA in four frame sizes. It is available with 24 Vdc/24 Vac/120 Vac control voltage options. A low temperature version is available with 24 Vac/Vdc with operation ambient temperature minimum of -40°C.

SmartWire-DT

Our SmartWire-DT interface completely eliminates the need for conventional control wiring. This has several advantages:

- No incorrect wiring
- Faster wiring
- Cost saving

The interface can be used to send control commands to the DS7 SmartWire-DT and change and diagnose its parameter configuration; in addition, the control electronics can be powered via the SmartWire-DT cable. The device is controlled with one of the selectable profiles:

- A "start/stop" profile
- An 8 bit-wide profile for the soft starter, which is provided the same way for the variable frequency drive and features more options

Regardless of the profile chosen, the DS7 SmartWire-DT's parameters can be read and written to at any time by using acyclic services.

DS7 SmartWire-DT makes it possible to read and write to all device parameters. It is also possible to overwrite the potentiometer settings on the DS7 SmartWire-DT, which can come in handy, for instance, when a change made to the machine needs to be undone.

The DS7 SmartWire-DT comes with a detailed diagnostic system with options that extend far beyond those of wired devices. In addition to having an error log, the DS7 SmartWire-DT can detect and report nine different device faults. A warning parameter reports any present warning messages. Moreover, the response to each individual fault can be customized. Finally, there are 35 additional messages for communication errors. Using the DS7 SmartWire-DT in connection with the PKE opens up new functionalities that were previously thought impossible to implement with a low-cost soft starter and that were reserved to significantly more expensive devices. Combining a PKE unit and a DS7 SmartWire-DT makes it possible to completely protect the DS7 SmartWire-DT device against overloads. In addition, it provides a current limiting function and can report thermal capacity utilization levels to higher level controllers.

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.

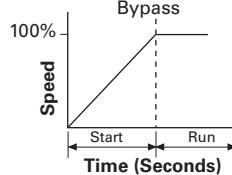
- Adjustable initial voltage 30–92% of full voltage (120/230 Vac control voltage)
- Adjustable initial voltage 30–100% of full voltage (24 Vac/Vdc control voltage)
- Adjustable initial voltage 30–92% of full voltage (24 Vdc control voltage—SmartWire-DT)
- Adjustable ramp time 1–30 seconds
- Bypass relays close at the end the ramp time (TOR)

Soft Stop

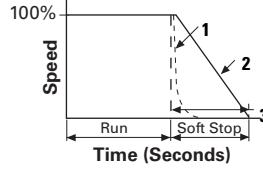
Allows for a controlled stopping of load. Used when a stop-time that is greater than the coast-to-stop time is desired. Often used with high friction loads where a sudden stop may cause system or product damage. Setting the soft stop time to a value of 0 turns off this feature.

- Soft stop time = 0–30 seconds

Start Ramp



Stop Ramp



- 1 = Coast to Stop (Speed)
2 = Soft Stop Ramp (Voltage)
3 = Soft Stop Time

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, 3 and 4 (16A to 200A)—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.

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

Single-Phase Applications

All DS7 frame sizes can be configured for single-phase operation at 200–480 Vac main voltages.

- 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 as well. 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

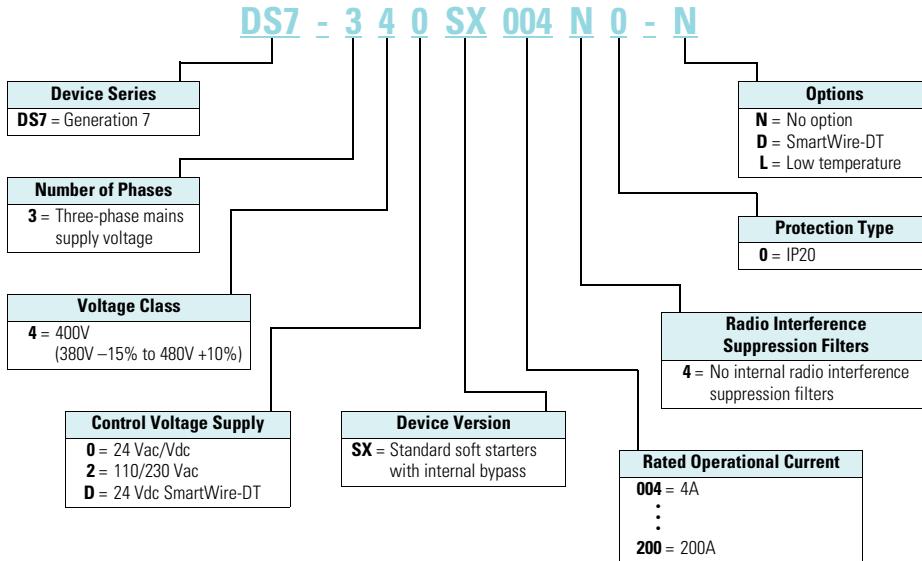
Standards and Certifications

- IEC 60947-4-2
- EN 60947-4-2
- UL® listed
- CSA certified
- CE marked
- C-Tick



Instructional Leaflets

- Instruction Leaflet IL03901001E

Catalog Number Selection**DS7 Soft Start Controllers**

Product Selection**DS7 Soft Start Horsepower Ratings**

Please refer to Application Note AP039004EN for additional information on proper size selection.

**DS7 Soft Start Controller—
Frames 1 and 2**



**DS7 Soft Start Controllers—Horsepower Ratings—
10 Second Ramp, One Start per Hour, 300% Current Limit at 40°C ①**

Rated Current (A)	Motor Power (hp)	Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended		PKE MMP	MMP ②	Connection Kit to MMP	Catalog Number
				XTOB Overload (Direct Connect) ②	XTOE Recommended Overload ②				
3.7	0.75 0.75 2	HFD3015	15A Class RK5	XTOB004BC1	XTOE005BCS	XTPE012BCS	XTPR004BC1	XTPAXTPCB	DS7-340SX004N0-N ④⑤ DS7-342SX004N0-N ⑥ DS7-34DSX004N0-D ⑦
6.9	1.5 2 3	HFD3015	15A Class RK5	XTOB006BC1 ③	XTOE020BCS	XTPE012BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX007N0-N ④⑤ DS7-342SX007N0-N ⑥ DS7-34DSX007N0-D ⑦
7.8	2 2 5	HFD3020	20A Class RK5	XTOB010BC1	XTOE020BCS	XTPE012BCS	XTPR010BC1	XTPAXTPCB	DS7-340SX009N0-N ④⑤ DS7-342SX009N0-N ⑥ DS7-34DSX009N0-D ⑦
11	3 3 7.5	HFD3030	20A Class RK5	XTOB012BC1	XTOE020BCS	XTPE032BCS	XTPR012BC1	XTPAXTPCB	DS7-340SX012N0-N ④⑤ DS7-342SX012N0-N ⑥ DS7-34DSX012N0-D ⑦
15.2	3 5 10	HFD3035	25A Class RK5	XTOB016CC1	XTOE020CCS	XTPE032BCS	XTPR016BC1	XTPAXTPCC	DS7-340SX016N0-N ④⑤ DS7-342SX016N0-N ⑥ DS7-34DSX016N0-D ⑦
22	5 7.5 15	HFD3060	40A Class RK5	XTOB024CC1	XTOE045CCS	XTPE032BCS	XTPR025BC1	XTPAXTPCC	DS7-340SX024N0-N ④⑤ DS7-342SX024N0-N ⑥ DS7-34DSX024N0-D ⑦
32	7.5 10 20	HFD3070	50A Class RK5	XTOB032CC1	XTOE045CCS	XTPE032BCS	XTPR032BC1	XTPAXTPCC	DS7-340SX032N0-N ④⑤ DS7-342SX032N0-N ⑥ DS7-34DSX032N0-D ⑦

Notes

- ① Actual motor FLAs vary. Verify these devices cover the motor specific FLA.
- ② Selections are based on motor FLA value at 480V.
- ③ Not to be used with 230V.
- ④ 24 Vac/Vdc device.
- ⑤ -40°C rated low temperature version available in 24 Vac/Vdc, change to "NO-L."
- ⑥ 120/230 Vac device.
- ⑦ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24 Vdc output	ELC-PS01
100–240V input and 24 Vdc output	PSG60E
400–500V input and 24 Vdc output	PSG60F24RM

Please refer to Application Note AP039004EN for additional information on proper size selection.

**DS7 Soft Start Controller—
Frames 3 and 4**



**DS7 Soft Start Controllers—Horsepower Ratings—
10 Second Ramp, One Start per Hour, 300% Current Limit at 40°C**

Rated Current (A)	Motor Power (hp)			Maximum Allowable Breaker Size ①	Maximum Allowable Fuse Size ①	Recommended XTOB Overload	Recommended C440 Overload	Catalog Number
	200V	230V	460V					
40	10	10	30	HFD3150L	150A Class RK5	XTOB040DC1 ②	C440A1A045SAX	DS7-340SX041N0-N ⑤⑥ DS7-342SX041N0-N ⑦ DS7-34DSX041N0-D ⑧
52	15	20	40	HFD3200L	200A Class RK5	XTOB057DC1 ②	C440B1A100SAX	DS7-340SX055N0-N ⑤⑥ DS7-342SX055N0-N ⑦ DS7-34DSX055N0-D ⑧
65	20	25	50	HJD3250	200A Class RK5	XTOB065DC1 ②	C440B1A100SAX	DS7-340SX070N0-N ⑤⑥ DS7-342SX070N0-N ⑦ DS7-34DSX070N0-D ⑧
77	25	30	60	HKD3300	300A Class RK5	XTOB100GC1S	C440B1A100SAX	DS7-340SX081N0-N ⑤⑥ DS7-342SX081N0-N ⑦ DS7-34DSX081N0-D ⑧
96	30	30	75	HKD3350	350A Class RK5	XTOB100GC1S	C440B1A100SAX	DS7-340SX100N0-N ⑤⑥ DS7-342SX100N0-N ⑦ DS7-34DSX100N0-D ⑧
124	40	50	100	HKD3400	500A Class RK5	XTOB125GC1S	C440A1A005SAX ④	DS7-340SX135N0-N ⑤⑥ DS7-342SX135N0-N ⑦ DS7-34DSX135N0-D ⑧
156	50	60	125	HLD3450	500A Class RK5	XTOB160LC1 ③	C440A1A005SAX ④	DS7-340SX160N0-N ⑤⑥ DS7-342SX160N0-N ⑦ DS7-34DSX160N0-D ⑧
180	60	75	150	HLD3500	500A Class RK5	XTOB220LC1 ③	C440A1A005SAX ④	DS7-340SX200N0-N ⑤⑥ DS7-342SX200N0-N ⑦ DS7-34DSX200N0-D ⑧

Notes

- 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.
- ⑤ 24 Vac/Vdc device.
- ⑥ -40°C rated low temperature version available in 24 Vac/Vdc, change to "N0-L."
- ⑦ 120/230 Vac device.
- ⑧ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24 Vdc output	ELC-PS01
100–240V input and 24 Vdc output	PSG60E
400–500V input and 24 Vdc output	PSG60F24RM

Please refer to Application Note AP039004EN for additional information on proper size selection.

**DS7 Soft Start Controller—
Frames 1 and 2**



**DS7 Soft Start Controllers—Horsepower Ratings—
10 Second Ramp, One Start per Hour, 400% Current Limit at 40°C ①**

Rated Current (A)	Motor Power (hp)				Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended XTOB Overload (Direct Connect) ②		Recommended XTOE Overload ③		PKE MMP	MMP ④	Connection Kit to MMP	Catalog Number
	200V	230V	480V	HFD3015			XTOB004BC1	XTOE005BCS	XTP012BCS	XTPR004BC1				
3	0.5	0.5	1.5	HFD3015	15A Class RK5									DS7-340SX004NO-N ④
														DS7-342SX004NO-N ⑤
														DS7-34DSX004NO-D ⑥
4.8	1	1	3	HFD3015	15A Class RK5	XTOB006BC1 ③	XTOE020BCS	XTP012BCS	XTPR012BC1	XTPAXTPCB				DS7-340SX007NO-N ④
														DS7-342SX007NO-N ⑤
														DS7-34DSX007NO-D ⑥
6.9	1.5	2	3	HFD3020	20A Class RK5	XTOB006BC1	XTOE020BCS	XTP012BCS	XTPR012BC1	XTPAXTPCB				DS7-340SX009NO-N ④
														DS7-342SX009NO-N ⑤
														DS7-34DSX009NO-D ⑥
9	2	2	5	HFD3030	20A Class RK5	XTOB010BC1	XTOE020BCS	XTP032BCS	XTPR010BC1	XTPAXTPCB				DS7-340SX012NO-N ④
														DS7-342SX012NO-N ⑤
														DS7-34DSX012NO-D ⑥
11	3	3	7.5	HFD3035	25A Class RK5	XTOB016CC1	XTOE020CCS	XTP032BCS	XTPR016BC1	XTPAXTPCC				DS7-340SX016NO-N ④
														DS7-342SX016NO-N ⑤
														DS7-34DSX016NO-D ⑥
17.5	5	5	10	HFD3060	40A Class RK5	XTOB016CC1	XTOE045CCS	XTP032BCS	XTPR016BC1	XTPAXTPCC				DS7-340SX024NO-N ④
														DS7-342SX024NO-N ⑤
														DS7-34DSX024NO-D ⑥
22	5	7.5	15	HFD3070	50A Class RK5	XTOB024CC1	XTOE045CCS	XTP032BCS	XTPR025BC1	XTPAXTPCC				DS7-340SX032NO-N ④
														DS7-342SX032NO-N ⑤
														DS7-34DSX032NO-D ⑥

Notes

- ① Actual motor FLAs vary. Verify these devices cover the motor specific FLA.
- ② Selections are based on motor FLA value at 480V.
- ③ Not to be used with 230V.
- ④ 24 Vac/Vdc device.
- ⑤ 120/230 Vac device.
- ⑥ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24V output	ELC-PS01
380–480V input and 24V output	PSS25F
100–240 Vac input and 24 Vdc output	PSS60F
380–480 Vac input and 24 Vdc output	PSS60F

Please refer to Application Note AP039004EN for additional information on proper size selection.

DS7 Soft Start Controller—Frames 1 and 2



**DS7 Soft Start Controllers—Horsepower Ratings—
10 Second Ramp, One Start per Hour, 400% Current Limit at 40°C ①**

Rated Current (A)	Motor Power (hp)				Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended XTOB Overload (Direct Connect) ②				Recommended XTOE Overload ②	PKE MMP	MMP ②	Connection Kit to MMP	Catalog Number
	200V	230V	480V	Hp											
3	0.5	0.5	1.5	HFD3015	15A Class RK5	XTOB004BC1	XTOE005BCS	XTPE012BCS	XTPR004BC1	XTPAXTPCB	DS7-340SX004N0-N ④⑤				
4.8	1	1	3	HFD3015	15A Class RK5	XTOB006BC1 ③	XTOE020BCS	XTPE012BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX007N0-N ④⑤				
6.9	1.5	2	3	HFD3020	20A Class RK5	XTOB006BC1	XTOE020BCS	XTPE012BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX009N0-N ④⑤				
9	2	2	5	HFD3030	20A Class RK5	XTOB010BC1	XTOE020BCS	XTPE032BCS	XTPR010BC1	XTPAXTPCB	DS7-340SX012N0-N ④⑤				
11	3	3	7.5	HFD3035	25A Class RK5	XTOB016CC1	XTOE020CCS	XTPE032BCS	XTPR016BC1	XTPAXTPCC	DS7-340SX016N0-N ④⑤				
17.5	5	5	10	HFD3060	40A Class RK5	XTOB016CC1	XTOE045CCS	XTPE032BCS	XTPR016BC1	XTPAXTPCC	DS7-340SX024N0-N ④⑤				
22	5	7.5	15	HFD3070	50A Class RK5	XTOB024CC1	XTOE045CCS	XTPE032BCS	XTPR025BC1	XTPAXTPCC	DS7-340SX032N0-N ④⑤				

Notes

- ① Actual motor FLAs vary. Verify these devices cover the motor specific FLA.
- ② Selections are based on motor FLA value at 480V.
- ③ Not to be used with 230V.
- ④ 24 Vac/Vdc device.
- ⑤ -40°C rated low temperature version available in 24 Vac/Vdc, change to "N0-L."
- ⑥ 120/230 Vac device.
- ⑦ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24 Vdc output	ELC-PS01
100–240V input and 24 Vdc output	PSG60E
400–500V input and 24 Vdc output	PSG60F24RM

Please refer to Application Note AP039004EN for additional information on proper size selection.

**DS7 Soft Start Controller—
Frames 3 and 4**



**DS7 Soft Start Controllers—Horsepower Ratings—
10 Second Ramp, One Start per Hour, 400% Current Limit at 40°C**

Rated Current (A)	200V	230V	460V	Motor Power (hp)	Maximum Allowable Breaker Size ①	Maximum Allowable Fuse Size ①	Recommended XTOB Overload	Recommended C440 Overload	Catalog Number
27	7.5	10	20	HFD3150L	150A Class RK5	XTOB040DC1	C440A1A045SAX		DS7-340SX041N0-N ④⑤
									DS7-342SX041N0-N ⑥
									DS7-34DSX041N0-D ⑦
34	10	10	30	HFD3200L	200A Class RK5	XTOB040DC1	C440A1A045SAX		DS7-340SX055N0-N ④⑤
									DS7-342SX055N0-N ⑥
									DS7-34DSX055N0-D ⑦
40	15	15	30	HJD3250	200A Class RK5	XTOB057DC1 ②	C440A1A045SAX		DS7-340SX070N0-N ④⑤
									DS7-342SX070N0-N ⑥
									DS7-34DSX070N0-D ⑦
52	15	20	40	HKD3300	300A Class RK5	XTOB057DC1 ②	C440B1A100SAX		DS7-340SX081N0-N ④⑤
									DS7-342SX081N0-N ⑥
									DS7-34DSX081N0-D ⑦
65	20	25	50	HKD3350	350A Class RK5	XTOB100GC1S	C440B1A100SAX		DS7-340SX100N0-N ④⑤
									DS7-342SX100N0-N ⑥
									DS7-34DSX100N0-D ⑦
80	30	30	75	HKD3350	500A Class RK5	XTOB100GC1S	C440B1A100SAX		DS7-340SX135N0-N ④⑤
									DS7-342SX135N0-N ⑥
									DS7-34DSX135N0-D ⑦
96	30	40	75	HLD3450	500A Class RK5	XTOB100GC1S	C440B1A100SAX		DS7-340SX160N0-N ④⑤
									DS7-342SX160N0-N ⑥
									DS7-34DSX160N0-D ⑦
124	40	50	100	HLD3500	500A Class RK5	XTOB150GC1S	C440A1A005SAX ③		DS7-340SX200N0-N ④⑤
									DS7-342SX200N0-N ⑥
									DS7-34DSX200N0-D ⑦

Notes

- 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 ZEB-XCT300 current transformer must be used with this overload.
- ④ 24 Vac/Vdc device.
- ⑤ -40°C rated low temperature version available in 24 Vac/Vdc, change to "NO-L."
- ⑥ 120/230 Vac device.
- ⑦ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24 Vdc output	ELC-PS01
100–240V input and 24 Vdc output	PSG60E
400–500V input and 24 Vdc output	PSG60F24RM

DS7 Soft Start kW Ratings

Please refer to Application Note AP039004EN for additional information on proper size selection.

**DS7 Soft Start Controller—
Frames 1 and 2**



**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 (A)	Motor Power (kW)		Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended XTOB Overload (Direct Connect) ②		Recommended XTOE Overload ③		PKE MMP	MMP ④	Connection Kit to MMP	Catalog Number
	230V	400V			XTOB004BC1	XTOE005BCS	XTPE012BCS	XTPR004BC1				
3.8	0.75	1.5	HFD3015	15A Class RK5	XTOB004BC1	XTOE005BCS	XTPE012BCS	XTPR004BC1	XTPAXTPCB	DS7-340SX004N0-N ④⑤	DS7-342SX004N0-N ⑥	DS7-34DSX004N0-D ⑦
7	1.5	3	HFD3015	15A Class RK5	XTOB006BC1 ⑤	XTOE020BCS	XTPE012BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX007N0-N ④⑤	DS7-342SX007N0-N ⑥	DS7-34DSX007N0-D ⑦
9	2.2	4	HFD3020	20A Class RK5	XTOB010BC1	XTOE020BCS	XTPE012BCS	XTPR010BC1	XTPAXTPCB	DS7-340SX009N0-N ④⑤	DS7-342SX009N0-N ⑥	DS7-34DSX009N0-D ⑦
12	3	5.5	HFD3030	20A Class RK5	XTOB012BC1	XTOE020BCS	XTPE032BCS	XTPR012BC1	XTPAXTPCB	DS7-340SX012N0-N ④⑤	DS7-342SX012N0-N ⑥	DS7-34DSX012N0-D ⑦
16	4	7.5	HFD3035	25A Class RK5	XTOB016CC1	XTOE020CCS	XTPE032BCS	XTPR016BC1	XTPAXTPCC	DS7-340SX016N0-N ④⑤	DS7-342SX016N0-N ⑥	DS7-34DSX016N0-D ⑦
24	5.5	11	HFD3060	40A Class RK5	XTOB024CC1	XTOE045CCS	XTPE032BCS	XTPR025BC1	XTPAXTPCC	DS7-340SX024N0-N ④⑤	DS7-342SX024N0-N ⑥	DS7-34DSX024N0-D ⑦
32	7.5	15	HFD3070	50A Class RK5	XTOB032CC1	XTOE045CCS	XTPE032BCS	XTPR032BC1	XTPAXTPCC	DS7-340SX032N0-N ④⑤	DS7-342SX032N0-N ⑥	DS7-34DSX032N0-D ⑦

Notes

- ① Actual motor FLAs vary. Verify these devices cover the motor specific FLA.
- ② Selections are based on motor FLA value at 480V.
- ③ Not to be used with 230V.
- ④ 24 Vac/Vdc device.
- ⑤ -40°C rated low temperature version available in 24 Vac/Vdc, change to "N0-L."
- ⑥ 120/230 Vac device.
- ⑦ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24 Vdc output	ELC-PS01
100–240V input and 24 Vdc output	PSG60E
400–500V input and 24 Vdc output	PSG60F24RM

Please refer to Application Note AP039004EN for additional information on proper size selection.

**DS7 Soft Start Controller—
Frames 3 and 4**



**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**

Rated Current (A)	Motor Power (kW)		Maximum Allowable Breaker Size ①	Maximum Allowable Fuse Size ①	Recommended XTOB Overload	Recommended C440 Overload	Catalog Number
	230V	400V					
41	11	22	HFD3150L	150A Class RK5	XTOB057DC1 ②	C440A1A045SAX	DS7-340SX041N0-N ⑤⑥ DS7-342SX041N0-N ⑦ DS7-34DSX041N0-D ⑧
55	15	30	HFD3200L	200A Class RK5	XTOB057DC1 ②	C440B1A100SAX	DS7-340SX055N0-N ⑤⑥ DS7-342SX055N0-N ⑦ DS7-34DSX055N0-D ⑧
68	15	37	HJD3250	200A Class RK5	XTOB070GC1 ②	C440B1A100SAX	DS7-340SX070N0-N ⑤⑥ DS7-342SX070N0-N ⑦ DS7-34DSX070N0-D ⑧
81	22	45	HKD3300	300A Class RK5	XTOB100GC1S	C440B1A100SAX	DS7-340SX081N0-N ⑤⑥ DS7-342SX081N0-N ⑦ DS7-34DSX081N0-D ⑧
99	30	55	HKD3350	350A Class RK5	XTOB100GC1S	C440B1A100SAX	DS7-340SX100N0-N ⑤⑥ DS7-342SX100N0-N ⑦ DS7-34DSX100N0-D ⑧
134	30	75	HKD3400	500A Class RK5	XTOB150GC1S	C440A1A005SAX ④	DS7-340SX135N0-N ⑤⑥ DS7-342SX135N0-N ⑦ DS7-34DSX135N0-D ⑧
160	45	90	HLD3450	500A Class RK5	XTOB160LC1 ③	C440A1A005SAX ④	DS7-340SX160N0-N ⑤⑥ DS7-342SX160N0-N ⑦ DS7-34DSX160N0-D ⑧
196	55	110	HLD3500	500A Class RK5	XTOB220LC1 ③	C440A1A005SAX ④	DS7-340SX200N0-N ⑤⑥ DS7-342SX200N0-N ⑦ DS7-34DSX200N0-D ⑧

Notes

- 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.
- ⑤ 24 Vac/Vdc device.
- ⑥ -40°C rated low temperature version available in 24 Vac/Vdc, change to "N0-L."
- ⑦ 120/230 Vac device.
- ⑧ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24 Vdc output	ELC-PS01
100–240V input and 24 Vdc output	PSG60E
400–500V input and 24 Vdc output	PSG60F24RM

Please refer to Application Note AP039004EN for additional information on proper size selection.

**DS7 Soft Start Controller—
Frames 1 and 2**



**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 ①**

Rated Current (A)	Motor Power (kW)			Maximum Allowable Breaker Size	Maximum Allowable Fuse Size	Recommended XTOB Overload (Direct Connect) ②	Recommended			Connection Kit to MMP	Catalog Number
	230V	400V					XTOE	MMP ②			
2.5	0.33	1	HFD3015	15A Class RK5		XTOB004BC1	XTOE005BCS	XTPE012BCS	XTPR004BC1	XTPAXTPCB	DS7-340SX004N0-N ④⑤
											DS7-342SX004N0-N ⑥
											DS7-34DSX004N0-D ⑦
3.8	0.75	1.5	HFD3015	15A Class RK5		XTOB006BC1 ③	XTOE020BCS	XTPE012BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX007N0-N ④⑤
											DS7-342SX007N0-N ⑥
											DS7-34DSX007N0-D ⑦
7	1.5	3	HFD3020	20A Class RK5		XTOB006BC1	XTOE020BCS	XTPE012BCS	XTPR6P3BC1	XTPAXTPCB	DS7-340SX009N0-N ④⑤
											DS7-342SX009N0-N ⑥
											DS7-34DSX009N0-D ⑦
9	2.2	4	HFD3030	20A Class RK5		XTOB010BC1	XTOE020BCS	XTPE032BCS	XTPR010BC1	XTPAXTPCB	DS7-340SX012N0-N ④⑤
											DS7-342SX012N0-N ⑥
											DS7-34DSX012N0-D ⑦
12	3	5.5	HFD3035	25A Class RK5		XTOB016CC1	XTOE020CCS	XTPE032BCS	XTPR016BC1	XTPAXTPCC	DS7-340SX016N0-N ④⑤
											DS7-342SX016N0-N ⑥
											DS7-34DSX016N0-D ⑦
16	4	7.5	HFD3060	40A Class RK5		XTOB016CC1	XTOE045CCS	XTPE032BCS	XTPR016BC1	XTPAXTPCC	DS7-340SX024N0-N ④⑤
											DS7-342SX024N0-N ⑥
											DS7-34DSX024N0-D ⑦
24	5.5	11	HFD3070	50A Class RK5		XTOB024CC1	XTOE045CCS	XTPE032BCS	XTPR025BC1	XTPAXTPCC	DS7-340SX032N0-N ④⑤
											DS7-342SX032N0-N ⑥
											DS7-34DSX032N0-D ⑦

Notes

- ① Actual motor FLAs vary. Verify these devices cover the motor specific FLA.
- ② Selections are based on motor FLA value at 480V.
- ③ Not to be used with 230V.
- ④ 24 Vac/Vdc device.
- ⑤ -40°C rated low temperature version available in 24 Vac/Vdc, change to "N0-L."
- ⑥ 120/230 Vac device.
- ⑦ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24 Vdc output	ELC-PS01
100–240V input and 24 Vdc output	PSG60E
400–500V input and 24 Vdc output	PSG60F24RM

Please refer to Application Note AP039004EN for additional information on proper size selection.

**DS7 Soft Start Controller—
Frames 3 and 4**



**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**

Rated Current (A)	Motor Power (kW)		Maximum Allowable Breaker Size ①	Maximum Allowable Fuse Size ①	Recommended XTOB Overload	Recommended C440 Overload	Catalog Number
28.8	7.5	11	HFD3150L	150A Class RK5	XTOB040DC1	C440A1A045SAX	DS7-340SX041N0-N ⑤⑥
37.5	11	18.5	HFD3200L	200A Class RK5	XTOB040DC1	C440A1A045SAX	DS7-342SX041N0-N ⑦
							DS7-34DSX041N0-D ⑧
46	11	22	HJD3250	200A Class RK5	XTOB057DC1 ②	C440B1A100SAX	DS7-340SX070N0-N ⑤⑥
							DS7-342SX070N0-N ⑦
							DS7-34DSX070N0-D ⑧
56	15	30	HKD3300	300A Class RK5	XTOB065DC1 ②	C440B1A100SAX	DS7-340SX081N0-N ⑤⑥
							DS7-342SX081N0-N ⑦
							DS7-34DSX081N0-D ⑧
68	18.5	37	HKD3350	350A Class RK5	XTOB100GC1S	C440B1A100SAX	DS7-340SX100N0-N ⑤⑥
							DS7-342SX100N0-N ⑦
							DS7-34DSX100N0-D ⑧
90	22	45	HKD3350	500A Class RK5	XTOB100GC1S	C440B1A100SAX	DS7-340SX135N0-N ⑤⑥
							DS7-342SX135N0-N ⑦
							DS7-34DSX135N0-D ⑧
106	30	55	HLD3450	500A Class RK5	XTOB160LC1 ③	C440A1A005SAX ④	DS7-340SX160N0-N ⑤⑥
							DS7-342SX160N0-N ⑦
							DS7-34DSX160N0-D ⑧
134	37	75	HLD3500	500A Class RK5	XTOB160LC1 ③	C440A1A005SAX ④	DS7-340SX200N0-N ⑤⑥
							DS7-342SX200N0-N ⑦
							DS7-34DSX200N0-D ⑧

Notes

- 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.
- ⑤ 24 Vac/Vdc device.
- ⑥ -40°C rated low temperature version available in 24 Vac/Vdc, change to "NO-L."
- ⑦ 120/230 Vac device.
- ⑧ 24 Vdc for SmartWire-DT device.

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 lightweight, 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.

Power Supply Selection

Description	Catalog Number
85–264V input and 24 Vdc output	ELC-PS01
100–240V input and 24 Vdc output	PSG60E
400–500V input and 24 Vdc output	PSG60F24RM

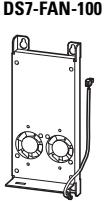
Accessories

Device Fans

	Description	For Use With ...	Std. Pack	Catalog Number
DS7-FAN-032	Device fan for increasing the load cycle (more starts per hour higher or longer ramp times exceeding 10 seconds.)	DS7-34...SX004... DS7-34...SX007... DS7-34...SX009... DS7-34...SX012... DS7-34...SX016... DS7-34...SX024... DS7-34...SX032...	1 off	DS7-FAN-032^①
DS7-FAN-100		DS7-34...SX041... DS7-34...SX055... DS7-34...SX070... DS7-34...SX081... DS7-34...SX100...	1 off	DS7-FAN-100
		DS7-34...SX135... DS7-34...SX160... DS7-34...SX200...	1 off	DS7-FAN-200

Note

^① NA Certification. Request filed for UL and CSA.



Technical Data and Specifications**DS7 Soft Start Controllers****Rated Control Circuit**

Voltage 24 Vac/Vdc	DS7-340SX004N0-N	DS7-340SX007N0-N	DS7-340SX009N0-N	DS7-340SX012N0-N
Voltage 110/230 Vac	DS7-342SX004N0-N	DS7-342SX007N0-N	DS7-342SX009N0-N	DS7-342SX012N0-N
Voltage 24 Vdc	DS7-34DSX004N0-D	DS7-34DSX007N0-D	DS7-34DSX009N0-D	DS7-34DSX012N0-D

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 de-rate linearly by 1% of rated current per Celsius to 60°C –40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C –40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C –40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C –40 to +40°C for low temperature version	
Ambient temperature (storage)	°C –25 to 55°C	–25 to 55°C	–25 to 55°C	–25 to 55°C	
Altitude	0–1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0–1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0–1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0–1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	
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/11ms	8g/11ms	8g/11ms	8g/11ms	
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)					
DS7-340... and DS7-342...	in (mm)	1.77 x 5.12 x 3.74 (45 x 130 x 95)	1.77 x 5.12 x 3.74 (45 x 130 x 95)	1.77 x 5.12 x 3.74 (45 x 130 x 95)	1.77 x 5.12 x 3.74 (45 x 130 x 95)
DS7-34D...	in (mm)	1.77 x 5.31 x 3.74 (45 x 135 x 95)	1.77 x 5.31 x 3.74 (45 x 135 x 95)	1.77 x 5.31 x 3.74 (45 x 135 x 95)	1.77 x 5.31 x 3.74 (45 x 135 x 95)
Weight					
DS7-340...	lb (kg)	0.77 (0.35)	0.77 (0.35)	0.77 (0.35)	0.77 (0.35)
DS7-342...	lb (kg)	0.88 (0.40)	0.88 (0.40)	0.88 (0.40)	0.88 (0.40)
DS7-34D...	lb (kg)	0.90 (0.41)	0.90 (0.41)	0.90 (0.41)	0.90 (0.41)
Main Circuit					
Rated operational voltage	V 230–460 Vac	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	50/60 Hz
Rated operation current AC 53	I _e 4	7	9	12	
Motor Power Ratings					
200V	hp 0.75	1.5	2	3	
230V	hp 0.75	2	2	5	
480V	hp 2	3	5	10	
230V	kW 0.75	1.5	2.2	3	
400V	kW 1.5	3	4	5.5	
Overload cycle according to EN 60947-4-2	4A: AC53a; 3-5; 75-10	7A: AC53a; 3-5; 75-10	9A: AC53a; 3-5; 75-10	12A: AC53a; 3-5; 75-10	

DS7 Soft Start Controllers, continued**Rated Control Circuit**

Voltage 24 Vac/Vdc		DS7-340SX004N0-N	DS7-340SX007N0-N	DS7-340SX009N0-N	DS7-340SX012N0-N
Voltage 110/230 Vac		DS7-342SX004N0-N	DS7-342SX007N0-N	DS7-342SX009N0-N	DS7-342SX012N0-N
Voltage 24 Vdc	Unit	DS7-34DSX004N0-D	DS7-34DSX007N0-D	DS7-34DSX009N0-D	DS7-34DSX012N0-D

Wire Specifications

Power terminals

Single conductor—solid or stranded	AWG	18–10	18–10	18–10	18–10
Terminal torque	lb-in	11	11	11	11

Control signals

Single conductor—solid or stranded	AWG	18–10	18–10	18–10	18–10
Terminal torque	lb-in	11	11	11	11

Power Section

Rated impulse withstand voltage	U_{imp} 1.2/50_s	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	Vac/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
Pick-up voltage		+17.3–+27	+17.3–+27	+17.3–+27	+17.3–+27
Drop-out voltage		+3–0	+3–0	+3–0	+3–0

Relay Outputs

Number of relays		1 (TOR)	1 (TOR)	1 (TOR)	1 (TOR)
Maximum voltage	Vac	250	250	250	250
Maximum current	A	1A	1A	1A	1A

Soft Start Functions

Ramp times					
Start ramp	s	1–30	1–30	1–30	1–30
Stop ramp	s	0–30	0–30	0–30	0–30
Initial voltage % line voltage					
DS7-342...		30–92%	30–92%	30–92%	30–92%
DS7-340...		30–100%	30–100%	30–100%	30–100%
DS7-34D...		30–92%	30–92%	30–92%	30–92%

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
Pick-up voltage	Vac	102–230	102–230	102–230	102–230
Drop-out 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	3A	3A	3A	3A

Soft Start Functions

Ramp times					
Start ramp	s	1–30	1–30	1–30	1–30
Stop ramp	s	0–30	0–30	0–30	0–30
Initial voltage % line voltage		30–92%	30–92%	30–92%	30–92%

DS7 Soft Start Controllers, continued**Rated Control Circuit**

Voltage 24 Vac/Vdc	DS7-340SX016N0-N	DS7-340SX024N0-N	DS7-340SX032N0-N
Voltage 110/230 Vac	DS7-342SX016N0-N	DS7-342SX024N0-N	DS7-342SX032N0-N
Voltage 24 Vdc	DS7-34DSX016N0-D	DS7-34DSX024N0-D	DS7-34DSX032N0-D

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/marking	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 de-rate linearly by 1% of rated current per Celsius to 60°C –40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C –40 to +40°C for low temperature version
Ambient temperature (storage)	°C	–25 to 55°C	–25 to 55°C
Altitude		0–1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0–1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m
Installation		Vertical	Vertical
Protection class		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
Busbar tag shroud		Back of hand and finger-proof (from front face)	Back of hand and finger-proof (from front face)
Oversupply category/pollution degree		II/2	II/2
Shock resistance		8g/11ms	8g/11ms
Vibration resistance according to EN 60721-3-2		2M2	2M2
Mean heat dissipation at rated duty cycle	W	0.8	1.1
Radio interference		B	B
Dimensions (W x H x D)			
DS7-340... and DS7-342...	in (mm)	1.77 x 5.91 x 4.65 (45 x 150 x 118)	1.77 x 5.91 x 4.65 (45 x 150 x 118)
DS7-34D...	in (mm)	1.77 x 5.91 x 4.65 (45 x 150 x 118)	1.77 x 5.91 x 4.65 (45 x 150 x 118)
Weight			
DS7-340...	lb (kg)	0.88 (0.40)	0.88 (0.40)
DS7-342...	lb (kg)	0.99 (0.45)	0.99 (0.45)
DS7-34D...	lb (kg)	0.90 (0.41)	0.90 (0.41)
Main Circuit			
Rated operational voltage	V	230–460 Vac	230–460 Vac
Mains frequency	Hz	50/60 Hz	50/60 Hz
Rated operation current AC 53	I _e	16	24
Motor Power Ratings			
200V	hp	3	5
230V	hp	5	7.5
480V	hp	10	15
230V	kW	4	5.5
400V	kW	7.5	11
Overload cycle according to EN 60947-4-2		16A: AC53a; 3-5; 75-10	24A: AC53a; 3-5; 75-10
			32A: AC53a; 3-5; 75-10

DS7 Soft Start Controllers, continued**Rated Control Circuit**

Voltage 24 Vac/Vdc	DS7-340SX016N0-N	DS7-340SX024N0-N	DS7-340SX032N0-N
Voltage 110/230 Vac	DS7-342SX016N0-N	DS7-342SX024N0-N	DS7-342SX032N0-N
Voltage 24 Vdc	DS7-34DSX016N0-D	DS7-34DSX024N0-D	DS7-34DSX032N0-D

Wire Specifications

Power terminals

Single conductor—solid or stranded	AWG	18–6	18–6	18–6
Terminal torque	lb-in	11	11	11

Control Signals

Single conductor—solid or stranded	AWG	18–10	18–10	18–10
Terminal torque	lb-in	11	11	11

Power Section

Rated impulse withstand voltage	U_{imp} 1.2/50_s	4 kV	4 kV	4 kV
Rated insulation voltage		500	500	500

Control Commands—Vac/Vdc

Supply voltage control board U_s nominal	Vac/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
Pick-up voltage		+17.3–+27	+17.3–+27	+17.3–+27
Drop-out voltage		+3–0	+3–0	+3–0

Relay Outputs

Number of relays		2 (TOR, Ready)	2 (TOR, Ready)	2 (TOR, Ready)
Maximum voltage	Vac	250	250	250
Maximum current	A	1A	1A	1A

Soft Start Functions

Ramp times				
Start ramp	s	1–30	1–30	1–30
Stop ramp	s	0–30	0–30	0–30
Initial voltage % line voltage				
DS7-342...		30–92%	30–92%	30–92%
DS7-340...		30–100%	30–100%	30–100%
DS7-34D...		30–92%	30–92%	30–92%

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
Pick-up voltage	Vac	102–230	102–230	102–230
Drop-out 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	3A	3A	3A

Soft Start Functions

Ramp times				
Start ramp	s	1–30	1–30	1–30
Stop ramp	s	0–30	0–30	0–30
Initial voltage % line voltage		30–92%	30–92%	30–92%

DS7 Soft Start Controllers, continued

Rated Control Circuit

Voltage 24 Vac/Vdc	DS7-340SX041N0-N	DS7-340SX055N0-N	DS7-340SX070N0-N	DS7-340SX081N0-N
Voltage 110/230 Vac	DS7-342SX041N0-N	DS7-342SX055N0-N	DS7-342SX070N0-N	DS7-342SX081N0-N
Voltage 24 Vdc	DS7-34DSX041N0-D	DS7-34DSX055N0-D	DS7-34DSX070N0-D	DS7-34DSX081N0-D

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/marking	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 de-rate linearly by 1% of rated current per Celsius to 60°C -40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C -40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C -40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C -40 to +40°C for low temperature version	
Ambient temperature (storage) °C	-25 to 55°C	-25 to 55°C	-25 to 55°C	-25 to 55°C	
Altitude	0-1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0-1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0-1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0-1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	
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/11ms	8g/11ms	8g/11ms	8g/11ms	
Vibration resistance according to EN 60721-3-2	2M2	2M2	2M2	2M2	
Mean heat dissipation at rated duty cycle W	7	10	13	18	
Radio interference	B	B	B	B	
Dimensions (W x H x D)					
DS7-340..., DS7-342... and DS7-34D...	in (mm)	3.66 x 6.89 x 5.47 (93 x 175 x 139)	3.66 x 6.89 x 5.47 (93 x 175 x 139)	3.66 x 6.89 x 5.47 (93 x 175 x 139)	3.66 x 6.89 x 5.47 (93 x 175 x 139)
Weight					
DS7-340..., DS7-342... and DS7-34D...	lb (kg)	3.97 (1.8)	3.97 (1.8)	3.97 (1.8)	3.97 (1.8)
Main Circuit					
Rated operational voltage V	230–460 Vac	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	50/60 Hz
Rated operation current AC 53 I _e	41	55	70	81	
Motor Power Ratings					
200V	hp	10	15	20	25
230V	hp	10	20	25	30
480V	hp	30	40	50	60
230V	kW	11	15	15	22
400V	kW	22	30	37	45
Overload cycle according to EN 60947-4-2		41A: AC53a; 3-5; 75-10	55A: AC53a; 3-5; 75-10	70A: AC53a; 3-5; 75-10	81A: AC53a; 3-5; 75-10

DS7 Soft Start Controllers, continued**Rated Control Circuit**

Voltage 24 Vac/Vdc		DS7-340SX041N0-N	DS7-340SX055N0-N	DS7-340SX070N0-N	DS7-340SX081N0-N
Voltage 110/230 Vac		DS7-342SX041N0-N	DS7-342SX055N0-N	DS7-342SX070N0-N	DS7-342SX081N0-N
Voltage 24 Vdc	Unit	DS7-34DSX041N0-D	DS7-34DSX055N0-D	DS7-34DSX070N0-D	DS7-34DSX081N0-D

Wire Specifications

Power terminals

Single conductor—solid or stranded	AWG	12–2/0	12–2/0	12–2/0	12–2/0
Terminal torque	lb-in	53–80	53–80	53–80	53–80
Control signals					
Single conductor—solid or stranded	AWG	18–10	18–10	18–10	18–10
Terminal torque	lb-in	11	11	11	11

Power Section

Rated impulse withstand voltage	U_{imp} 1.2/50_s	4 kV	4 kV	4 kV	4 kV
Rated insulation voltage		500	500	500	500

Control Commands—24 Vac/Vdc

Supply voltage control board U_s nominal	Vac/Vdc	20.4–26.4	20.4–26.4	20.4–26.4	20.4–26.4
Current consumption at 24 Vac/Vdc	mA	65	65	65	65
Pick-up voltage		+17.3–+27	+17.3–+27	+17.3–+27	+17.3–+27
Drop-out voltage		+3–0	+3–0	+3–0	+3–0

Relay Outputs

Number of relays		2 (TOR)	2 (TOR)	2 (TOR)	2 (TOR)
Maximum voltage	Vac	250	250	250	250
Maximum current	A	1A	1A	1A	1A

Soft Start Functions

Ramp times					
Start ramp	s	1–30	1–30	1–30	1–30
Stop ramp	s	0–30	0–30	0–30	0–30
Initial voltage % line voltage					
DS7-342...		30–92%	30–92%	30–92%	30–92%
DS7-340...		30–100%	30–100%	30–100%	30–100%
DS7-34D...		30–92%	30–92%	30–92%	30–92%

Control Commands—110–230 Vac

Supply voltage control board U_s nominal	Vac	102–253	102–253	102–253	102–253
Current consumption at 24 Vac/Vdc	mA	14	14	14	14
Pick-up voltage	Vac	102–230	102–230	102–230	102–230
Drop-out voltage	Vac	0–28	0–28	0–28	0–28

Relay Outputs

Number of relays		2 (TOR)	2 (TOR)	2 (TOR)	2 (TOR)
Maximum voltage	Vac	250	250	250	250
Maximum current	A	3A	3A	3A	3A

Soft Start Functions

Ramp times					
Start ramp	s	1–30	1–30	1–30	1–30
Stop ramp	s	0–30	0–30	0–30	0–30
Initial voltage % line voltage		30–92%	30–92%	30–92%	30–92%

DS7 Soft Start Controllers, continued

Rated Control Circuit

Voltage 24 Vac/Vdc	DS7-340SX100N0-N	DS7-340SX135N0-N	DS7-340SX160N0-N	DS7-340SX200N0-N
Voltage 110/230 Vac	DS7-342SX100N0-N	DS7-342SX135N0-N	DS7-342SX160N0-N	DS7-342SX200N0-N
Voltage 24 Vdc	Unit	DS7-34DSX100N0-D	DS7-34DSX135N0-D	DS7-34DSX160N0-D

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/marking	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 de-rate linearly by 1% of rated current per Celsius to 60°C -40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C -40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C -40 to +40°C for low temperature version	0 to 40°C, above 40°C de-rate linearly by 1% of rated current per Celsius to 60°C -40 to +40°C for low temperature version	
Ambient temperature (storage) °C	-25 to 55°C	-25 to 55°C	-25 to 55°C	-25 to 55°C	
Altitude	0-1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0-1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0-1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	0-1000m, above 1000m de-rate linearly by 2.5% of rated current per 100m to a maximum of 2000m	
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/11ms	8g/11ms	8g/11ms	8g/11ms	
Vibration resistance according to EN 60721-3-2	2M2	2M2	2M2	2M2	
Mean heat dissipation at rated duty cycle W	25	24	30	42	
Radio interference	B	B	B	B	
Dimensions (W x H x D)					
DS7-340..., DS7-342... and DS7-34D...	in (mm)	3.66 x 6.89 x 5.47 (93 x 175 x 139)	4.25 x 8.46 x 7.01 (108 x 215 x 178)	4.25 x 8.46 x 7.01 (108 x 215 x 178)	4.25 x 8.46 x 7.01 (108 x 215 x 178)
Weight					
DS7-340..., DS7-342... and DS7-34D...	lb (kg)	3.97 (1.8)	8.16 (3.7)	8.16 (3.7)	8.16 (3.7)
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	100	135	160	200	
Motor Power Ratings					
200V hp	30	40	50	60	
230V hp	30	50	60	75	
480V hp	75	100	125	150	
230V kW	30	30	45	55	
400V kW	55	75	90	110	
Overload cycle according to EN 60947-4-2	100A: AC53a; 3-5; 75-10	135A: AC53a; 3-5; 75-10	160A: AC53a; 3-5; 75-10	200A: AC53a; 3-5; 75-10	

DS7 Soft Start Controllers, continued**Rated Control Circuit**

Voltage 24 Vac/Vdc		DS7-340SX100N0-N	DS7-340SX135N0-N	DS7-340SX160N0-N	DS7-340SX200N0-N
Voltage 110/230 Vac		DS7-342SX100N0-N	DS7-342SX135N0-N	DS7-342SX160N0-N	DS7-342SX200N0-N
Voltage 24 Vdc	Unit	DS7-34DSX100N0-D	DS7-34DSX135N0-D	DS7-34DSX160N0-D	DS7-34DSX200N0-D

Wire Specifications

Power terminals

Single conductor—solid or stranded	AWG	12–2/0	12–350 kcmil	12–350 kcmil	12–350 kcmil
Terminal torque	lb-in	53–80	44–123	44–123	44–123

Control signals

Single conductor—solid or stranded	AWG	18–10	18–10	18–10	18–10
Terminal torque	lb-in	11	11	11	11

Power Section

Rated impulse withstand voltage	U_{imp} 1.2/50_s	4 kV	4 kV	4 kV	4 kV
Rated insulation voltage		500	500	500	500

Control Commands—24 Vac/Vdc

Supply voltage control board U_s nominal	Vac/Vdc	20.4–26.4	20.4–26.4	20.4–26.4	20.4–26.4
Current consumption at 24 Vac/Vdc	mA	65	65	65	65
Pick-up voltage		+17.3–+27	+17.3–+27	+17.3–+27	+17.3–+27
Drop-out voltage		+3–0	+3–0	+3–0	+3–0

Relay Outputs

Number of relays		2 (TOR)	2 (TOR)	2 (TOR)	2 (TOR)
Maximum voltage	Vac	250	250	250	250
Maximum current	A	1A	1A	1A	1A

Soft Start Functions

Ramp times					
Start ramp	s	1–30	1–30	1–30	1–30
Stop ramp	s	0–30	0–30	0–30	0–30
Initial voltage % line voltage					
DS7-342...		30–92%	30–92%	30–92%	30–92%
DS7-340...		30–100%	30–100%	30–100%	30–100%
DS7-34D...		30–92%	30–92%	30–92%	30–92%

Control Commands—110–230 Vac

Supply voltage control board U_s nominal	Vac	102–253	102–253	102–253	102–253
Current consumption at 24 Vac/Vdc	mA	14	14	14	14
Pick-up voltage	Vac	102–230	102–230	102–230	102–230
Drop-out voltage	Vac	0–28	0–28	0–28	0–28

Relay Outputs

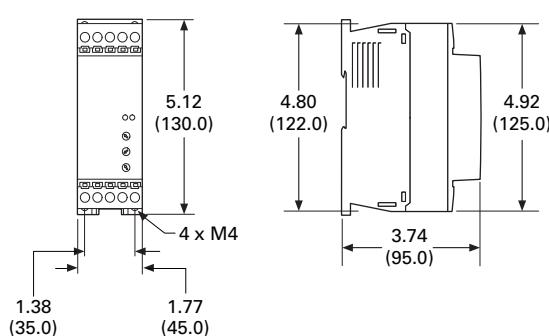
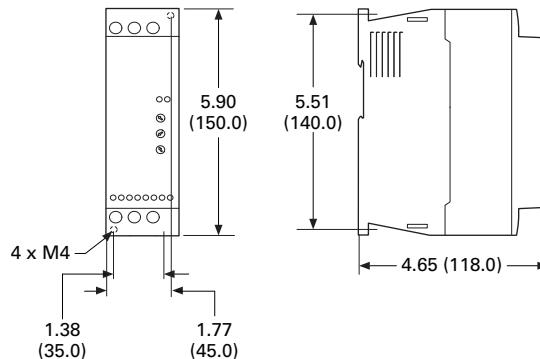
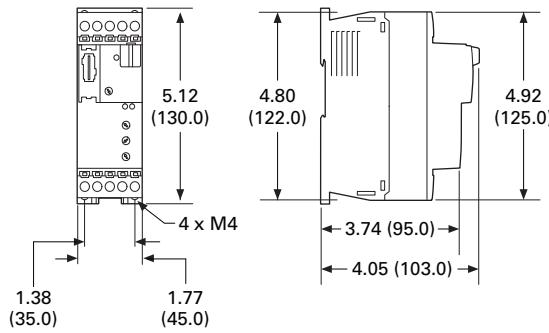
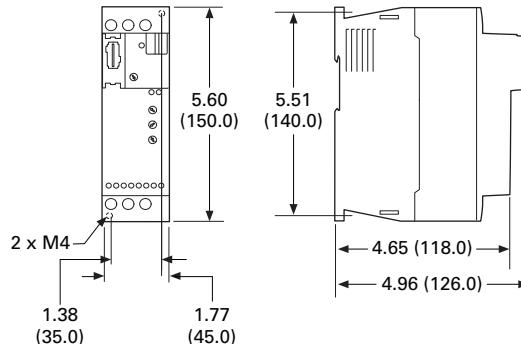
Number of relays		2 (TOR)	2 (TOR)	2 (TOR)	2 (TOR)
Maximum voltage	Vac	250	250	250	250
Maximum current	A	3A	3A	3A	3A

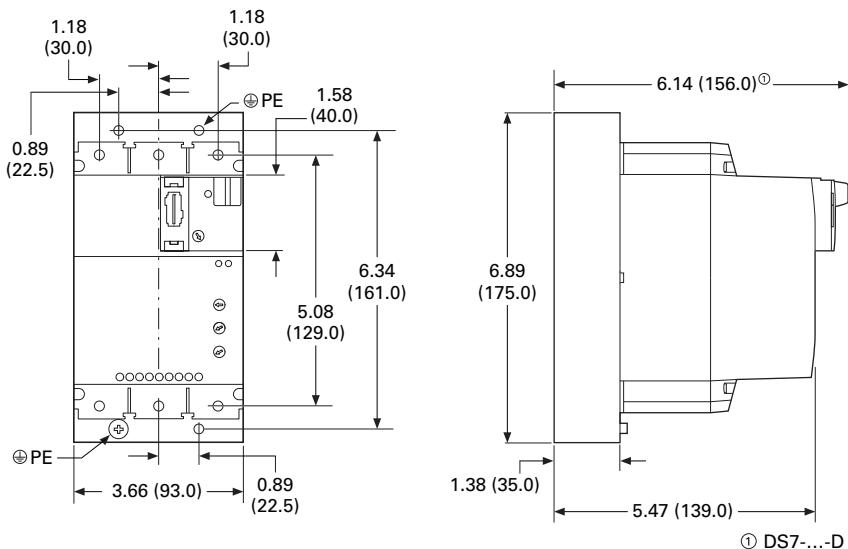
Soft Start Functions

Ramp times					
Start ramp	s	1–30	1–30	1–30	1–30
Stop ramp	s	0–30	0–30	0–30	0–30
Initial voltage % line voltage		30–92%	30–92%	30–92%	30–92%

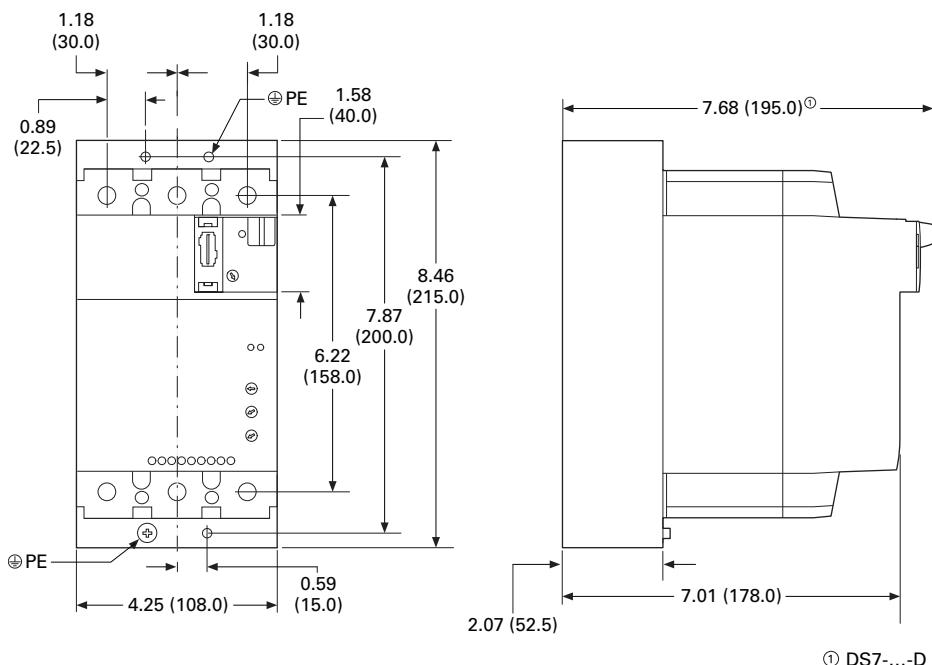
Dimensions

Approximate Dimensions in Inches (mm)

Frame 1**Catalog Numbers****DS7-340SX004N0-N** **DS7-342SX004N0-N****DS7-340SX007N0-N** **DS7-342SX007N0-N****DS7-340SX009N0-N** **DS7-342SX009N0-N****DS7-340SX012N0-N** **DS7-342SX012N0-N****Frame 2****Catalog Numbers****DS7-340SX016N0-N** **DS7-342SX016N0-N****DS7-340SX024N0-N** **DS7-342SX024N0-N****DS7-340SX032N0-N** **DS7-342SX032N0-N****Frame 1—SmartWire-DT****Catalog Numbers****DS7-34DSX004N0-D** **DS7-34DSX009N0-D****DS7-34DSX007N0-D** **DS7-34DSX012N0-D****Frame 2—SmartWire-DT****Catalog Numbers****DS7-34DSX016N0-D****DS7-34DSX024N0-D****DS7-34DSX032N0-D**

Frame 3—SmartWire-DT and Standard (Non SmartWire-DT)**Catalog Numbers**

DS7-340SX041N0-N	DS7-342SX041N0-N	DS7-34DSX041N0-D
DS7-340SX055N0-N	DS7-342SX055N0-N	DS7-34DSX055N0-D
DS7-340SX070N0-N	DS7-342SX070N0-N	DS7-34DSX070N0-D
DS7-340SX081N0-N	DS7-342SX081N0-N	DS7-34DSX081N0-D
DS7-340SX100N0-N	DS7-342SX100N0-N	DS7-34DSX100N0-D

Frame 4—SmartWire-DT and Standard (Non SmartWire-DT)**Catalog Numbers**

DS7-342SX135N0-N	DS7-340SX135N0-N	DS7-34DSX135N0-D
DS7-342SX160N0-N	DS7-340SX160N0-N	DS7-34DSX160N0-D
DS7-342SX200N0-N	DS7-340SX200N0-N	DS7-34DSX200N0-D

Solid-State Starters**Contents****Description**

	Page
Solid-State Starters	
Type S611, Solid-State Soft Starters	V6-T1-44
Type S801+, Soft Starters	V6-T1-61
Type S811+, Soft Starters with DIM	V6-T1-77

Product Overview**Type S611**

The S611 soft starter is a powerful combination of performance capability, application flexibility, and the industry's best user interface experience.

Designed to control acceleration and deceleration of three-phase motors, the line is available for current ranges from 26A through 414A applications.

The S611 has integrated bypass and overload protection. The S611 is available as a component for panel mounting or in enclosed control—NEMA Type 1, 12, 3R, 4, 4X.

Type S801+

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 for current ranges from 11A to 1000A applications, and is suitable for mounting in motor control centers or in enclosed control (NEMA Type 1, 4, 4X and 12) applications.

Type S811+

Eaton's S811+ offers all the popular features of the S801+ and adds enhanced functionality with the new DIM (Digital Interface Module), communications, metering, monitoring and diagnostics capabilities.

Eaton's line of S811+ reduced voltage soft starters is very compact, multi-functional, easy to install and easy to set operating parameters. Designed to control the acceleration and deceleration of three-phase motors up to 690V, the line is available from 11A to 1000A.

The S811+ is designed to be a complete package, combining the silicon controlled rectifiers (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).

Type S611, Solid-State Soft Starter**Type S611, Solid-State Soft Starters****Product Description**

Eaton revolutionized the reduced voltage control marketplace with its advanced feature set and user-friendly user interface module to enhance system performance and 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 600V, the line is available from 26 amps through 414 amps.

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

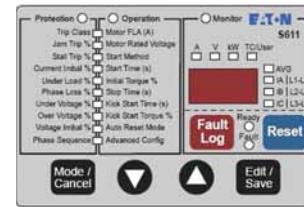
Application Description

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 eliminating the "water-hammer" effect that can damage pipes, valves and pumps.

Contents**Description**

Description	Page
Type S611, Solid-State Soft Starters	V6-T1-45
Communications	V6-T1-46
Operation	V6-T1-49
Features and Benefits	V6-T1-52
Standards and Certifications	V6-T1-52
Instructional Leaflets	V6-T1-52
Catalog Number Selection	V6-T1-52
Product Selection	V6-T1-53
Accessories	V6-T1-54
Replacement Parts	V6-T1-55
Technical Data and Specifications	V6-T1-56
Dimensions	V6-T1-59
Type S801+, Soft Starters	V6-T1-61
Type S811+, Soft Starters with DIM	V6-T1-77

User Interface Module (UI)

The UI can be removed from the S611 and 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 (resident), DeviceNet™, PROFIBUS®, and Ethernet.

The S611 communication parameters can be configured with the UI or through the Fieldbus.

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

Network Communications Reference

Description	Catalog Number
Modbus communication adapter without I/O	C441M
Modbus communication adapter with 120 Vac I/O	C441N
Modbus communication adapter with 24 Vdc I/O	C441P
DeviceNet communication adapter with 120 Vac I/O	C441K
DeviceNet communication adapter with 24 Vdc I/O	C441L
PROFIBUS communication adapter with 120 Vac I/O	C441S
PROFIBUS communication adapter with 24 Vdc I/O	C441Q
Ethernet IP/Modbus TCP communication adapter with 120 Vac I/O	C441R
Ethernet IP/Modbus TCP communication adapter with 24 Vdc I/O	C441T
Communication adapter	C440-COM-ADP

Operation

Starting and Stopping Modes

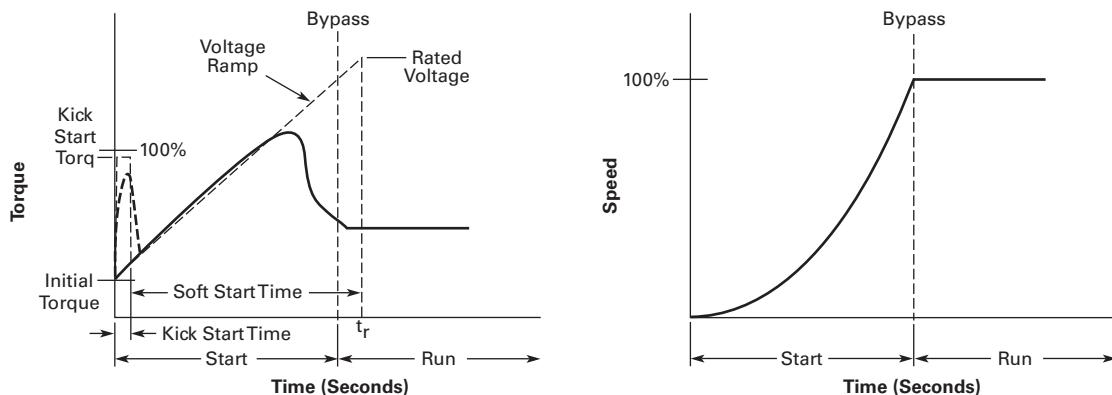
The S611 has a variety of starting and stopping methods to provide superior performance in the most demanding applications. The motor can be started in either Voltage Ramp Start or Current Limit Start mode. Kick Start and Soft Stop are available within both starting modes.

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)

Starting Characteristics—Ramp Start



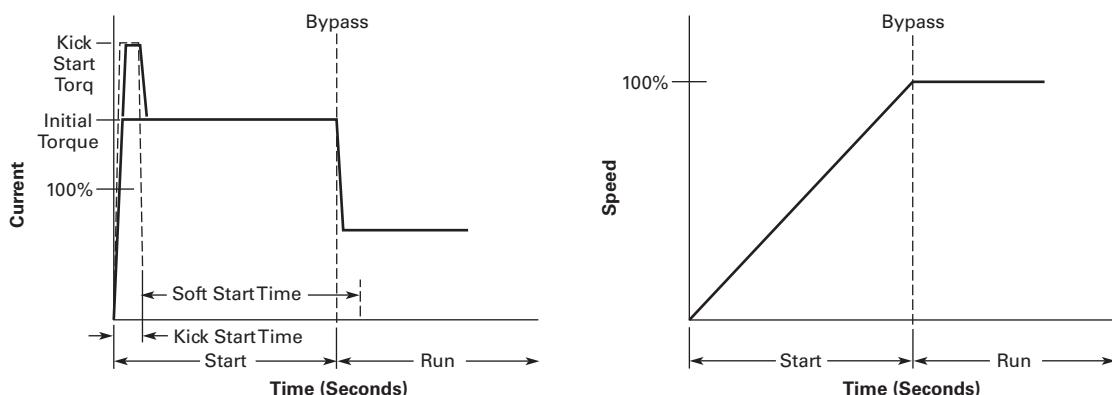
Current Limit Start

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)

Starting Characteristics—Current Limit Start

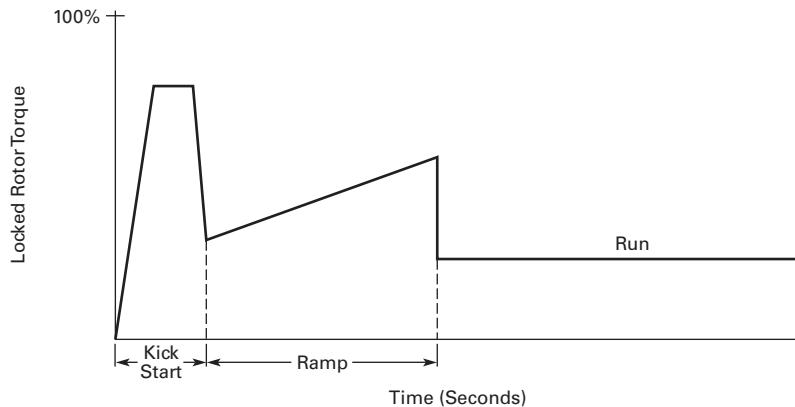


Kick Start

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 breakaway a high friction load.

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

Starting Characteristics—Kick Start

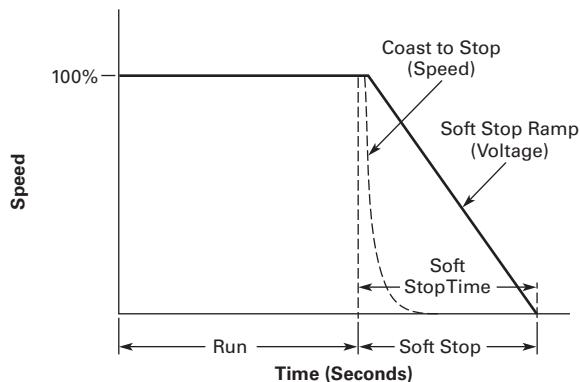


Soft Stop

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

Starting Characteristics—Soft Stop



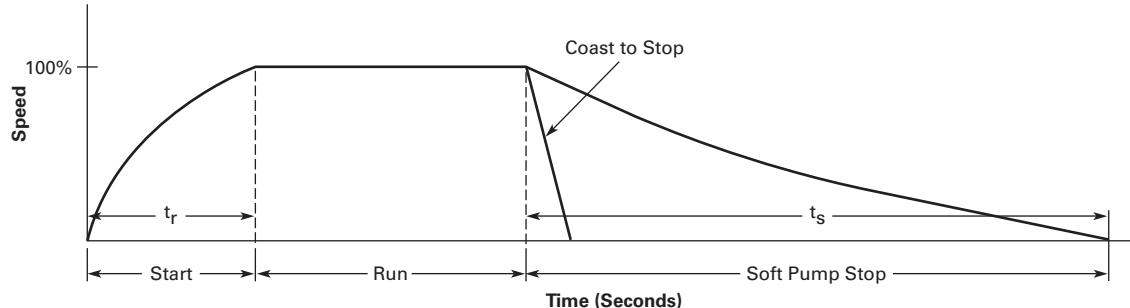
Pump Control Option

This option is intended to reduce the potential for water hammer in a centrifugal pump system by using a starting and stopping algorithm developed for pump control. Upon a start command, the speed of the motor is

increased, under the control of the S611 soft starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors close and the pump operates as with any other starter.

Upon a stop command, the bypass contactors are opened and the motor speed is decreased in a tapered manner, to gradually slow the flow until the motor is brought to a stop.

Pump Control Option



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 reapplied to the start terminal 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 120V AC 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.

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

Features and Benefits

- The User Interface Module (UI) 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 contactors directly connect 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
- The S611 lends itself to serviceability. The PCBs and contactors can be replaced in the field

Protective Features

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

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 over heat 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 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. The short circuit ratings can go up to 100KA.

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 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. 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 UI 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 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 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 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 to 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 to 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.

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 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 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 to 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 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 S611 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.

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

Start Count

Number of starts are stored in the device and can be displayed using field bus.

Diagnostics**Fault Queue**

Current fault and a fault queue containing the last nine system faults can be read through the UI or 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.

Field Serviceability

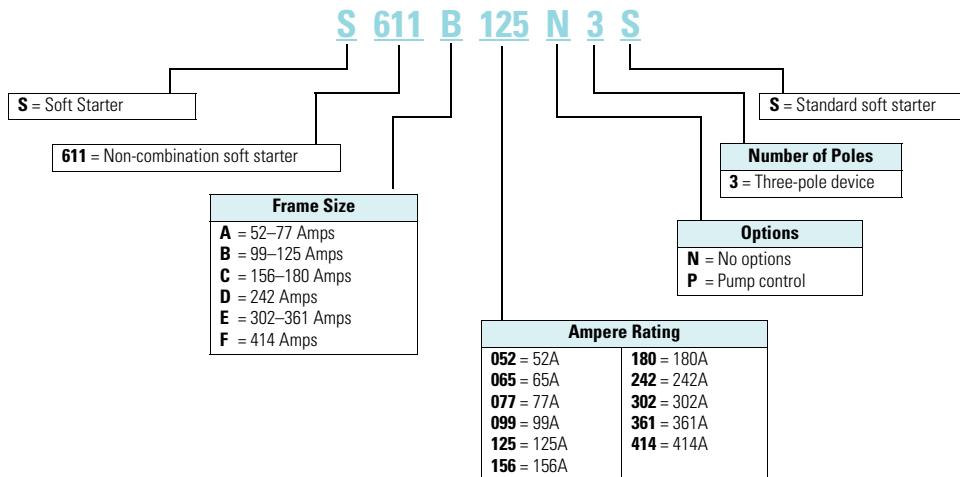
In the case of maintenance, the S611 provides easy access and replacement of key components including control board and internal bypass contactors—significantly increasing its service life. If a component ever needs to be replaced, this straightforward operation can be completed by an end-user without the need to call in an outside service technician or engineer. These components are stocked and available for order and quick fulfillment—ensuring your operation continues with minimal downtime.

Standards and Certifications

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

**Instructional Leaflets**

- Instruction Manual: MN03902011E
- Quick Start Guide: MN03901003E

Catalog Number Selection**S611 Soft Starters**

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 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 the Eaton Technical Resource Center.

Horsepower Ratings

Note: Always refer to motor plate FLA and ensure that the motor plate FLA is equal to or lower than the maximum current value in the tables.

S611



Standard Duty—300% Current for 15 Seconds, 115% Continuous

Maximum Current (Amps)	Horsepower Rating				Catalog Number
	208V	240V	480V	600V	
52	15	15	40	50	S611A052N3S
65	20	20	50	60	S611A065N3S
77	25	25	60	75	S611A077N3S
99	30	30	75	100	S611B099N3S
125	40	40	100	125	S611B125N3S
156	50	60	125	150	S611C156N3S
180	60	60	150	150	S611C180N3S
242	75	75	200	250	S611D242N3S
302	100	100	250	300	S611E302N3S
361	125	150	300	350	S611E361N3S
414	150	150	350	450	S611F414N3S

Standard Duty Plus—350% FLA for 30 Seconds, 115% Continuous

Maximum Current (Amps)	Horsepower Rating				Catalog Number
	208V	240V	480V	600V	
52	15	15	40	50	S611A052N3S
65	20	20	50	60	S611A065N3S
71	20	25	60	75	S611A077N3S
99	30	30	75	100	S611B099N3S
119	40	40	100	125	S611B125N3S
156	50	60	125	150	S611C156N3S
180	60	60	150	150	S611C180N3S
242	75	75	200	250	S611D242N3S
302	100	100	250	300	S611E302N3S
361	125	150	300	350	S611E361N3S
407	150	150	350	400	S611F414N3S

Note: Always refer to motor plate FLA and ensure that the motor plate FLA is equal to or lower than the maximum current value in the tables.

S611



Heavy Duty—500% FLA for 30 Seconds, 125% Continuous

Maximum Current (Amps)	Horsepower Rating				Catalog Number
	208V	240V	480V	600V	
49	15	15	40	50	S611A052N3S
83	25	30	60	75	S611B099N3S
142	40	60	125	150	S611C156N3S
225	75	75	200	200	S611D242N3S
256	75	100	200	250	S611E361N3S
285	100	125	250	300	S611F414N3S

Severe Duty—600% FLA for 30 Seconds, 125% Continuous

Maximum Current (Amps)	Horsepower Rating				Catalog Number
	208V	240V	480V	600V	
41	10	15	30	40	S611A052N3S
69	20	30	60	60	S611B099N3S
117	30	50	100	125	S611C180N3S
187	60	75	150	200	S611D242N3S
213	75	75	150	200	S611E361N3S
238	75	100	200	250	S611F414N3S

Accessories

Optional Accessory Kits

Description	S611 Current Rating	Accessory Kit Part Number
User interface remote mounting kit—3.28 ft (1m)	52–414A	S611-RMK-100
User interface remote mounting kit—6.56 ft (2m)	52–414A	S611-RMK-200
User interface remote mounting kit—9.84 ft (3m)	52–414A	S611-RMK-300
User interface communication cable—3.28 ft (1m)	52–414A	D77E-QPIP100
User interface communication cable—6.56 ft (2m)	52–414A	D77E-QPIP200
User interface communication cable—9.84 ft (3m)	52–414A	D77E-QPIP300
Lug kit—mechanical	52–77A	S611-LUG-M01
	99–125A	S611-LUG-M02
	156–242A	S611-LUG-M03
	302–414A	S611-LUG-M04

Options

Pump Control

For pump control option, change the **8th** digit in the Catalog Number to **P**, as in S611XXXP3S.

Replacement Parts

S611 Replacement Components

Description	Part Number
User interface	S611-KEYPAD
User interface communication cable—0.25m (0.82 ft)	D77E-QPIP25
Control board assembly—52A standard	S611-PCB-052S
Control board assembly—65A standard	S611-PCB-065S
Control board assembly—77A standard	S611-PCB-077S
Control board assembly—99A standard	S611-PCB-099S
Control board assembly—125A standard	S611-PCB-125S
Control board assembly—156A standard	S611-PCB-156S
Control board assembly—180A standard	S611-PCB-180S
Control board assembly—242A standard	S611-PCB-242S
Control board assembly—302A standard	S611-PCB-302S
Control board assembly—361A standard	S611-PCB-361S
Control board assembly—414A standard	S611-PCB-414S
Control board assembly—52A pump	S611-PCB-052P
Control board assembly—65A pump	S611-PCB-065P
Control board assembly—77A pump	S611-PCB-077P
Control board assembly—99A pump	S611-PCB-099P
Control board assembly—125A pump	S611-PCB-125P
Control board assembly—156A pump	S611-PCB-156P
Control board assembly—180A pump	S611-PCB-180P
Control board assembly—242A pump	S611-PCB-242P
Control board assembly—302A pump	S611-PCB-302P
Control board assembly—361A pump	S611-PCB-361P
Control board assembly—414A pump	S611-PCB-414P
Frame A/B CT	S611-CT-AB
Frame C/D CT	S611-CT-CD
Frame E/F CT	S611-CT-EF
Contactor assembly—52–180A	C25DNY172
Contactor assembly—242–414A	C25DNY173

Technical Data and Specifications**Soft Starters—S611**

S611 Soft Starter (Partial Catalog Number)					
Description	S611A052	S611A065	S611A072	S611B099	
Max. current capacity	A	52	65	77	99
FLA range	A	26–52	32.5–65	38.5–77	48–99
Dimensions					
Width	inch (mm)	11.58 (294)	11.58 (294)	11.58 (294)	11.58 (294)
Height	inch (mm)	19.45 (494)	19.45 (494)	19.45 (494)	19.45 (494)
Depth	inch (mm)	7.46 (189)	7.46 (189)	7.46 (189)	7.46 (189)
Weight	lb (kg)	24 (11)	24 (11)	24 (11)	24 (11)
General Information					
Bypass mechanical lifespan		10M	10M	10M	10M
Insulating voltage	V	660	660	660	660
Ramp time range	Seconds	0.5–180	0.5–180	0.5–180	0.5–180
Vibration resistance—non-operating	g	3g up to 242A units, 2g on 302A to 414A units	3g up to 242A units, 2g on 302A to 414A units	3g up to 242A units, 2g on 302A to 414A units	3g up to 242A units, 2g on 302A to 414A units
Vibration resistance—operating	g	1	1	1	1
Shock resistance	g	15g up to 242A units, 5g on 302A to 414A units	15g up to 242A units, 5g on 302A to 414A units	15g up to 242A units, 5g on 302A to 414A units	15g up to 242A units, 5g on 302A to 414A units
Electrical Information					
Operating voltage	V	130–600	130–600	130–600	130–600
Operating frequency	Hertz	47–63	47–63	47–63	47–63
Overload setting (frame)	% FLA	50–100	50–100	50–100	50–100
Trip class		5, 10, 20, 30	5, 10, 20, 30	5, 10, 20, 30	5, 10, 20, 30
Cabling Capacity (IEC 947)					
Number of conductors		1	1	1	1
Wire sizes	AWG	14–2/0	14–2/0	14–2/0	14–2/0
Type of connectors		Lug	Lug	Lug	Lug
Control Wiring					
Wire sizes	AWG	22–12	22–12	22–12	22–12
Number of conductors		2 (or one 12–14 AWG)			
Torque requirements	lb-in	3.5	3.5	3.5	3.5
Maximum size	AWG	12	12	12	12
Control Power Requirements					
Voltage range (120V ±10%)	V	108–132	108–132	108–132	108–132
Steady state current	A	0.375	0.375	0.375	0.375
Inrush current	A	0.5	0.5	0.5	0.5
Ripple	%	1	1	1	1
Relays (1) Class A and C					
Voltage AC—maximum	V	120	120	120	120
Voltage DC—maximum	V	24	24	24	24
Amps—maximum	A	3	3	3	3
Environment					
Temperature—operating	°C	-20° to 50°C	-20° to 50°C	-20° to 50°C	-20° to 50°C
Temperature—storage	°C	-40° to 85°C	-40° to 85°C	-40° to 85°C	-40° to 85°C
Altitude	Meters	<2000m, derate 0.5% per 100m >2000m			
Humidity	%	<95% non-condensing	<95% non-condensing	<95% non-condensing	<95% non-condensing
Operating position		Vertical, line side up			
Pollution degree IEC947-1		3	3	3	3
Impulse withstand voltage IEC947-4-1	V	6000	6000	6000	6000

Soft Starters—S611, continued

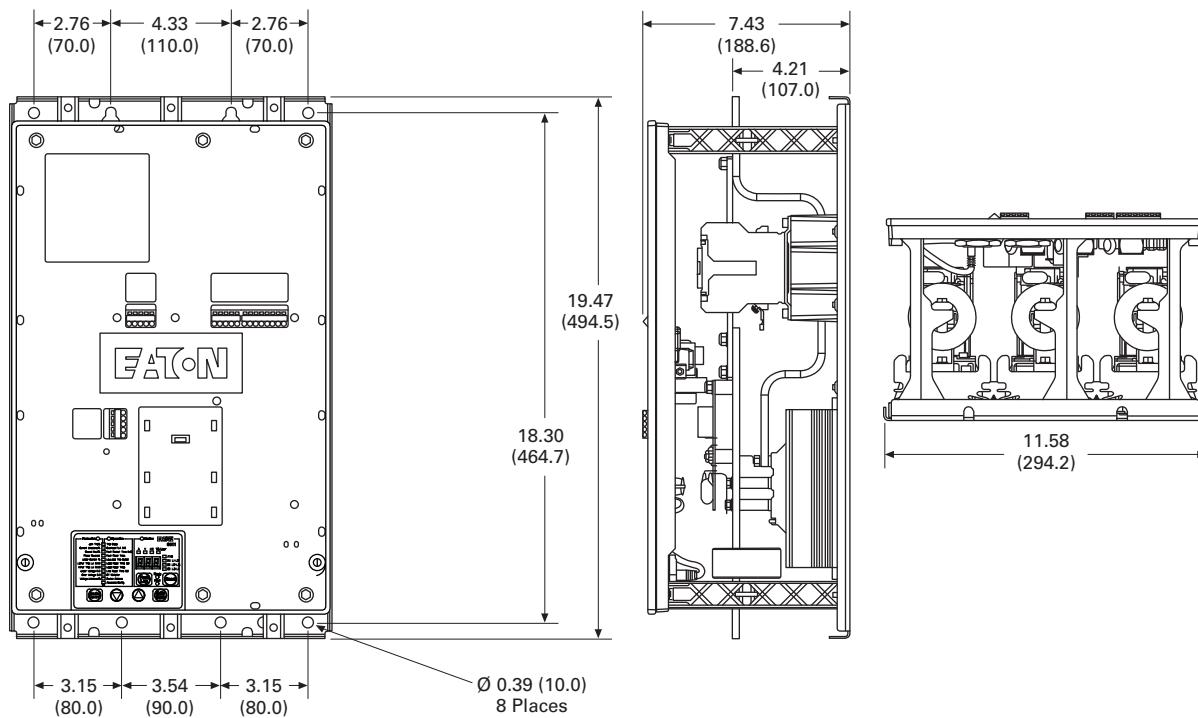
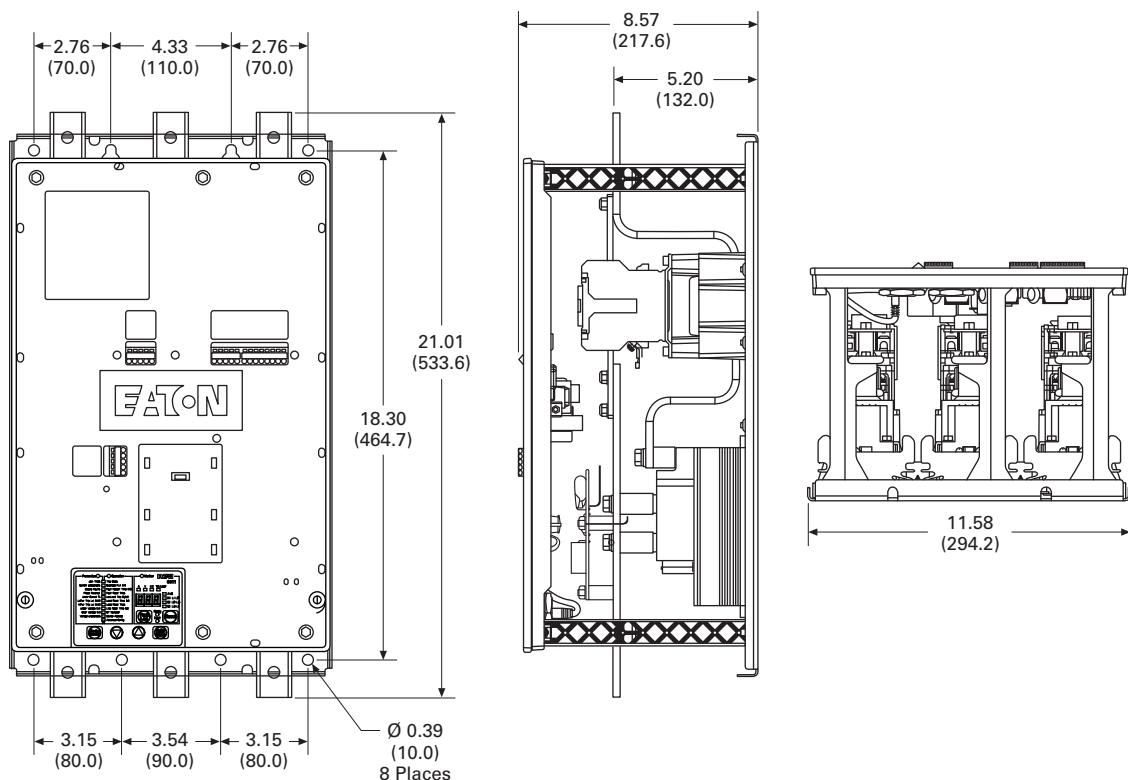
S611 Soft Starter (Partial Catalog Number)					
Description		S611B125	S611C156	S611C180	S611D242
Max. current capacity	A	125	156	180	242
FLA range	A	62.5–125	78–156	90–180	120–242
Dimensions					
Width	inch (mm)	11.58 (294)	11.58 (294)	11.58 (294)	11.58 (294)
Height	inch (mm)	19.45 (494)	20.83 (529)	20.83 (529)	20.83 (529)
Depth	inch (mm)	7.46 (189)	8.37 (213)	8.37 (213)	8.37 (213)
Weight	lb (kg)	24 (11)	33 (15)	33 (15)	38 (17)
General Information					
Bypass mechanical lifespan		10M	10M	10M	10M
Insulating voltage	V	660	660	660	660
Ramp time range	Seconds	0.5–180	0.5–180	0.5–180	0.5–180
Vibration resistance—non-operating	g	3g up to 242A units, 2g on 302A to 414A units	3g up to 242A units, 2g on 302A to 414A units	3g up to 242A units, 2g on 302A to 414A units	3g up to 242A units, 2g on 302A to 414A units
Vibration resistance—operating	g	1	1	1	1
Shock resistance	g	15g up to 242A units, 5g on 302A to 414A units	15g up to 242A units, 5g on 302A to 414A units	15g up to 242A units, 5g on 302A to 414A units	15g up to 242A units, 5g on 302A to 414A units
Electrical Information					
Operating voltage	V	130–600	130–600	130–600	130–600
Operating frequency	Hertz	47–63	47–63	47–63	47–63
Overload setting (frame)	% FLA	50–100	50–100	50–100	50–100
Trip class		5, 10, 20, 30	5, 10, 20, 30	5, 10, 20, 30	5, 10, 20, 30
Cabling Capacity (IEC 947)					
Number of conductors		1	1	1	1
Wire sizes	AWG	2–600 kcmil	2–600 kcmil	2–600 kcmil	2–600 kcmil
Type of connectors		Lug	Lug	Lug	Lug
Control Wiring					
Wire sizes	AWG	22–12	22–12	22–12	22–12
Number of conductors		2 (or one 12–14 AWG)			
Torque requirements	lb-in	3.5	3.5	3.5	3.5
Maximum size	AWG	12	12	12	12
Control Power Requirements					
Voltage range (120V ±10%)	V	108–132	108–132	108–132	108–132
Steady state current	A	0.375	0.375	0.375	0.375
Inrush current	A	0.5	0.5	0.5	0.5
Ripple	%	1	1	1	1
Relays (1) Class A and C					
Voltage AC—maximum	V	120	120	120	120
Voltage DC—maximum	V	24	24	24	24
Amps—maximum	A	3	3	3	3
Environment					
Temperature—operating	°C	−20° to 50°C	−20° to 50°C	−20° to 50°C	−20° to 50°C
Temperature—storage	°C	−40° to 85°C	−40° to 85°C	−40° to 85°C	−40° to 85°C
Altitude	Meters	<2000m, derate 0.5% per 100m >2000m			
Humidity	%	<95% non-condensing	<95% non-condensing	<95% non-condensing	<95% non-condensing
Operating position		Vertical, line side up			
Pollution degree IEC947-1		3	3	3	3
Impulse withstand voltage IEC947-4-1	V	6000	6000	6000	6000

Soft Starters—S611, continued

S611 Soft Starter (Partial Catalog Number)				
Description		S611E302	S611E361	S611F414
Max. current capacity	A	302	361	414
FLA range	A	151–302	180.5–361	207–414
Dimensions				
Width	inch (mm)	17.56 (446)	17.56 (446)	17.56 (446)
Height	inch (mm)	31.15 (791)	31.15 (791)	31.15 (791)
Depth	inch (mm)	9.54 (242)	9.54 (242)	9.54 (242)
Weight	lb (kg)	86 (39)	86 (39)	102 (46)
General Information				
Bypass mechanical lifespan		10M	10M	10M
Insulating voltage	V	660	660	660
Ramp time range	Seconds	0.5–180	0.5–180	0.5–180
Vibration resistance—non-operating	g	3g up to 242A units, 2g on 302A to 414A units	3g up to 242A units, 2g on 302A to 414A units	3g up to 242A units, 2g on 302A to 414A units
Vibration resistance—operating	g	1	1	1
Shock resistance	g	15g up to 242A units, 5g on 302A to 414A units	15g up to 242A units, 5g on 302A to 414A units	15g up to 242A units, 5g on 302A to 414A units
Electrical Information				
Operating voltage	V	130–600	130–600	130–600
Operating frequency	Hertz	47–63	47–63	47–63
Overload setting (frame)	% FLA	50–100	50–100	50–100
Trip class		5, 10, 20, 30	5, 10, 20, 30	5, 10, 20, 30
Cabling Capacity (IEC 947)				
Number of conductors		2	2	2
Wire sizes	AWG	2–600 kcmil	2–600 kcmil	2–600 kcmil
Type of connectors		Lug	Lug	Lug
Control Wiring				
Wire sizes	AWG	22–12	22–12	22–12
Number of conductors		2 (or one 12–14 AWG)	2 (or one 12–14 AWG)	2 (or one 12–14 AWG)
Torque requirements	lb-in	3.5	3.5	3.5
Maximum size	AWG	12	12	12
Control Power Requirements				
Voltage range (120V ±10%)	V	108–132	108–132	108–132
Steady state current	A	0.75	0.75	0.75
Inrush current	A	1	1	1
Ripple	%	1	1	1
Relays (1) Class A and C				
Voltage AC—maximum	V	120	120	120
Voltage DC—maximum	V	24	24	24
Amps—maximum	A	3	3	3
Environment				
Temperature—operating	°C	−20° to 50°C	−20° to 50°C	−20° to 50°C
Temperature—storage	°C	−40° to 85°C	−40° to 85°C	−40° to 85°C
Altitude	Meters	<2000m, derate 0.5% per 100m >2000m	<2000m, derate 0.5% per 100m >2000m	<2000m, derate 0.5% per 100m >2000m
Humidity	%	<95% non-condensing	<95% non-condensing	<95% non-condensing
Operating position		Vertical, line side up	Vertical, line side up	Vertical, line side up
Pollution degree IEC947-1		3	3	3
Impulse withstand voltage IEC947-4-1	V	6000	6000	6000

Dimensions

Approximate Dimensions in inches (mm)

A and B Frame**C and D Frame**

1.2

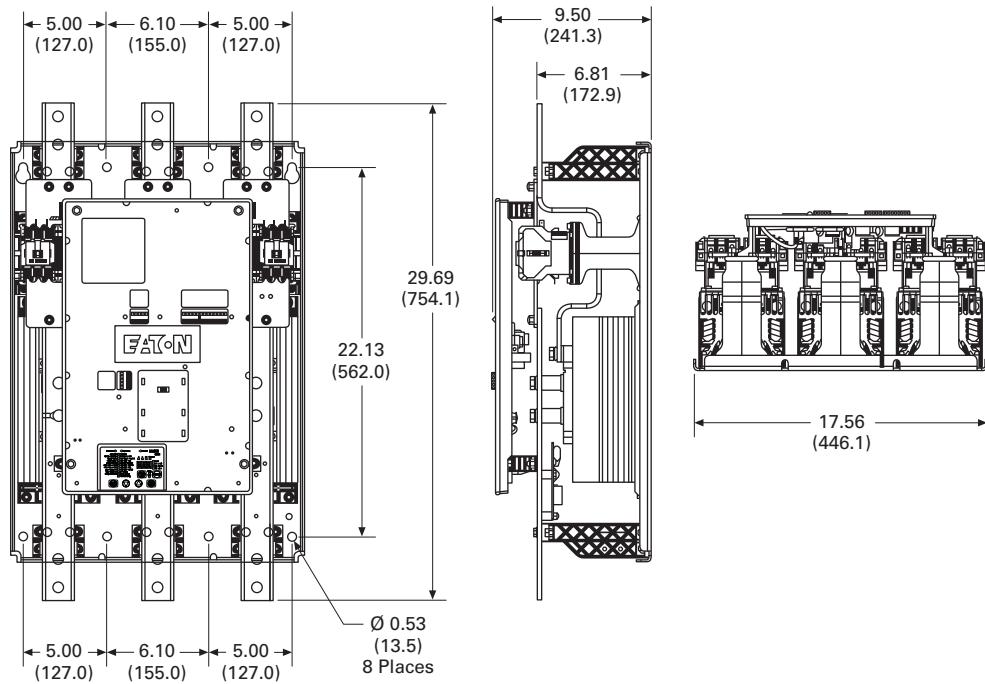
Reduced Voltage Motor Starters

Solid-State Starters

1

Approximate Dimensions in inches (mm)

E and F Frame



Type S801+, Soft Starters**Contents****Description**

Type S611, Solid-State Soft Starters

V6-T1-44

Type S801+, Soft Starters

Operation

Features

Benefits

Standards and Certifications

User Manuals

Catalog Number Selection

Product Selection

Accessories

Options

Technical Data and Specifications

Wiring Diagram

Dimensions

Type S811+, Soft Starters with DIM

V6-T1-62**V6-T1-64****V6-T1-64****V6-T1-64****V6-T1-64****V6-T1-64****V6-T1-64****V6-T1-65****V6-T1-67****V6-T1-68****V6-T1-69****V6-T1-73****V6-T1-73****V6-T1-77****Type S801+, Soft Starters****Product 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 for current ranges from 11A all the way through 1000A applications, and is suitable for mounting in motor control centers or in enclosed control (NEMA 1, 4, 4X and 12) applications.

Application Description

The S801+ line of soft starters is designed to be the smallest, most compact soft starter in the market today. With this small size, it can easily fit in place of existing soft starter designs, wye-delta starters or across-the-line NEMA and IEC starters. This feature allows easy retrofits of existing motor control centers or enclosures, and saves the expense of replacing existing structure or adding a new one to house a soft starter.

The product 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 1000A of steady-state current. The built-in overload (in ranges from 11–1000A) and run bypass contactor make installation and setup quick and easy. The overload also offers some advanced protective functions to give additional motor protection.

Operation

Overload Functionality

Overtightperature

Protects the device from overheating. Starter will shut down at 100°C.

Stall

Selectable protective feature, unit trips to protect system in event motor can not get to rated speed in the defined ramp period.

Jam

Selectable protective feature, unit trips to prevent damage to motor during normal run.

Phase Loss

Selectable protective feature, trips under voltage loss condition to any phase.

Phase Reversal

Selectable protective feature, trips when phase rotation is something other than A-B-C.

Kick Start

Selectable feature that provides a current "kick" of up to 550% of full load current for 0 to 2.0 seconds. This provides the additional torque required at startup to break free a motor.

Ramp Start

Provides a constant increase in torque to the motor.

Current Limit Start

Limits the maximum current available to the motor during the startup phase.

Soft Stop

Allows for a controlled stopping of a frictional load.

Shorted SCR Detection

Monitors for shorted SCR in the power poles.

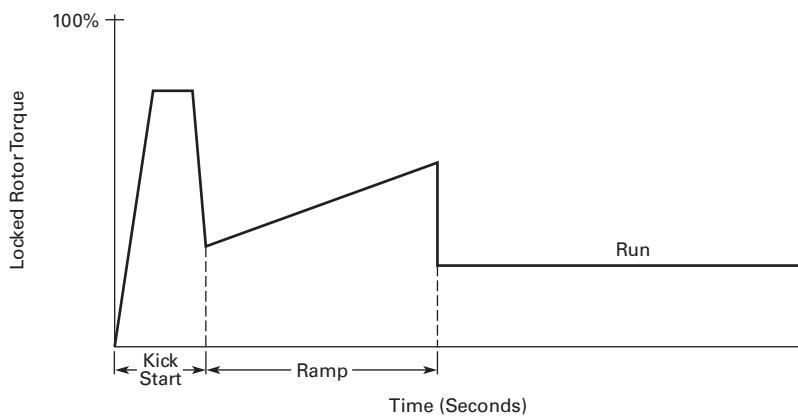
Starting Characteristics

Kick Start

Provides an initial boost of current to the motor to help overcome motor inertia and begin motor rotation.

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

Starting Characteristics—Kick Start

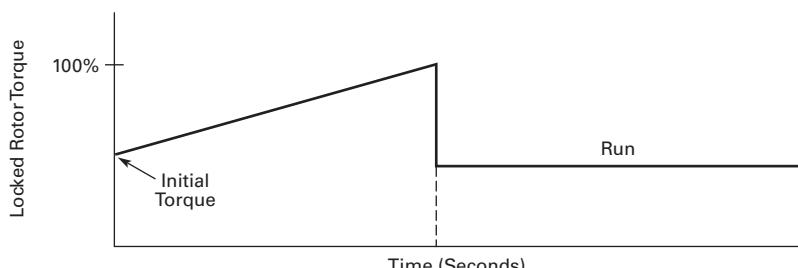


Ramp Start

The most commonly used form of soft start. This allows you to set the initial torque value (of the ramp) and then raises it to full voltage conditions.

- Adjustable initial torque = 0–85% of locked rotor torque
- Adjustable ramp time = 0.5–180 seconds

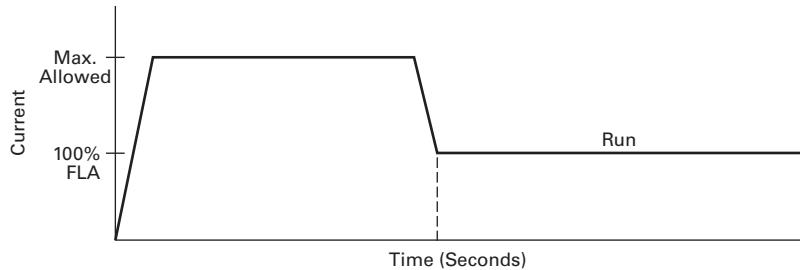
Starting Characteristics—Ramp Start



Current Limit

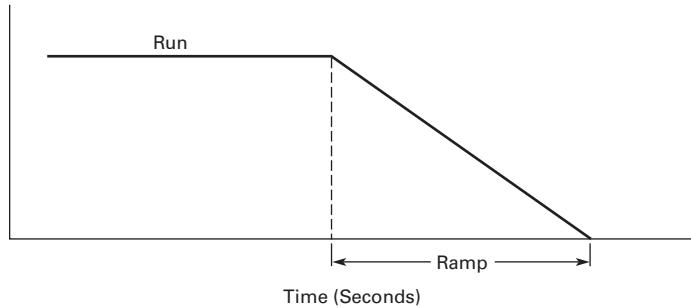
This mode of soft starting is used when it becomes necessary to limit the maximum starting current due to long start times or to protect the motor.

- Maximum current of 0–85% locked rotor current
- Adjustable ramp time = 0.5–180 seconds

Starting Characteristics—Current Limit**Soft Stop**

Used when an extended coast-to-rest period is desired. Often used with high friction loads where a sudden stop may cause system or product damage.

- Stop time = 0–60 seconds

Starting Characteristics—Soft Stop

Features

- Built-in overload protection
- Built-in run bypass contactor
- Adjustable ramp times
- Adjustable torque control
- Adjustable kick start control
- Programmable overload settings, 31–100% (3.2:1) of rated current for the unit
- Physically fits in place of most NEMA and IEC starters

- Easy to use control interface module
- Soft stop control
- Multiple trip class settings (5, 10, 20 and 30)
- Six SCR control
- Optional CIM door mount kit for safety
- Optional IP20 protection

Benefits

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

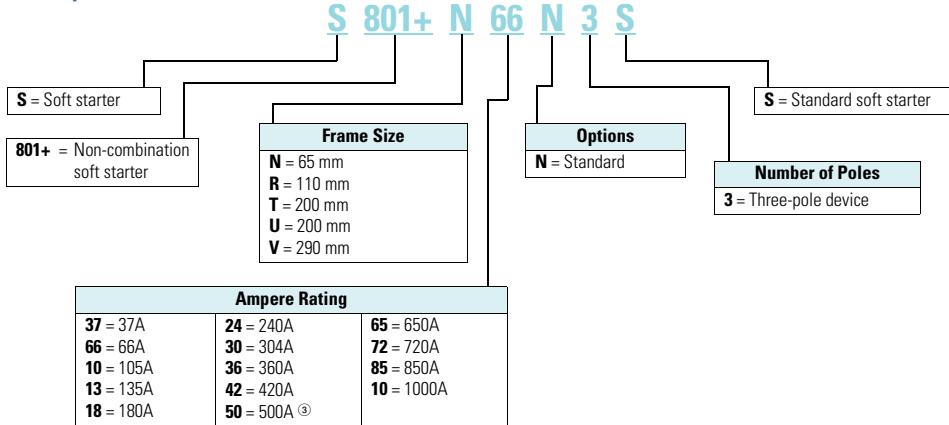
- Less shock to product on conveyor lines and material handling gear
- 24 Vdc control enhances personnel and equipment safety

Standards and Certifications

- IEC 947 compliant
- EN 60947-4-2
- CSA certification
- cULus listed (File No. E202571)
- CE marked
- CSA elevator (2411 01)

**User Manuals**

A comprehensive user manual is available and can be downloaded free of charge from www.eaton.com by performing a document search for MN03900002E.

Catalog Number Selection**S801+ Open Soft Starters** ^{①②}**Notes**

- ① S801+T_-, S801+U_- and S801+V_- units require lug kits found on [Page V6-T1-67](#).
- ② All units require a 24 Vdc power supply found on catalog [Page V6-T1-67](#), or equivalent.
- ③ S801+U50N35 unit does not have IEC certification.

Product Selection

Standard Duty Ratings

The table below is the base ratings for the soft starter. The tables included in this catalog are meant to be a reference table for different applications, but to match a unit to your exact application, consult with your local Eaton representative or call our Technical Resource Center.

Standard Duty Ratings

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

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 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.

S801+

Standard Duty—15 Second Ramp, 300% Current Limit at 40°C, Inline Connection



Max. Current	Three-Phase Motors			hp Rating (60 Hz)						Catalog Number			
	230V	380–400V	440V	200V	230V	460V	575–600V	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF
Frame Size N													
37	10	18.5	18.5	10	10	10	25	20	30	30	30	30	S801+N37N3S
66	18.5	30	37	20	15	20	50	40	60	60	50	50	S801+N66N3S
Frame Size R													
105	30	55	59	30	25	40	75	60	100	75	75	75	S801+R10N3S
135	40	63	80	40	30	50	100	75	125	100	100	100	S801+R13N3S
Frame Size T													
180	51	90	110	60	50	60	150	125	150	150	150	150	S801+T18N3S
240	75	110	147	75	60	75	200	150	200	200	200	200	S801+T24N3S
304	90	160	185	100	75	100	250	200	300	300	250	250	S801+T30N3S
Frame Size U													
360	110	185	220	125	100	150	300	250	350	300	300	300	S801+U36N3S
420	129	220	257	150	125	175	350	300	450	350	350	350	S801+U42N3S
500	150	257	300	150	150	200	400	350	500	450	450	450	S801+U50N3S ①
Frame Size V													
360	110	185	220	125	100	150	300	250	350	300	300	300	S801+V36N3S
420	129	220	257	150	125	175	350	300	450	350	350	350	S801+V42N3S
500	150	257	300	150	150	200	400	350	500	450	450	450	S801+V50N3S
650	200	355	425	250	200	250	500	450	600	500	500	500	S801+V65N3S
720	220	400	450	—	—	300	250	600	500	700	600	600	S801+V72N3S
850	257	475	500	—	—	350	300	700	600	900	700	700	S801+V85N3S
1000	277	525	550	—	—	400	350	800	700	900	800	800	S801+V10N3S

Note

① S801+U50N3S does not have IEC certification.

Severe Duty Ratings

The table below is the base ratings for the soft starter. The tables included in this catalog are meant to be a reference table for different applications, but to match a unit to your exact application, consult with your local Eaton representative or call our Technical Resource Center.

Severe Duty Ratings

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

Severe duty ratings are defined as any combination of parameters that exceed the standard duty ratings where

the ramp time is over 30 seconds, and/or the number of starts per hour exceeds 4, and/or the current limit set is

over 300%. Example: 35-second ramp, 5 starts per hour, 350% current limit at 40°C ambient.

S801+

Severe Duty—>30 Second Ramp, >300% Current Limit

Max. Current	Three-Phase Motor			hp Rating (60 Hz)			200V			230V			460V			575V			Catalog Number
	230V	380–400V	440V	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF		
Frame Size N																			
22	5.5	10	11	5	5	7-1/2	5	15	10	20	15	S801+N37N3S							
42	11	18.5	22	10	10	15	10	30	25	40	30	S801+N66N3S							
Frame Size R																			
65	15	30	33	15	15	20	15	50	40	50	50	S801+R10N3S							
80	22	40	45	25	20	30	25	60	50	75	60	S801+R13N3S							
Frame Size T																			
115	33	59	63	30	30	40	30	75	75	100	100	S801+T18N3S							
150	45	80	90	50	40	50	50	100	100	150	125	S801+T24N3S							
192	55	100	110	60	50	75	60	150	125	200	150	S801+T30N3S							
Frame Size U																			
240	75	110	147	75	60	75	75	200	150	200	200	S801+U36N3S							
305	90	160	185	100	75	100	100	250	200	300	250	S801+U42N3S							
365	110	185	220	125	100	150	125	300	250	350	300	S801+U50N3S ^①							
Frame Size V																			
240	75	110	147	75	60	75	75	200	150	200	200	S801+V36N3S							
305	90	160	185	100	75	100	100	250	200	300	250	S801+V42N3S							
365	110	185	220	125	100	150	125	300	250	350	300	S801+V50N3S							
420	129	220	257	150	125	150	150	350	300	450	350	S801+V65N3S							
480	147	257	295	150	150	200	150	400	350	500	450	S801+V72N3S							
525	160	280	335	150	150	200	150	450	350	500	450	S801+V85N3S							
600	185	315	375	200	150	250	200	500	450	600	500	S801+V10N3S							

Note

^① S801+U50N3S unit does not have IEC certification.

Accessories**Lug Kits**

S801+T_, S801+U_ and S801+V_ soft starters each have different lug options based on your wiring needs.

Each lug kit contains three lugs that can be mounted on either the load or line side.

Lug Kit**Lug Kits**

S801+ Catalog Number	Description	Kits Required	Catalog Number
S801+T_	2 cable connections, 4 AWG to 1/0 cable	2	EML22
S801+U_	1 cable connection, 4/0 to 500 kcmil cable		EML23
	2 cable connections, 4/0 to 500 kcmil cable		EML24
	1 cable connection, 2/0 to 300 kcmil cable		EML25
	2 cable connections, 2/0 to 300 kcmil cable		EML26
S801+V_	2 cable connections, 4/0 to 500 kcmil cable	2	EML28
	4 cable connections, 4/0 to 500 kcmil cable		EML30
	6 cable connections, 4/0 to 500 kcmil cable		EML32
	4 cable connections, 2/0 to 300 kcmil cable		EML33

Power Supplies

24 Vdc power supply that can be used with the S801+ SSRV or as a stand-alone device.

Power Supplies

Description	Catalog Number
85–264 Vac input 24 Vdc output	PSG240E
360–575 Vac input 24 Vdc output	PSG240F
600 Vac input 24 Vdc output	PSS55D

Lug Cover Kits

Replacement covers for the S801+T_ and S801+U_ soft starters are available in case of damage to the existing covers.

Lug Cover Kits

Description	Catalog Number
Lug cover S801+T_, S801+U_	EML27
Lug cover S801+V_	EML34

IP20 Kits**IP20 Kits**

Description	Catalog Number
S801+N_	SS-IP20-N
S801+R_	SS-IP20-R
S801+T_ and S801+U_	SS-IP20-TU
S801+V_	SS-IP20-V

Surge Suppressors

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

Surge Suppressor**Surge Suppressors**

Description	Catalog Number
600V MOV for S801+_ units	EMS39
690V MOV for S801+_ units	EMS41

Mounting Plates

The mounting plates are designed to help make it easy to install or retrofit the soft starter into enclosures and MCCs. The soft starter can be mounted onto the plate prior to installation. The mounting plate is designed with tear drop mounting holes for easier installation.

Mounting Plates

Description	Catalog Number
S801+N_	EMM13N
S801+R_	EMM13R
S801+T_ and S801+U_	EMM13T
S801+V_	EMM13V

Vibration Plates

The vibration plates allow the soft starter to be applied in high shock and vibration applications. The vibration plate allows vibration up to 5g and shock in up to 40g. The soft starter is mounted onto the vibration plate prior to installation in the panel.

Vibration Plates

Description	Catalog Number
S801+N_	EMM14N
S801+R_	EMM14R
S801+T_ and S801+U_	EMM14T
S801+V_	EMM14V

Adapter Plates

The adapter plate allows customers to retrofit a S801+V_ soft starter with the S801+U_ soft starter.

Adapter Plates

Description	Catalog Number
Adapter plates	EMM13U

Control Interface Module

The Control Interface Module (CIM) is available as a replacement part.

CIM

Description	Catalog Number
Blank cover (filler)	EMA68
CIM for standard unit	EMA71
Panel mounting kit	
3 ft cable	EMA69A
5 ft cable	EMA69B
8 ft cable	EMA69C
10 ft cable	EMA69D

Options**Cooling Fan Kit**

The EMM18 cooling fan kit mounts on either side of any frame size S801+ soft starter to provide additional printed circuit board cooling in high ambient operating temperatures.

Cooling Fan Kit

Description	Catalog Number
Fan kit	EMM18

Technical Data and Specifications

1

Soft Starters—S801+

Description	S801+N37N3S	S801+N66N3S	S801+R10N3S	S801+R13N3S
Max. current capacity	37	66	105	135
General Information				
Bypass mechanical lifespan	10M	10M	10M	10M
Insulating voltage Ui	660V	660V	660V	660V
Ramp time range	0.5–180 seconds	0.5–180 seconds	0.5–180 seconds	0.5–180 seconds
Resistance to vibration	3g	3g	3g	3g
Resistance to shock	15g	15g	15g	15g
Electrical Information				
Operating voltage	200–600V	200–600V	200–600V	200–600V
Operating frequency	47–63 Hz	47–63 Hz	47–63 Hz	47–63 Hz
Overload setting	30–100%	30–100%	30–100%	30–100%
Trip class	5, 10, 20 and 30			
Cabling Capacity (IEC 947)				
Number of conductors	1	1	1	1
Wire sizes	14–2	14–2	14–4/0	14–4/0
Type of connectors	Box lug	Box lug	Box lug	Box lug
Control Wiring (12-Pin)				
Wire sizes in AWG	22–14	22–14	22–14	22–14
Number of conductors (stranded)	2 (or one AWG 12)			
Torque requirements in lb-in	3.5	3.5	3.5	3.5
Solid, stranded or flexible max. size in mm ²	3.31	3.31	3.31	3.31
Control Power Requirements				
Voltage range (24V ±10%)	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4
Steady-state current amps	1.0	1.0	1.0	1.0
Inrush current amps	10	10	10	10
Ripple	1%	1%	1%	1%
Relays (1) Class A and C				
Voltage AC—maximum	240	240	240	240
Voltage DC—maximum	120	120	120	120
Amps—maximum	3	3	3	3
Environment				
Temperature—operating	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C
Temperature—storage	−50° to 70°C	−50° to 70°C	−50° to 70°C	−50° to 70°C
Altitude	<2000m—consult factory for operation >2000m			
Humidity	<95% noncondensing	<95% noncondensing	<95% noncondensing	<95% noncondensing
Operating position	Any	Any	Any	Any
Pollution degree IEC947-1	3	3	3	3
Impulse withstand voltage IEC947-4-1	6000V	6000V	6000V	6000V

Soft Starters—S801+, continued

Description	S801+T18N3S	S801+T24N3S	S801+T30N3S	S801+U36N3S ①②
Max. current capacity	180	240	304	360
General Information				
Bypass mechanical lifespan	10M	10M	10M	10M
Insulating voltage Ui	660V	660V	660V	660V
Ramp time range	0.5–180 seconds	0.5–180 seconds	0.5–180 seconds	0.5–180 seconds
Resistance to vibration	3g	3g	3g	3g
Resistance to shock	15g	15g	15g	15g
Electrical Information				
Operating voltage	200–600V	200–600V	200–600V	200–600V
Operating frequency	47–63 Hz	47–63 Hz	47–63 Hz	47–63 Hz
Overload setting	30–100%	30–100%	30–100%	30–100%
Trip class	5, 10, 20 and 30			
Cabling Capacity (IEC 947)				
Number of conductors	1 or 2	1 or 2	1 or 2	1 or 2
Wire sizes	4 AWG to 500 kcmil			
Type of connectors	Add-on lug kit	Add-on lug kit	Add-on lug kit	Add-on lug kit
Control Wiring (12-Pin)				
Wire sizes in AWG	22–14	22–14	22–14	22–14
Number of conductors (stranded)	2 (or one AWG 12)			
Torque requirements in lb-in	3.5	3.5	3.5	3.5
Solid, stranded or flexible max. size in mm ²	3.31	3.31	3.31	3.31
Control Power Requirements				
Voltage range (24V ±10%)	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4
Steady-state current amps	1.0	1.0	1.0	1.0
Inrush current amps	10	10	10	10
Ripple	1%	1%	1%	1%
Relays (1) Class A and C				
Voltage AC—maximum	240	240	240	240
Voltage DC—maximum	120	120	120	120
Amps—maximum	3	3	3	3
Environment				
Temperature—operating	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C
Temperature—storage	−50° to 70°C	−50° to 70°C	−50° to 70°C	−50° to 70°C
Altitude	<2000m—consult factory for operation >2000m			
Humidity	<95% noncondensing	<95% noncondensing	<95% noncondensing	<95% noncondensing
Operating position	Any	Any	Any	Any
Pollution degree IEC947-1	3	3	3	3
Impulse withstand voltage IEC947-4-1	6000V	6000V	6000V	6000V

Notes

① 801+U50N3S unit does not have IEC certification.

② UL recognized component.

Soft Starters—S801+, continued

Description	S801+U42N3S	S801+U50N3S ^①	S801+V36N3S	S801+V42N3S
Max. current capacity	420	500	360	420
General Information				
Bypass mechanical lifespan	10M	10M	10M	10M
Insulating voltage Ui	660V	660V	660V	660V
Ramp time range	0.5–180 seconds	0.5–180 seconds	0.5–180 seconds	0.5–180 seconds
Resistance to vibration	3g	3g	3g	3g
Resistance to shock	15g	15g	15g	15g
Electrical Information				
Operating voltage	200–600V	200–600V	200–600V	200–600V
Operating frequency	47–63 Hz	47–63 Hz	47–63 Hz	47–63 Hz
Overload setting	30–100%	30–100%	30–100%	30–100%
Trip class	5, 10, 20 and 30			
Cabling Capacity (IEC 947)				
Number of conductors	1 or 2	1 or 2	2, 4 or 6	2, 4 or 6
Wire sizes	4 AWG to 500 kcmil	4 AWG to 500 kcmil	2/0 to 500 kcmil	2/0 to 500 kcmil
Type of connectors	Add-on lug kit	Add-on lug kit	Add-on lug kit	Add-on lug kit
Control Wiring (12-Pin)				
Wire sizes in AWG	22–14	22–14	22–14	22–14
Number of conductors (stranded)	2 (or one AWG 12)			
Torque requirements in lb-in	3.5	3.5	3.5	3.5
Solid, stranded or flexible max. size in mm ²	3.31	3.31	3.31	3.31
Control Power Requirements				
Voltage range (24V ±10%)	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4
Steady-state current amps	1.0	1.0	1.4	1.4
Inrush current amps	10	10	10	10
Ripple	1%	1%	1%	1%
Relays (1) Class A and C				
Voltage AC—maximum	240	240	240	240
Voltage DC—maximum	120	120	120	120
Amps—maximum	3	3	3	3
Environment				
Temperature—operating	–30° to 50°C (no derating) consult factory for operation >50°C	–30° to 50°C (no derating) consult factory for operation >50°C	–30° to 50°C (no derating) consult factory for operation >50°C	–30° to 50°C (no derating) consult factory for operation >50°C
Temperature—storage	–50° to 70°C	–50° to 70°C	–50° to 70°C	–50° to 70°C
Altitude	<2000m—consult factory for operation >2000m			
Humidity	<95% noncondensing	<95% noncondensing	<95% noncondensing	<95% noncondensing
Operating position	Any	Any	Any	Any
Pollution degree IEC947-1	3	3	3	3
Impulse withstand voltage IEC947-4-1	6000V	6000V	6000V	6000V

Note

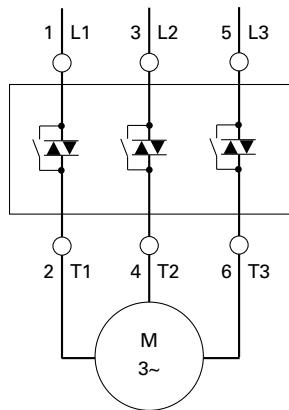
^① 801+U50N3S unit does not have IEC certification.

Soft Starters—S801+, continued

Description	S801+V50N3S	S801+V65N3S	S801+V72N3S	S801+V85N3S	S801+V10N3S ⁽²⁾
Max. current capacity	500	650	720	850	1000
Dimensions					
Width in inches (mm)	11.03 (280.2)	11.03 (280.2)	11.03 (280.2)	11.03 (280.2)	11.03 (280.2)
Height in inches (mm)	16.57 (420.8)	16.57 (420.8)	16.57 (420.8)	16.57 (420.8)	16.57 (420.8)
Depth in inches (mm)	7.23 (183.7)	7.23 (183.7)	7.23 (183.7)	7.23 (183.7)	7.23 (183.7)
Weight in lbs (kg)	103 (46.8) with lugs 91 (41.4) without lugs				
General Information					
Bypass mechanical lifespan	10M	10M	10M	10M	10M
Insulating voltage Ui	660V	660V	660V	660V	660V
Ramp time range	0.5–180 seconds				
Resistance to vibration	3g	3g	3g	3g	3g
Resistance to shock	15g	15g	15g	15g	15g
Electrical Information					
Operating voltage	200–600V	200–600V	200–600V	200–600V	200–600V
Operating frequency	47–63 Hz				
Overload setting	30–100%	30–100%	30–100%	30–100%	30–100%
Trip class	5, 10, 20 and 30				
Cabling Capacity (IEC 947)					
Number of conductors	2, 4 or 6				
Wire sizes	2/0 to 500 kcmil				
Type of connectors	Add-on lug kit				
Control Wiring (12-Pin)					
Wire sizes in AWG	22–14	22–14	22–14	22–14	22–14
Number of conductors (stranded)	2 (or one AWG 12)				
Torque requirements in lb-in	3.5	3.5	3.5	3.5	3.5
Solid, stranded or flexible max. size in mm ²	3.31	3.31	3.31	3.31	3.31
Control Power Requirements					
Voltage range (24V ±10%)	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4
Steady-state current amps	1.4	1.4	1.4	1.4	1.4
Inrush current amps	10	10	10	10	10
Ripple	1%	1%	1%	1%	1%
Relays (1) Class A and C					
Voltage AC—maximum	240	240	240	240	240
Voltage DC—maximum	120	120	120	120	120
Amps—maximum	3	3	3	3	3
Environment					
Temperature—operating	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C
Temperature—storage	−50° to 70°C				
Altitude	<2000m—consult factory for operation >2000m				
Humidity	<95% noncondensing				
Operating position	Any	Any	Any	Any	Any
Pollution degree IEC947-1	3	3	3	3	3
Impulse withstand voltage IEC947-4-1	6000V	6000V	6000V	6000V	6000V

Note

⁽¹⁾ UL recognized component.

Wiring Diagram**Line Connected Soft Starter****Dimensions**

Approximate Dimensions in Inches (mm)

Soft Starters—S801+

Catalog Number	W	H	D	Weight in Lbs (kg)
S801+N37N3S	2.66 (67.6)	7.37 (187.2)	6.45 (163.9)	5.8 (2.6)
S801+N66N3S	2.66 (67.6)	7.37 (187.2)	6.45 (163.9)	5.8 (2.6)
S801+R10N3S	4.38 (111.3)	7.92 (201.1)	6.64 (168.6)	10.5 (4.8)
S801+R13N3S	4.38 (111.3)	7.92 (201.1)	6.64 (168.6)	10.5 (4.8)
S801+T18N3S	7.65 (194.4)	12.71 (322.9)	6.47 (164.4)	48 (21.8) with lugs 41 (18.6) without lugs
S801+T24N3S	7.65 (194.4)	12.71 (322.9)	6.47 (164.4)	48 (21.8) with lugs 41 (18.6) without lugs
S801+T30N3S	7.65 (194.4)	12.71 (322.9)	6.47 (164.4)	48 (21.8) with lugs 41 (18.6) without lugs
S801+U36N3S	7.73 (196.3)	12.72 (323.1)	7.16 (181.8)	48 (21.8) with lugs 41 (18.6) without lugs
S801+U42N3S	7.73 (196.3)	12.72 (323.1)	7.16 (181.8)	48 (21.8) with lugs 41 (18.6) without lugs
S801+U50N3S	7.73 (196.3)	12.72 (323.1)	7.16 (181.8)	48 (21.8) with lugs 41 (18.6) without lugs
S801+V36N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S801+V42N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S801+V50N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S801+V65N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S801+V72N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S801+V85N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S801+V10N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs

Also refer to dimension drawings on **Pages V6-T1-74 through V6-T1-76.**

1.2

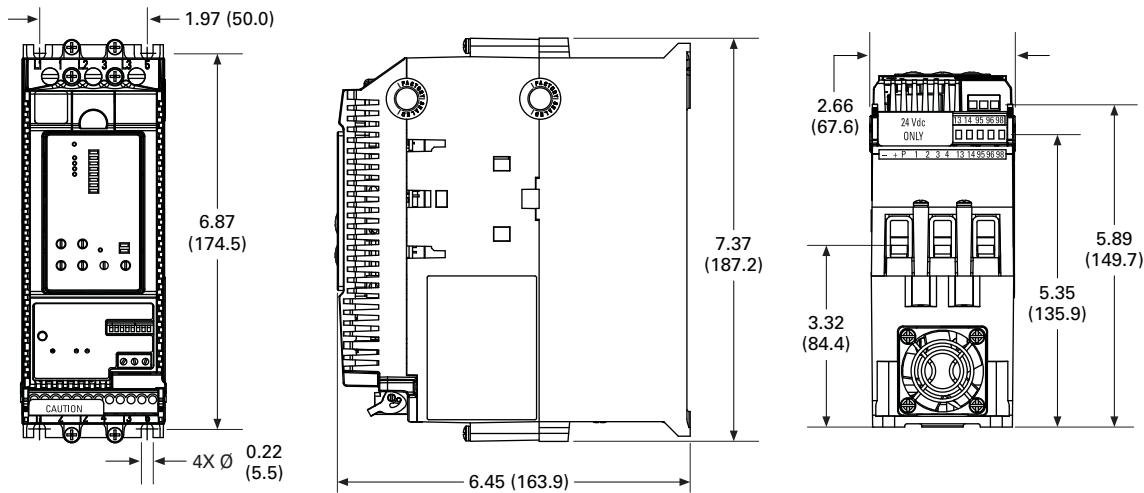
Reduced Voltage Motor Starters

Solid-State Starters

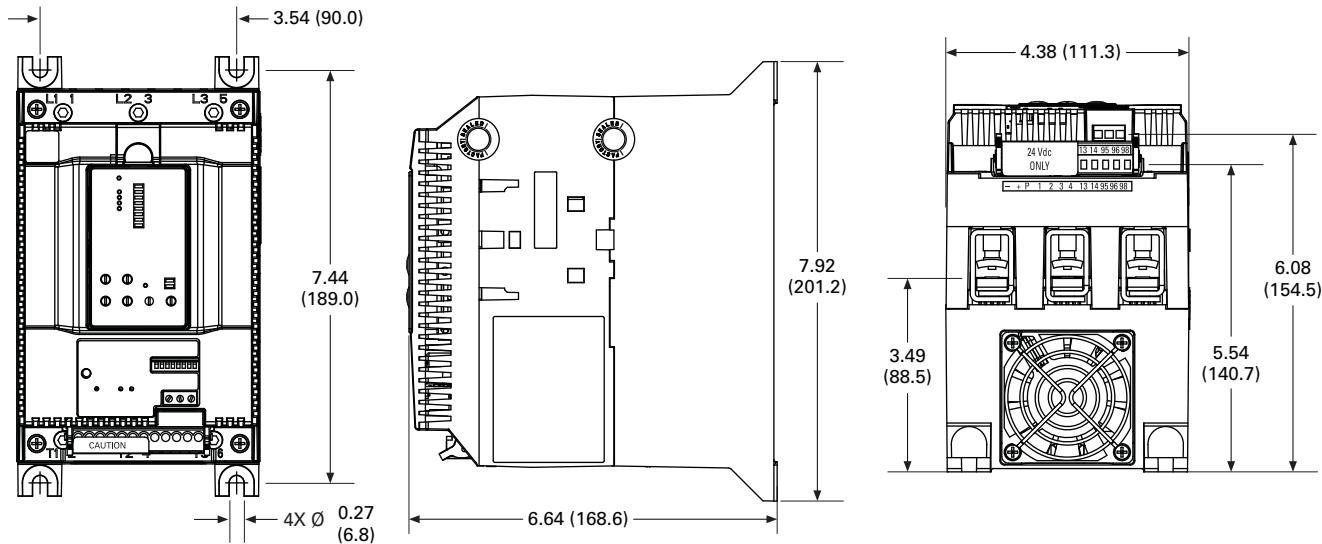
1

Approximate Dimensions in Inches (mm)

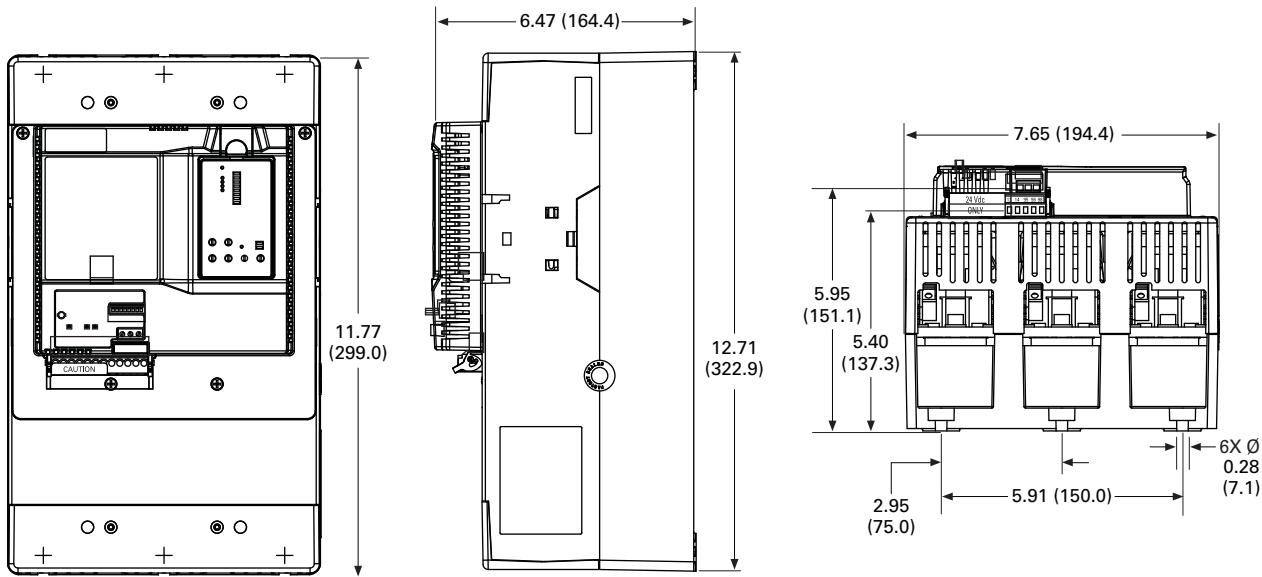
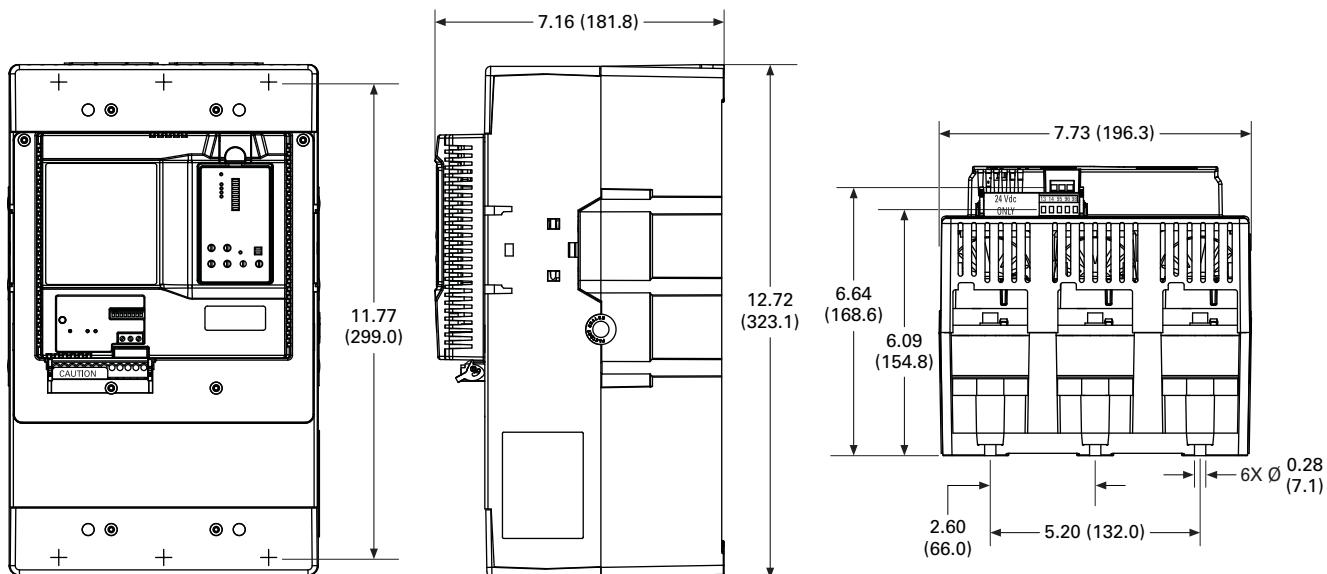
S801+N_



S801+R_



Approximate Dimensions in Inches (mm)

S801+T_**S801+U_**

1.2

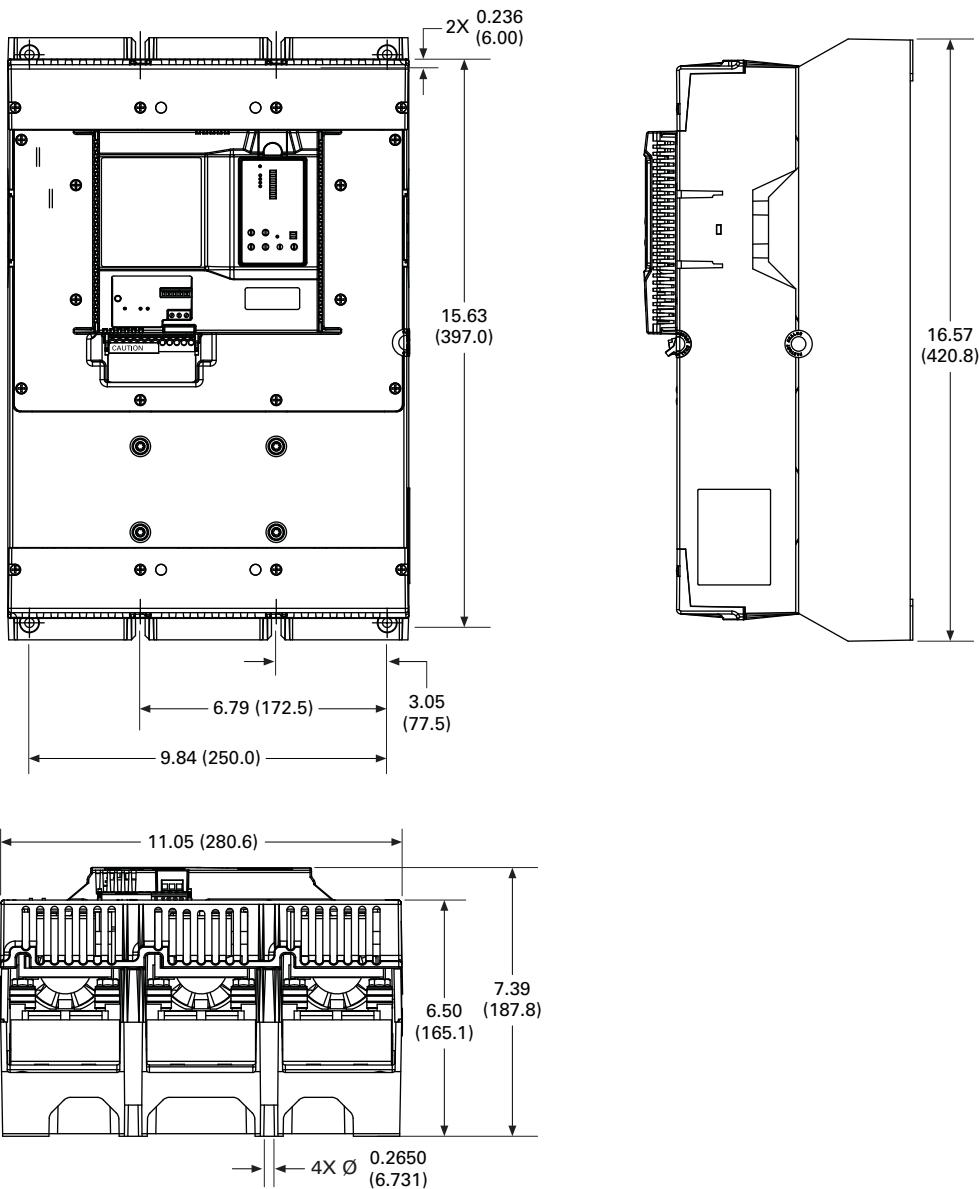
Reduced Voltage Motor Starters

Solid-State Starters

1

Approximate Dimensions in Inches (mm)

S801+V_



Type S811+, Soft Starters with Digital Interface Module (DIM)**Contents****Description**

Type S611, Solid-State Soft Starters.....

Page**V6-T1-44**

Type S801+, Soft Starters.....

V6-T1-61

Type S811+, Soft Starters with DIM

Communications

Operation

Features and Benefits

Standards and Certifications

Instructional Leaflets

Catalog Number Selection

Product Selection

Accessories

Options

Technical Data and Specifications

Wiring Diagrams

Dimensions

V6-T1-78**V6-T1-78****V6-T1-81****V6-T1-85****V6-T1-85****V6-T1-86****V6-T1-90****V6-T1-91****V6-T1-92****V6-T1-96****V6-T1-97****Type S811+, Soft Starters with DIM****Product Description**

Eaton's S811+ offers all the popular features of the S801+ and adds new enhanced functionality with the new Digital Interface Module (DIM), communications, metering, monitoring and diagnostics capabilities.

Eaton's line of S811+ reduced voltage soft starters is very compact, multi-functional, easy to install and easy to set operating parameters. Designed to control the acceleration and deceleration of three-phase motors up to 690V, the line is available from 11A to 1000A.

The S811+ is designed to be a complete package, combining the silicon controlled rectifiers (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

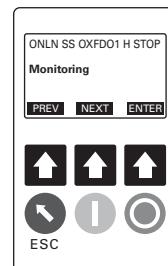
Designed to control the acceleration and deceleration of three-phase motors, the S811+ soft starter uses SCRs to control the voltage to soft start and soft stop the motor. After the motor is started, internal run bypass contactors close, resulting in the motor running directly across-the-line. The built-in 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 in the S811+ Premium 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 and adjustable time delays to ride through system discrepancies. Protective features may also be set to Warning status to avoid nuisance trips.

The S811+ has an easy to use Digital Interface Module (DIM) that allows the user to configure the device and to read system parameters and monitor system values. 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.

The DIM can be removed from the S811+ and be 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. This will help eliminate the possibility of an arc flash incident.

Digital Interface Module (DIM)

Communications

The S811+ has native Modbus RTU communication capabilities. The S811+ may be connected to a variety of networks, including DeviceNet, Modbus TCP, EtherNet/IP and PROFIBUS.

The S811+ communication parameters can be configured with the DIM or through the Fieldbus using CH Studio Component Manager. Advanced communication configuration settings provide the system integrator with powerful tools to facilitate system optimization.

Communications Reference

Description	Part Number
Modbus TCP Communication Adapter with 120 Vac I/O	C441U
Modbus TCP Communication Adapter with 24 Vdc I/O	C441V
EtherNet/IP Communication Adapter with 120 Vac I/O	C441U
EtherNet/IP Communication Adapter with 24 Vdc I/O	C441V
85–264 Vac input, 24 Vdc output	PSG240E
360–575 Vac input, 24 Vdc output	PSG240F

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. The user has the option to configure two independent start ramp profiles to accommodate variations in starting requirements.

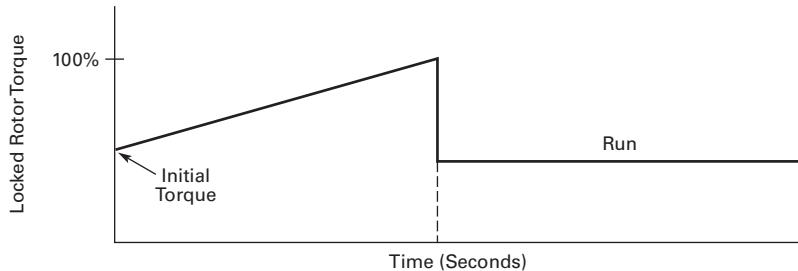
Voltage Ramp Start

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 (0.5–360 seconds with the S811+ Premium)

Starting Characteristics—Ramp Start



Current Limit Start

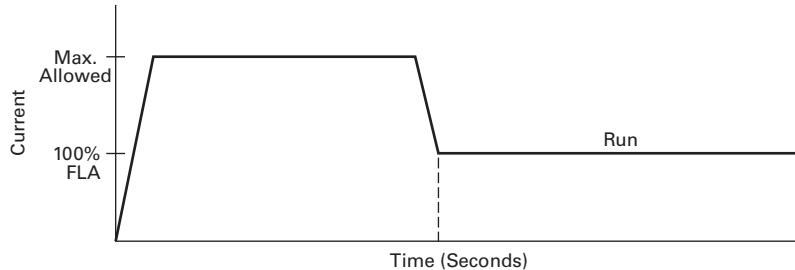
Limits the maximum current available to the motor during the start phase. This mode of soft starting is used when it becomes necessary to limit

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 (0.5–360 seconds with the S811+ Premium)

Starting Characteristics—Current Limit Start



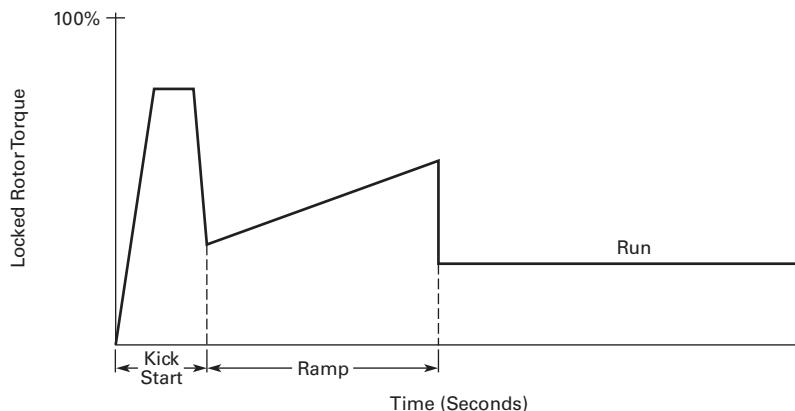
Kick Start

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 breakaway a high friction load.

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

Starting Characteristics—Kick Start



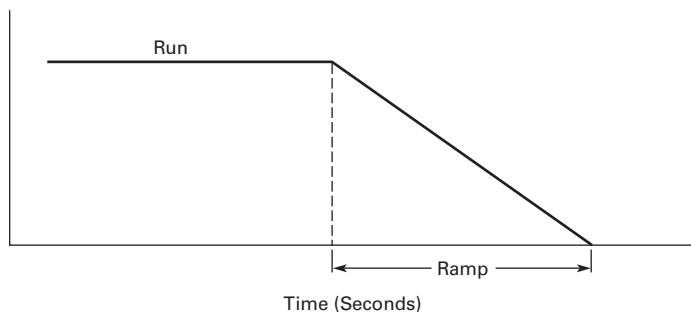
Soft Stop

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

Starting Characteristics—Soft Stop



Edge and Level Sensing Control**Edge Sensing**

Edge sensing requires +24 Vdc power be momentarily applied to Control Terminal Block Pin 1 (with Terminal P at +24 Vdc) to initiate a start under all conditions. After a stop or fault occurs, the +24 Vdc must be removed, then reapplied to Terminal 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 +24 Vdc power to Terminal 1 Pin before starting is required regardless of the position of the auto reset switch on the DIM.

Level Sensing

Level sensing will enable a motor to restart after a fault is cleared without cycling +24 Vdc power to Terminal Pin 1 as long as:

- Terminal Pin P is supplied with +24 Vdc (to start from Control Terminal Block, Terminal Pin 3 must also be enabled)
- The auto reset switch on the DIM is set to enabled
- All faults 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.

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

Features and Benefits

- Communication capabilities with various protocols
- The Digital Interface Module (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, 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 internal 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
- 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
- The S811+ Premium with sophisticated pump control algorithms on both starting and stopping that minimize the pressure surges that cause water hammer. The pump control feature 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
- Manage peak starting torque to diminish mechanical system wear and damage
- 24 Vdc control voltage 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 utilizing pre-assembled wire harnesses

Second Start Ramp Profile Capability

A second start ramp profile may be configured for the soft starter. This profile is independent of the primary profile and retains all the parameter options such as start time and initial torques. With a signal at a terminal programmed for this feature, the second profile may be selected by a pushbutton station or a network.

Alarm-No-Trip Functionality

Some applications require the ability to effectively disable most protections with the intent of enabling the RVSS unit to control a motor under the most severe operating conditions characterized by current or voltage imbalances, high or low value deviations, or other fault conditions. This function causes the S811+ to ignore most fault trip conditions and continue operation of the application.

Digital Interface Module (DIM) Cloning

For OEMs or other users that desire to load identical parameter settings into multiple RVSS units, the DIM may be used to extract and duplicate parameter settings from one RVSS and loaded into other units, saving time, effort, and reducing chances for errors while programming.

Motor Wiring Configuration User Selectable Inline or Inside-the-Delta

Mains Motor Wiring Configuration is accomplished by simply selecting the required configuration from a menu. This feature allows adaptability from one configuration to another without any additional programming operations and reduces inventory levels by not having to stock both configurations.

Modbus Native Communications Protocol

Modbus RTU communications is now standard on all S811+ units. This allows users to quickly configure the unit for network communications using a common protocol. Adapters are available for users who prefer to use EtherNet/IP or Modbus TCP protocols.

Programmable Control Terminal Block Functionality

Four programmable terminals on the S811+ enable the user to expand functionality with options such as a second start ramp profile, externally triggered trip or warning functions, analog inputs, and others, in addition to the normal start, stop, reset, and so on, functions.

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 based on the heat energy introduced into the motor during the start process. A 100% value represents the maximum safe internal 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 a thermal memory value of less than 100%. 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 parameter is adjustable from 32% to 100% of the unit's rated current. 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 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.

External E-Stop

Emergency Stop functionality may be triggered from an external source. Removal of the 24 Vdc signal from a terminal configured for E-Stop will initiate an E-Stop action. The External E-Stop option is useful in applications where it is desirable to accomplish a motor shutdown in the event that an external condition(s) exist that will damage system components and/or product flows or operations.

External Trip

External Trip functionality may be triggered from an external source. Removal of the 24 Vdc signal from a terminal configured for External Trip will initiate an External Trip action. The External Trip option is useful in applications where it is desirable to accomplish a motor stop in the event that an external condition(s) exist that will damage system components and/or product flows or operations.

Custom Fault/Warning Auxiliary Relays

Up to three fault and/or warning codes may be selected to operate an auxiliary relay configured to operate when any of these codes are detected. This option enables the user to provide external warnings or fault indications to increase monitoring effectiveness and to provide additional system control.

Motor Power

Motor Power can be not only be monitored, but trip levels can be adjusted to provide indications of system malfunctions or operating discrepancies. Both High and Low Power thresholds can be set to provide Fault Warning or Fault Trip functions. Additionally, fault delays times may be set to up to 60 seconds.

Analog Input

An input control terminal may be configured to accept a 0–20 mA DC signal with range scaling. This feature enables the S811+ to respond to an external device that may be monitoring a critical component or process and provides Fault Trip or Fault Warning capability to protect operating systems and processes.

Start Delay

Three start delay timers are available to enhance motor protection or to provide simple logic functions to coordinate motor control with other devices in the system. The timers will allow delays from 24 Vdc power up, receipt of a valid START command, or a delay in switch from one start ramp profile to another.

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 in bypass, 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 during 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 power pole's thermal capacity is exceeded. The soft starter will trip in over temperature conditions, preventing device failure.

Each power 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.

When using a communications network, alarms can be implemented in the process monitoring system warning of an impending trip before the trip occurs, halting the process.

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.

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 trip can be manually reset through the DIM or through the communications network. The trip 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 to accommodate short temporary voltage drops during the start process.

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 allows 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 trouble-shooting 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 inline 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 internal 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. When using a communications network, alarms can be implemented in the process monitoring system warning of an impending trip before the 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.

Pole Temperature

Increases in power 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.

PCB Device Temperature

An increase in printed circuit board (PCB) device temperature is a strong indication of an increase in ambient temperature. High ambient temperature operation can be identified with the device temperature data. Device temperature increases can be due to undersized enclosures, failure of cooling fans or blocked venting. High operating 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.

Average Line Power

Provides the average of the three-phase line power in kilowatts, accurate to 5%. Power data may be used to monitor power transmitted to the load. Increased power demand may indicate degraded system components or connections. Additionally, such data is useful in determine power utilization in branch circuits consisting of multiple loads.

Power Factor

Provides the three-phase power factor value, accurate to 5%. The power factor of the circuit may be used to identify circuit conditions that may need to be corrected due to low power factor indications. Low circuit power factor can indicate improper or degraded components.

Diagnostics**Fault Queue**

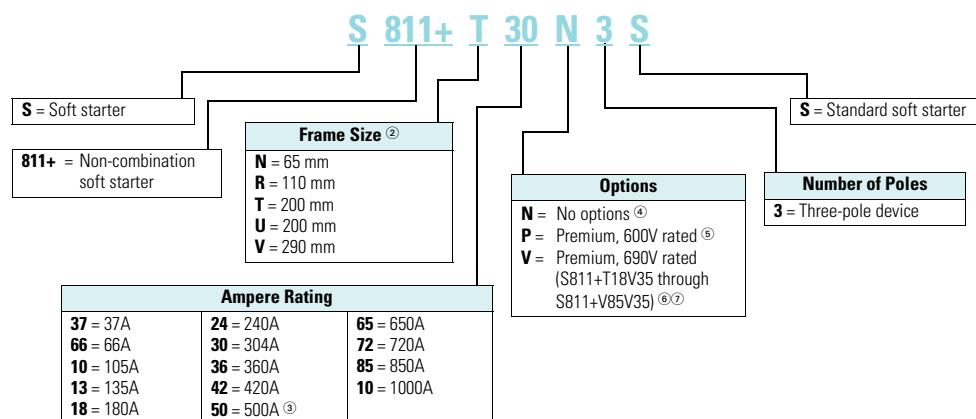
Current fault and a fault queue containing the last nine system faults can be read through the DIM or communications network. Fault identification can minimize troubleshooting time and cost, and prevent arc flash incidents. The fault queue can be remotely accessed through a communications network to assist in planning maintenance resources. Thirty (30) different faults can be identified by the S811+.

Standards and Certifications

- IEC 60947-4-2
- EN 60947-4-2
- UL listed (NMFT-E202571)
S811+N37_ through
S811+V85_
- UL recognized (NMFT2)
S811+V10_

**Instructional Leaflets**

- User manual MN03900001E
- Outline drawings:
 - S811+N_: 10-8574
 - S811+R_: 10-8575
 - S811+T_: 10-8576
 - S811+U_: 10-8857
 - S811+V_: 10-8577

Catalog Number Selection**S811+ Open Soft Starters** ^①**Notes**

- ① All units require a 24 Vdc power supply found on catalog **Page V6-T1-90**, or equivalent.
- ② S811+T_, S811+U_ and S811+V_ units require lug kits found on **Page V6-T1-90**.
- ③ S811+U50_ unit does not have IEC certification.
- ④ Level/Edge Sense, Inline or Inside-the-Delta wiring configuration.
- ⑤ Level/Edge Sense, Inline or Inside-the-Delta wiring configuration, pump control and extended ramp.
- ⑥ Not available in S811+U_.
- ⑦ Level/Edge Sense, Inline wiring configuration, pump control, extended ramp.

Product Selection**Standard Duty Ratings**

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

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 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.

S811+**Standard Duty—15 Second Ramp, 300% Current Limit at 40°C, Inline Connection**

Max. Current	Three-Phase Motors			hp Rating (60 Hz)						Catalog Number		
	230V	380–400V	440V	200V	1.0SF	1.15SF	230V	1.0SF	1.15SF	460V	1.0SF	1.15SF
Frame Size N												
37	10	18.5	18.5	10	10	10	10	10	25	20	30	30
66	18.5	30	37	20	15	20	20	20	50	40	60	50
Frame Size R												
105	30	55	59	30	25	40	30	30	75	60	100	75
135	40	63	80	40	30	50	40	40	100	75	125	100
Frame Size T												
180	51	90	110	60	50	60	60	60	150	125	150	150
240	75	110	147	75	60	75	75	75	200	150	200	200
304	90	160	185	100	75	100	100	100	250	200	300	250
Frame Size U												
360	110	185	220	125	100	150	125	125	300	250	350	300
420	129	220	257	150	125	175	150	150	350	300	450	350
500	150	257	300	150	150	200	150	150	400	350	500	450
Frame Size V												
360	110	185	220	125	100	150	125	125	300	250	350	300
420	129	220	257	150	125	175	150	150	350	300	450	350
500	150	257	300	150	150	200	150	150	400	350	500	450
650	200	355	425	250	200	250	200	200	500	450	600	500
720	220	400	450	—	—	300	250	250	600	500	700	600
850	257	475	500	—	—	350	300	300	700	600	900	700
1000	277	525	550	—	—	400	350	350	800	700	900	800

Notes

① 690V is available only from S811+T18V3S through S811+V85V3S. Not available on S811+U...V3S.

② S811+U50_ rating does not have IEC certification.

Severe Duty**Severe Duty Ratings**

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

Severe duty ratings are defined as any combination of parameters that exceed the standard duty ratings where

the ramp time is over 30 seconds, and/or the number of starts per hour exceeds 4, and/or the current limit set is

over 300%. Example: 35-second ramp, 5 starts per hour, 350% current limit at 40°C ambient.

S811+

Severe Duty—30 Second Ramp and/or 450% Current Limit at 50°C, Inline Connection

Max. Current	Three-Phase Motors			hp Rating (60 Hz)												Catalog Number
	230V	380–400V	440V	200V	230V	460V	575–690V ^①	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
Frame Size N																
22	5.5	10	11	5	5	7-1/2	5	15	10	20	15	S811+N37N3S				
42	11	18.5	22	10	10	15	10	30	25	40	30	S811+N66N3S				
Frame Size R																
65	15	30	33	15	15	20	15	50	40	50	50	S811+R10N3S				
80	22	40	45	25	20	30	25	60	50	75	60	S811+R13N3S				
Frame Size T																
115	33	59	63	30	30	40	30	75	75	100	100	S811+T18N3S				
150	45	80	90	50	40	50	50	100	100	150	125	S811+T24N3S				
192	55	100	110	60	50	75	60	150	125	200	150	S811+T30N3S				
Frame Size U																
240	75	110	147	75	60	75	75	200	150	200	200	S811+U36N3S				
305	90	160	185	100	75	100	100	250	200	300	250	S811+U42N3S				
365	110	185	220	125	100	150	125	300	250	350	300	S811+U50N3S				
Frame Size V																
240	75	110	147	75	60	75	75	200	150	200	200	S811+V36N3S				
305	90	160	185	100	75	100	100	250	200	300	250	S811+V42N3S				
365	110	185	220	125	100	150	125	300	250	350	300	S811+V50N3S				
420	129	220	257	150	125	150	150	350	300	450	350	S811+V65N3S				
480	147	257	295	150	150	200	150	400	350	500	450	S811+V72N3S				
525	160	280	335	150	150	200	150	450	350	500	450	S811+V85N3S				
575	172	303	370	200	150	250	200	500	450	600	500	S811+V10N3S				

Note

^① 690V is available only from S811+T18V3S through S811+V85V3S. Not available on S811+U...V3S.

Inside-the-Delta Standard Duty Ratings

S811+

**Standard Duty—15 Second Ramp, 300% Current Limit at 40°C, Inside-the-Delta Connection**

Max. Continuous Motor Line Current	Three-Phase Motor															Catalog Number			
	kW Rating (50 Hz)			hp Rating (60 Hz)						200V			230V			460V			
	230V	380–400V	440V	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF				
Frame Size N																			
65	10	18.5	18.5	15	15	15	15	40	30	50	50	50	S811+N37N3S						
114	18.5	30	37	30	25	30	30	75	60	100	100	75	S811+N66N3S						
Frame Size R																			
182	30	55	59	50	40	60	50	125	100	150	125	125	S811+R10N3S						
234	40	63	80	60	50	75	60	150	125	200	150	150	S811+R13N3S						
Frame Size T																			
311	51	90	110	100	75	100	100	250	200	250	250	250	S811+T18N3S						
415	75	110	147	125	100	125	125	300	250	300	300	300	S811+T24N3S						
526	90	160	185	150	125	150	150	400	300	400	400	400	S811+T30N3S						
Frame Size U																			
623	110	185	220	200	150	250	200	450	400	550	450	450	S811+U36N3S						
727	129	220	257	250	200	300	250	550	450	700	550	550	S811+U42N3S						
865	150	257	300	250	250	300	250	600	550	750	700	700	S811+U50N3S	①②					
Frame Size V																			
623	110	185	220	200	150	250	200	450	400	550	450	450	S811+V36N3S						
727	129	220	257	250	200	300	250	550	450	700	550	550	S811+V42N3S						
865	150	257	300	250	250	300	250	600	550	750	700	700	S811+V50N3S						
1125	200	355	425	400	300	400	300	750	700	900	750	750	S811+V65N3S						
1246	—	—	—	—	—	—	—	—	—	—	—	—	S811+V72N3S						
1471	—	—	—	—	—	—	—	—	—	—	—	—	S811+V85N3S						
—	—	—	—	—	—	—	—	—	—	—	—	—	S811+V10N3S						

Notes

① 15 sec. start, 300% inrush, 40°C, 1 start every 15 minutes. If these start parameters are exceeded, please refer to S811+V50_.

② S811+U50_ unit does not have IEC certification.

Inside-the-Delta Severe Duty Ratings

Severe duty ratings are defined as any combination of parameters that exceed the standard duty ratings where the ramp time is over 30 seconds, and/or the number of starts per hour exceeds 4, and/or the current limit set is over 300%.

Example: 35-second ramp, 5 starts per hour 350% current limit at 40°C ambient.

S811+**Severe Duty—30 Second Ramp and/or 450% Current Limit at 50°C, Inside-the-Delta Connection**

Max. Continuous Motor Line Current	kW Rating (50 Hz)			hp Rating (60 Hz)						Catalog Number		
	230V	380–400V	440V	200V	230V	460V	575V	1.0SF	1.15SF	1.0SF	1.15SF	
Frame Size N												
39	5.5	10	11	7-1/2	7-1/2	10	7-1/2	25	15	30	25	S811+N37N3S
73	11	18.5	22	15	15	25	15	50	40	60	50	S811+N66N3S
Frame Size R												
111	15	30	33	25	25	30	25	75	60	75	75	S811+R10N3S
138	22	40	45	40	30	50	40	100	75	120	100	S811+R13N3S
Frame Size T												
199	33	59	63	50	50	60	50	125	125	150	150	S811+T18N3S
257	45	80	90	75	60	75	75	150	150	250	200	S811+T24N3S
324	55	100	110	100	75	100	100	250	200	300	250	S811+T30N3S
Frame Size U												
415	75	110	147	125	100	125	125	300	250	300	300	S811+U36N3S
526	90	160	185	150	120	150	150	400	300	450	400	S811+U42N3S
623	110	185	220	200	150	250	200	450	400	550	450	S811+U50N3S ①
Frame Size V												
415	75	110	147	125	100	125	125	300	250	300	300	S811+V36N3S
526	90	160	185	150	120	150	150	400	300	450	400	S811+V42N3S
623	110	185	220	200	150	250	200	450	400	550	450	S811+V50N3S
727	129	220	257	250	200	250	250	550	450	700	550	S811+V65N3S
816	147	257	295	250	250	300	250	600	550	750	700	S811+V72N3S
908	160	280	335	250	250	300	250	700	550	750	700	S811+V85N3S
—	—	—	—	—	—	—	—	—	—	—	—	S811+V10N3S

Note

① S811+U50_ unit does not have IEC certification.

Accessories**Lug Kits**

S811+T_—, S811U_— and S811+V_— soft starters each have different lug options based on your wiring needs. Each lug kit contains three lugs that can be mounted on either the load or line side.

**Lug Kits**

Lug Kit	S811+ Catalog Number	Description	Kits Required	Catalog Number
S811+T _— , S811+U _—		2 cable connections, 4 AWG to 1/0 cable	2	EML22
		1 cable connection, 4/0 to 500 kcmil cable		EML23
		2 cable connections, 4/0 to 500 kcmil cable		EML24
		1 cable connection, 2/0 to 300 kcmil cable		EML25
		2 cable connections, 2/0 to 300 kcmil cable		EML26
S811+V _—		2 cable connections, 4/0 to 500 kcmil cable	2	EML28
		4 cable connections, 4/0 to 500 kcmil cable		EML30
		6 cable connections, 4/0 to 500 kcmil cable		EML32
		4 cable connections, 2/0 to 300 kcmil cable		EML33

Power Supplies

24 Vdc power supply that can be used with the S811+ SSRV or as a stand-alone device.

Power Supplies

Description	Catalog Number
85–264 Vac input 24 Vdc output	PSG240E
360–575 Vac input 24 Vdc output	PSG240F
600 Vac input 24 Vdc output	PSS55D

Lug Cover Kits

Replacement covers for the S811+T_—, S811+U_— and S811+V_— soft starters are available in case of damage to the existing covers.

Lug Cover Kits

Description	Catalog Number
Lug cover S811+T _— , S811+U _—	EML27
Lug cover S811+V _—	EML34

IP20 Kits**IP20 Kits**

Description	Catalog Number
S811+N _—	SS-IP20-N
S811+R _—	SS-IP20-R
S811+T _— and S811+U _—	SS-IP20-TU
S811+V _—	SS-IP20-V

Surge Suppressors

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

**Surge Suppressors**

Description	Catalog Number
600V MOV for S811+ units	EMS39
690V MOV for S811+ units ^①	EMS41

Note

^① S811+T_— only.

Mounting Plates

The mounting plates are designed to help make it easy to install or retrofit the soft starter into enclosures and MCCs. The soft starter can be mounted onto the plate prior to installation. The mounting plate is designed with tear drop mounting holes for easier installation.

Mounting Plates

Description	Catalog Number
S811+N_	EMM13N
S811+R_	EMM13R
S811+T_ and S811+U_	EMM13T
S811+V_	EMM13V

Vibration Plates

The vibration plates allow the soft starter to be applied in high shock and vibration applications. The vibration plate allows vibration up to 5g and shock in up to 40g. The soft starter is mounted onto the vibration plate prior to installation in the panel.

Vibration Plates

Description	Catalog Number
S811+N_	EMM14N
S811+R_	EMM14R
S811+T_ and S811+U_	EMM14T
S811+V_	EMM14V

Adapter Plates

The adapter plate allows customers to retrofit a S811+V_ soft starter with the S811+U_ soft starter.

Adapter Plates

Description	Catalog Number
Adapter plates	EMM13U

Digital Interface Module

The Digital Interface Module (DIM) is available as a replacement part.

DIM

Description	Catalog Number
Blank cover (filler)	EMA68
DIM for standard unit	EMA91
Panel mounting kit	
3 ft cable	EMA69A
5 ft cable	EMA69B
8 ft cable	EMA69C
10 ft cable	EMA69D

Options**S811+ Premium**

In addition to what is already there in the S811+ standard, these devices offer pump control and extended ramp functions.

S811+ Premium

Current Range	Catalog Number
11–37	S811+N37P3S
20–66	S811+N66P3S
32–105	S811+R10P3S
42–135	S811+R13P3S
56–180	S811+T18P3S
75–240	S811+T24P3S
95–304	S811+T30P3S
112–360	S811+U36P3S
131–420	S811+U42P3S
156–500	S811+U50P3S ^①
112–360	S811+V36P3S
131–420	S811+V42P3S
156–500	S811+V50P3S
203–650	S811+V65P3S
225–720	S811+V72P3S
265–850	S811+V85P3S
312–1000	S811+V10P3S

Note

① S811+U50_ unit does not have IEC certification.

Technical Data and Specifications**Soft Starters—S811+**

Description	S811+N37_	S811+N66_	S811+R10+	S811+R13_
Max. current capacity	37	66	105	135
FLA range	11–37	20–66	32–105	42–135
General Information				
Bypass mechanical lifespan	10M	10M	10M	10M
Insulating voltage Ui	660V	660V	660V	660V
Ramp time range	0.5–180 seconds (0.5–360 seconds S811+ Premium)			
Resistance to vibration	3g	3g	3g	3g
Resistance to shock	15g	15g	15g	15g
Electrical Information				
Operating voltage	200–600V	200–600V	200–600V	200–600V
Operating frequency	47–63 Hz	47–63 Hz	47–63 Hz	47–63 Hz
Overload setting	30–100%	30–100%	30–100%	30–100%
Trip class	5, 10, 20 and 30			
Cabling Capacity (IEC 947)				
Number of conductors	1	1	1	1
Wire sizes	14–2	14–2	14–4/0	14–4/0
Type of connectors	Box lug	Box lug	Box lug	Box lug
Control Wiring (12-Pin)				
Wire sizes in AWG	22–14	22–14	22–14	22–14
Number of conductors (stranded)	2 (or one AWG 12)			
Torque requirements in lb-in	3.5	3.5	3.5	3.5
Solid, stranded or flexible max. size in mm ²	3.31	3.31	3.31	3.31
Control Power Requirements				
Voltage range (24V ±10%)	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4
Steady-state current amps	1.0	1.0	1.0	1.0
Inrush current amps	10	10	10	10
Ripple	1%	1%	1%	1%
Relays (1) Class A and C				
Voltage AC—maximum	240	240	240	240
Voltage DC—maximum	120	120	120	120
Amps—maximum	3	3	3	3
Environment				
Temperature—operating	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C
Temperature—storage	−50° to 70°C	−50° to 70°C	−50° to 70°C	−50° to 70°C
Altitude	<2000m—consult factory for operation >2000m			
Humidity	<95% noncondensing	<95% noncondensing	<95% noncondensing	<95% noncondensing
Operating position	Any	Any	Any	Any
Pollution degree IEC947-1	3	3	3	3
Impulse withstand voltage IEC947-4-1	6000V	6000V	6000V	6000V

Soft Starters—S811+, continued

Description	S811+T18_	S811+T24_	S811+T30_	S811+U36_
Max. current capacity	180	240	304	360
FLA range	56–180	75–240	95–304	112–360
General Information				
Bypass mechanical lifespan	10M	10M	10M	10M
Insulating voltage Ui	660V	660V	660V	660V
Ramp time range	0.5–180 seconds (0.5–360 seconds S811+ Premium)			
Resistance to vibration	3g	3g	3g	3g
Resistance to shock	15g	15g	15g	15g
Electrical Information				
Operating voltage	200–600V	200–600V	200–600V	200–600V
Operating frequency	47–63 Hz	47–63 Hz	47–63 Hz	47–63 Hz
Overload setting	30–100%	30–100%	30–100%	30–100%
Trip class	5, 10, 20 and 30			
Cabling Capacity (IEC 947)				
Number of conductors	1 or 2	1 or 2	1 or 2	1 or 2
Wire sizes	4 AWG to 500 kcmil			
Type of connectors	Add-on lug kit	Add-on lug kit	Add-on lug kit	Add-on lug kit
Control Wiring (12-Pin)				
Wire sizes in AWG	22–14	22–14	22–14	22–14
Number of conductors (stranded)	2 (or one AWG 12)			
Torque requirements in lb-in	3.5	3.5	3.5	3.5
Solid, stranded or flexible max. size in mm ²	3.31	3.31	3.31	3.31
Control Power Requirements				
Voltage range (24V ±10%)	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4
Steady-state current amps	1.0	1.0	1.0	1.0
Inrush current amps	10	10	10	10
Ripple	1%	1%	1%	1%
Relays (1) Class A and C				
Voltage AC—maximum	240	240	240	240
Voltage DC—maximum	120	120	120	120
Amps—maximum	3	3	3	3
Environment				
Temperature—operating	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C
Temperature—storage	−50° to 70°C	−50° to 70°C	−50° to 70°C	−50° to 70°C
Altitude	<2000m—consult factory for operation >2000m			
Humidity	<95% noncondensing	<95% noncondensing	<95% noncondensing	<95% noncondensing
Operating position	Any	Any	Any	Any
Pollution degree IEC947-1	3	3	3	3
Impulse withstand voltage IEC947-4-1	6000V	6000V	6000V	6000V

Soft Starters—S811+, continued

Description	S811+U42_	S811+U50_ ^①	S811+V36_	S811+V42_
Max. current capacity	420	500	360	420
FLA range	131–420	156–500	112–360	131–420
General Information				
Bypass mechanical lifespan	10M	10M	10M	10M
Insulating voltage Ui	660V	660V	660V	660V
Ramp time range	0.5–180 seconds (0.5–360 seconds S811+ Premium)			
Resistance to vibration	3g	3g	3g	3g
Resistance to shock	15g	15g	15g	15g
Electrical Information				
Operating voltage	200–600V	200–600V	200–600V	200–600V
Operating frequency	47–63 Hz	47–63 Hz	47–63 Hz	47–63 Hz
Overload setting	30–100%	30–100%	30–100%	30–100%
Trip class	5, 10, 20 and 30			
Cabling Capacity (IEC 947)				
Number of conductors	1 or 2	1 or 2	2, 4 or 6	2, 4 or 6
Wire sizes	4 AWG to 500 kcmil	4 AWG to 500 kcmil	2/0 to 500 kcmil	2/0 to 500 kcmil
Type of connectors	Add-on lug kit	Add-on lug kit	Add-on lug kit	Add-on lug kit
Control Wiring (12-Pin)				
Wire sizes in AWG	22–14	22–14	22–14	22–14
Number of conductors (stranded)	2 (or one AWG 12)			
Torque requirements in lb-in	3.5	3.5	3.5	3.5
Solid, stranded or flexible max. size in mm ²	3.31	3.31	3.31	3.31
Control Power Requirements				
Voltage range (24V ±10%)	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4
Steady-state current amps	1.0	1.0	1.4	1.4
Inrush current amps	10	10	10	10
Ripple	1%	1%	1%	1%
Relays (1) Class A and C				
Voltage AC—maximum	240	240	240	240
Voltage DC—maximum	120	120	120	120
Amps—maximum	3	3	3	3
Environment				
Temperature—operating	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C	−30° to 50°C (no derating) consult factory for operation >50°C
Temperature—storage	−50° to 70°C	−50° to 70°C	−50° to 70°C	−50° to 70°C
Altitude	<2000m—consult factory for operation >2000m			
Humidity	<95% noncondensing	<95% noncondensing	<95% noncondensing	<95% noncondensing
Operating position	Any	Any	Any	Any
Pollution degree IEC947-1	3	3	3	3
Impulse withstand voltage IEC947-4-1	6000V	6000V	6000V	6000V

Note

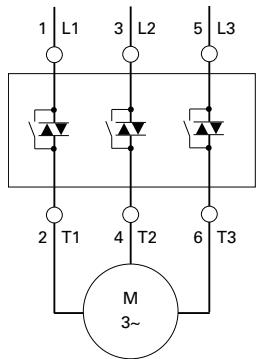
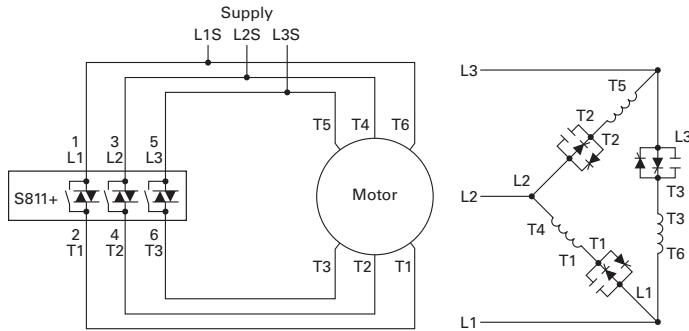
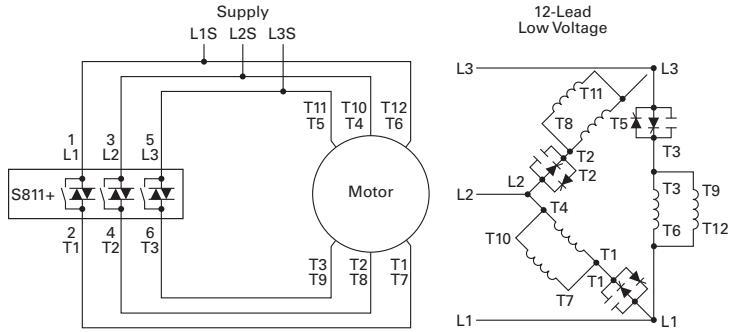
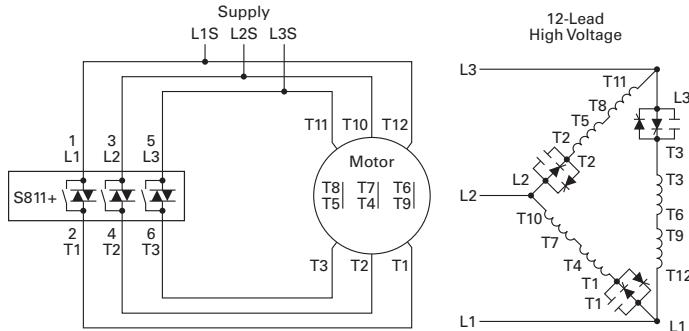
^① S811+U50_ unit does not have IEC certification.

Soft Starters—S811+, continued

Description	S811+V50_	S811+V65_	S811+V72_	S811+V85_	S811+V10_ ①
Max. current capacity	500	650	720	850	1000
FLA range	156–500	203–650	225–720	265–580	320–1000
General Information					
Bypass mechanical lifespan	10M	10M	10M	10M	10M
Insulating voltage Ui	660V	660V	660V	660V	660V
Ramp time range	0.5–180 seconds (0.5–360 seconds S811+ Premium)				
Resistance to vibration	3g	3g	3g	3g	3g
Resistance to shock	15g	15g	15g	15g	15g
Electrical Information					
Operating voltage	200–600V	200–600V	200–600V	200–600V	200–600V
Operating frequency	47–63 Hz				
Overload setting	30–100%	30–100%	30–100%	30–100%	30–100%
Trip class	5, 10, 20 and 30				
Cabling Capacity (IEC 947)					
Number of conductors	2, 4 or 6				
Wire sizes	2/0 to 500 kcmil				
Type of connectors	Add-on lug kit				
Control Wiring (12-Pin)					
Wire sizes in AWG	22–14	22–14	22–14	22–14	22–14
Number of conductors (stranded)	2 (or one AWG 12)				
Torque requirements in lb-in	3.5	3.5	3.5	3.5	3.5
Solid, stranded or flexible max. size in mm ²	3.31	3.31	3.31	3.31	3.31
Control Power Requirements					
Voltage range (24V ±10%)	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4	21.6–26.4
Steady-state current amps	1.4	1.4	1.4	1.4	1.4
Inrush current amps	10	10	10	10	10
Ripple	1%	1%	1%	1%	1%
Relays (1) Class A and C					
Voltage AC—maximum	240	240	240	240	240
Voltage DC—maximum	120	120	120	120	120
Amps—maximum	3	3	3	3	3
Environment					
Temperature—operating	–30° to 50°C (no derating) consult factory for operation >50°C	–30° to 50°C (no derating) consult factory for operation >50°C	–30° to 50°C (no derating) consult factory for operation >50°C	–30° to 50°C (no derating) consult factory for operation >50°C	–30° to 50°C (no derating) consult factory for operation >50°C
Temperature—storage	–50° to 70°C				
Altitude	<2000m—consult factory for operation >2000m				
Humidity	<95% noncondensing				
Operating position	Any	Any	Any	Any	Any
Pollution degree IEC947-1	3	3	3	3	3
Impulse withstand voltage IEC947-4-1	6000V	6000V	6000V	6000V	6000V

Note

① UR recognized product.

Wiring Diagrams**Line Connected Soft Starter****Inside-the-Delta Connected Soft Starter for a 6-Lead Motor****Inside-the-Delta Connected Soft Starter for a 12-Lead Low Voltage Motor****Inside-the-Delta Connected Soft Starter for a 12-Lead High Voltage Motor**

Dimensions

Approximate Dimensions in Inches (mm)

Soft Starters—S811+

Catalog Number	W	H	D	Weight in Lbs (kg)
S811+N37N3S	2.66 (67.6)	7.37 (187.2)	6.45 (163.9)	5.8 (2.6)
S811+N66N3S	2.66 (67.6)	7.37 (187.2)	6.45 (163.9)	5.8 (2.6)
S811+R10N3S	4.38 (111.3)	7.92 (201.1)	6.64 (168.6)	10.5 (4.8)
S811+R13N3S	4.38 (111.3)	7.92 (201.1)	6.64 (168.6)	10.5 (4.8)
S811+T18N3S	7.65 (194.4)	12.71 (322.9)	6.47 (164.4)	48 (21.8) with lugs 41 (18.6) without lugs
S811+T24N3S	7.65 (194.4)	12.71 (322.9)	6.47 (164.4)	48 (21.8) with lugs 41 (18.6) without lugs
S811+T30N3S	7.65 (194.4)	12.71 (322.9)	6.47 (164.4)	48 (21.8) with lugs 41 (18.6) without lugs
S811+U36N3S	7.73 (196.3)	12.72 (323.1)	7.16 (181.8)	48 (21.8) with lugs 41 (18.6) without lugs
S811+U42N3S	7.73 (196.3)	12.72 (323.1)	7.16 (181.8)	48 (21.8) with lugs 41 (18.6) without lugs
S811+U50N3S	7.73 (196.3)	12.72 (323.1)	7.16 (181.8)	48 (21.8) with lugs 41 (18.6) without lugs
S811+V36N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S811+V42N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S811+V50N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S811+V65N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S811+V72N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S811+V85N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs
S811+V10N3S	11.05 (280.6)	16.57 (420.8)	7.39 (187.8)	103 (46.8) with lugs 91 (41.4) without lugs

Also refer to dimension drawings on **Pages V6-T1-98 through V6-T1-100.**

1.2

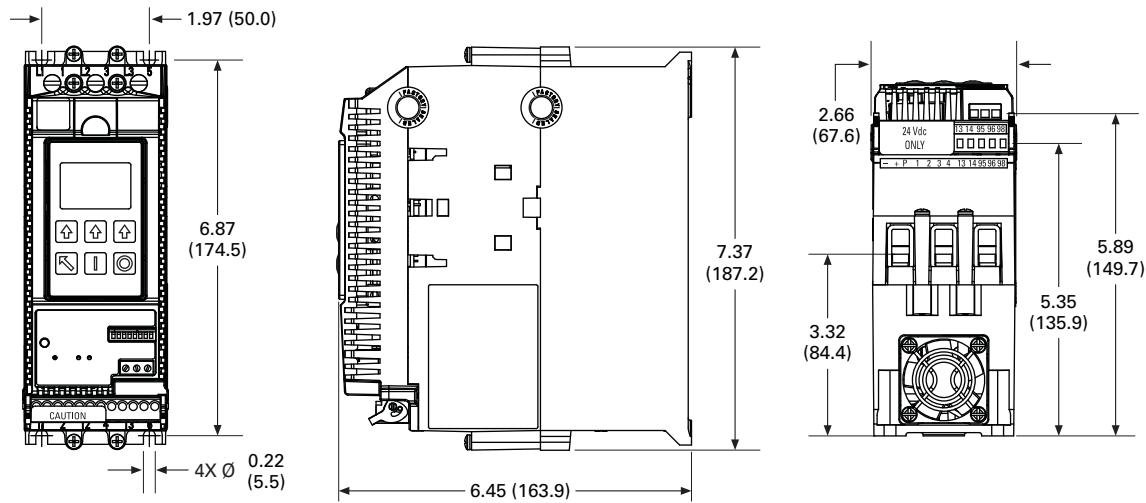
Reduced Voltage Motor Starters

Solid-State Starters

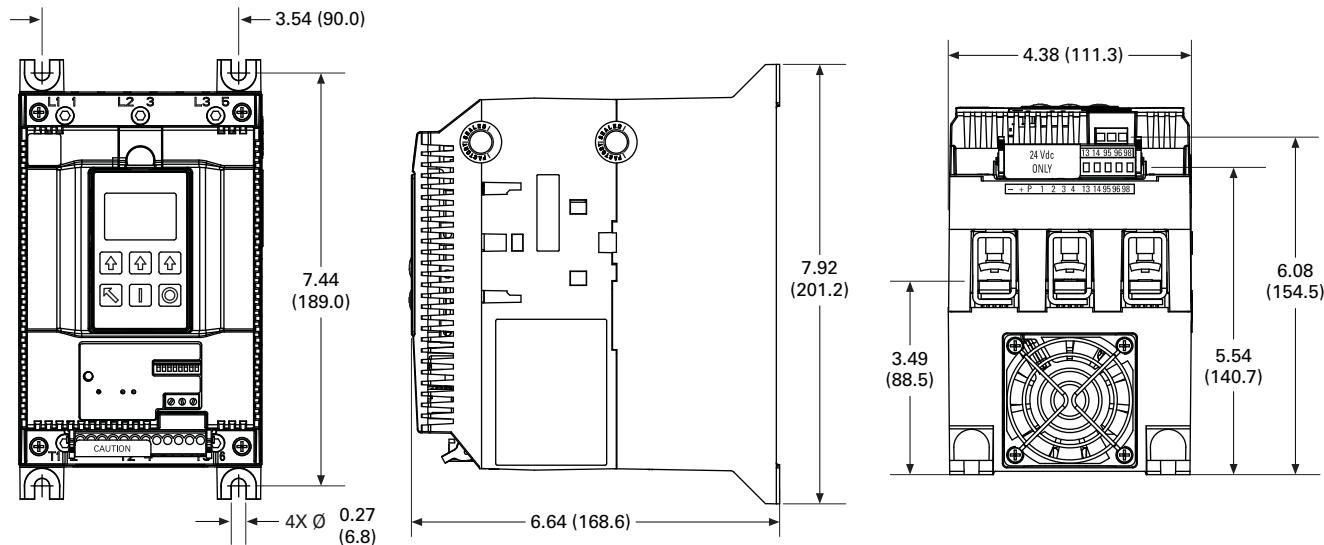
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Approximate Dimensions in Inches (mm)

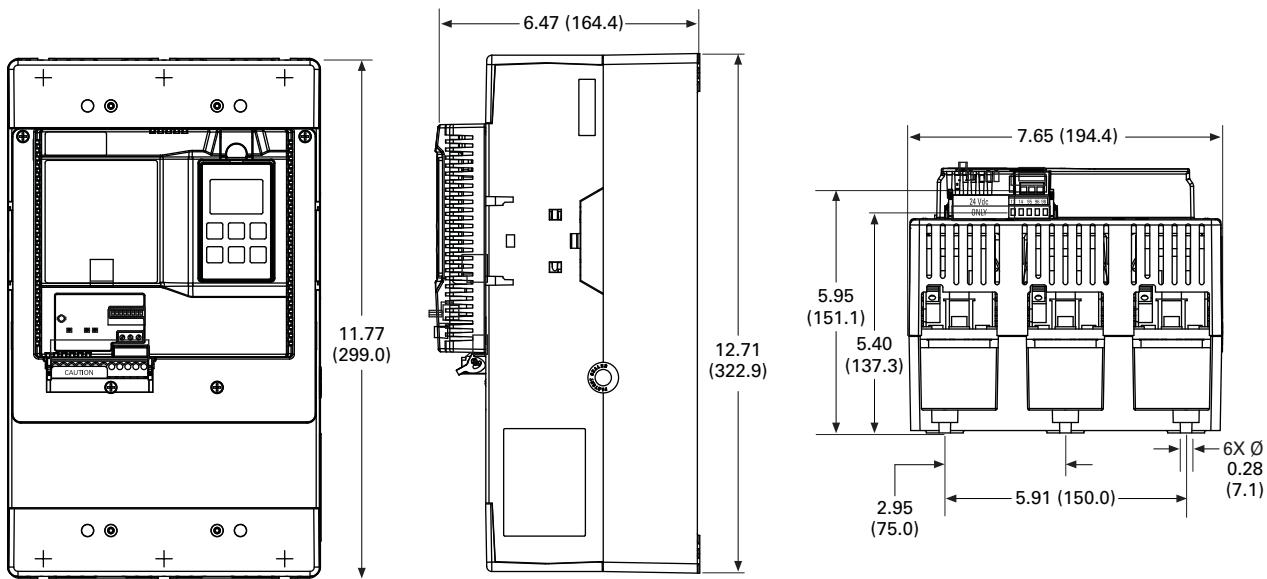
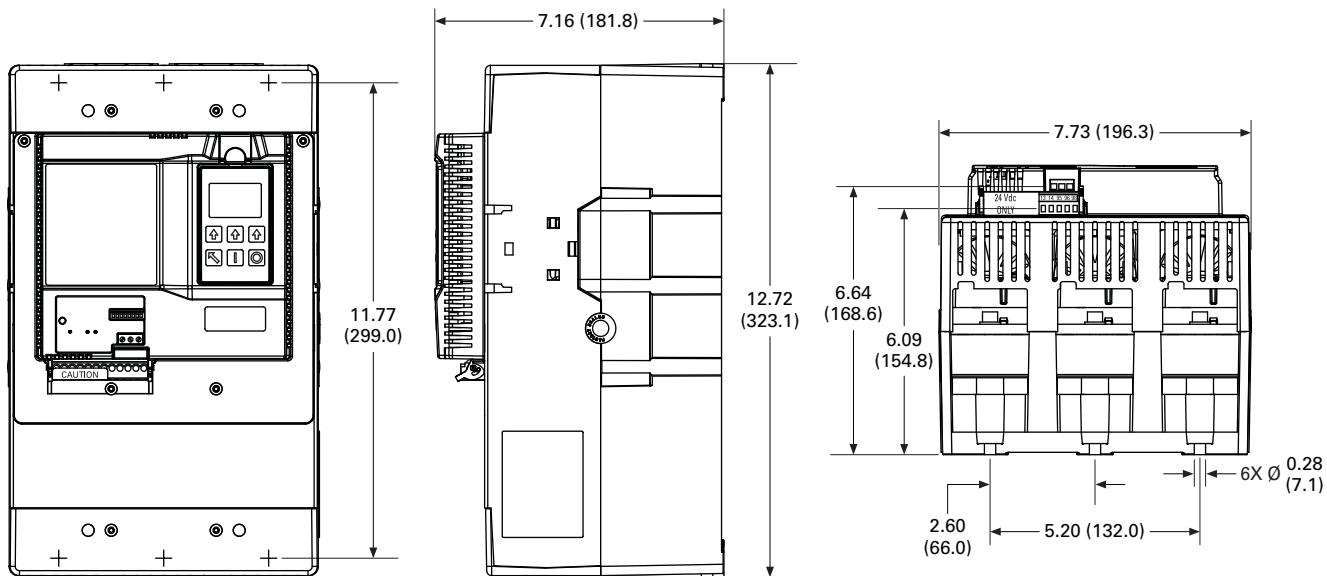
S811+N_



S811+R_



Approximate Dimensions in Inches (mm)

S811+T_**S811+U_**

1.2

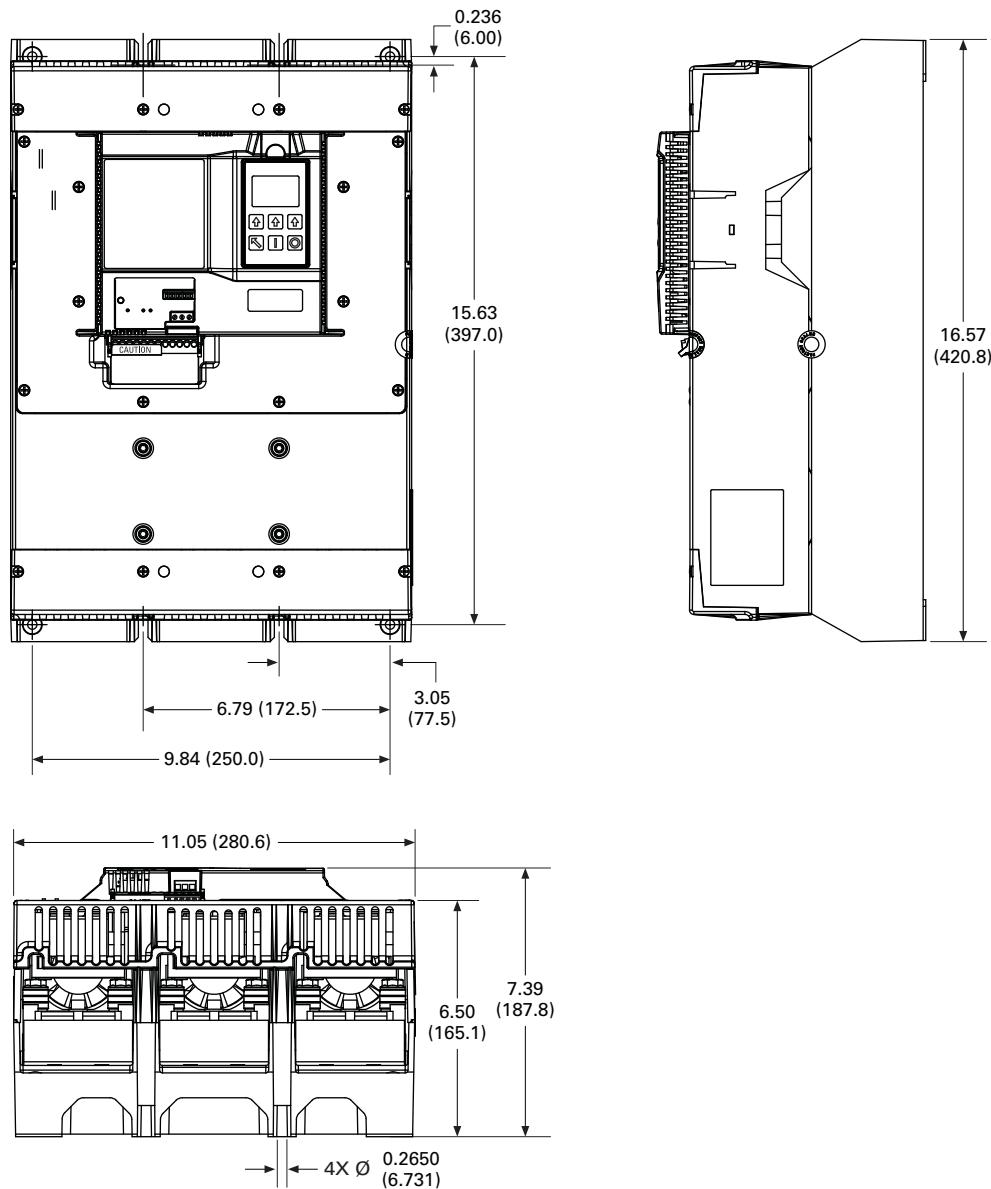
Reduced Voltage Motor Starters

Solid-State Starters

1

Approximate Dimensions in Inches (mm)

S811+V_



Adjustable Frequency Drives

PowerXL DC1



PowerXL DG1



Enclosed 18-Pulse Drive



OEM Drives

2.1 PowerXL DC1 Series Drives

Product Description

V6-T2-2

2

2.2 PowerXL DA1 Series Drives

Product Description

V6-T2-11

2.3 M-Max Series Drives

Product Description

V6-T2-20

General Purpose Industrial Drives

2.4 PowerXL DG1 Series Drives

Product Description

V6-T2-30

2.5 SVX9000 Drives

Product Overview

V6-T2-45

SVX9000 Drives

Product Description

V6-T2-48

SVX9000 Enclosed Drives

Product Description

V6-T2-87

SVX9000 VFD Pump Panels

Product Description

V6-T2-111

General Purpose HVAC Drives

2.6 H-Max Series Drives

Product Overview

V6-T2-131

H-Max Drives

Product Description

V6-T2-132

H-Max IntelliPass and IntelliDisconnect Drives

Product Description

V6-T2-141

Performance Drives

2.7 SPX9000 Drives

Product Description

V6-T2-158

2.8 Low Harmonic Drives

Enclosed Passive Filtered Drives

Product Description

V6-T2-200

Enclosed 18-Pulse Drives

Product Description

V6-T2-233

2.9 LCX9000 Liquid Cooled Drives

Product Description

V6-T2-263

2.10 SPA9000/SPN9000/SPI9000 Common DC Bus Drives

Product Description

V6-T2-280



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An Eaton
Green Solution

PowerXL DC1 Series Drives**2****Product Description**

Eaton's PowerXL™ DC1 variable frequency drives are the next generation of drives specifically engineered for today's machinery applications.

The DC1 is compact with only 14 basic parameters, SmartWire-DT™ connectivity, and outstanding ease of mounting and installation. The DC1 is perfect for quick commissioning and is ideal for panel builders. This drive supports single-phase motor applications, and detachable terminal blocks make control wiring much easier.

Models rated at 480 volts, three-phase, 50/60 Hz are available in sizes ranging from 1 to 15 hp. Models rated at 240 volts, single- or three-phase, 50/60 Hz are available in sizes ranging from 0.5 to 7.5 hp. Models rated at 115 volts, single-phase, 50/60 Hz are available in the 0.5 to 3 hp size range.

Features

- Compact, space-saving design
- Rugged and reliable—175% for 2s, 50°C rated
- DIN rail and screw mountable (FS1 and FS2)
- Side-by-side installation
- Industry-leading efficiency delivers energy savings to the customer
- Optional integrated EMC filters make the unit suitable for commercial and industrial networks

Contents**Description****Page**

PowerXL DC1 Series Drives	V6-T2-3
Catalog Number Selection	V6-T2-4
Product Selection	V6-T2-6
Accessories	V6-T2-7
Technical Data and Specifications	V6-T2-9
Dimensions	

Standards and Certifications**Product**

- Complies with EN61800-3 (2004)

EMC (At Default Settings)

- EMC Category C1, C2 and C3 at default settings (1m, 5m, 25m)

Safety ^①

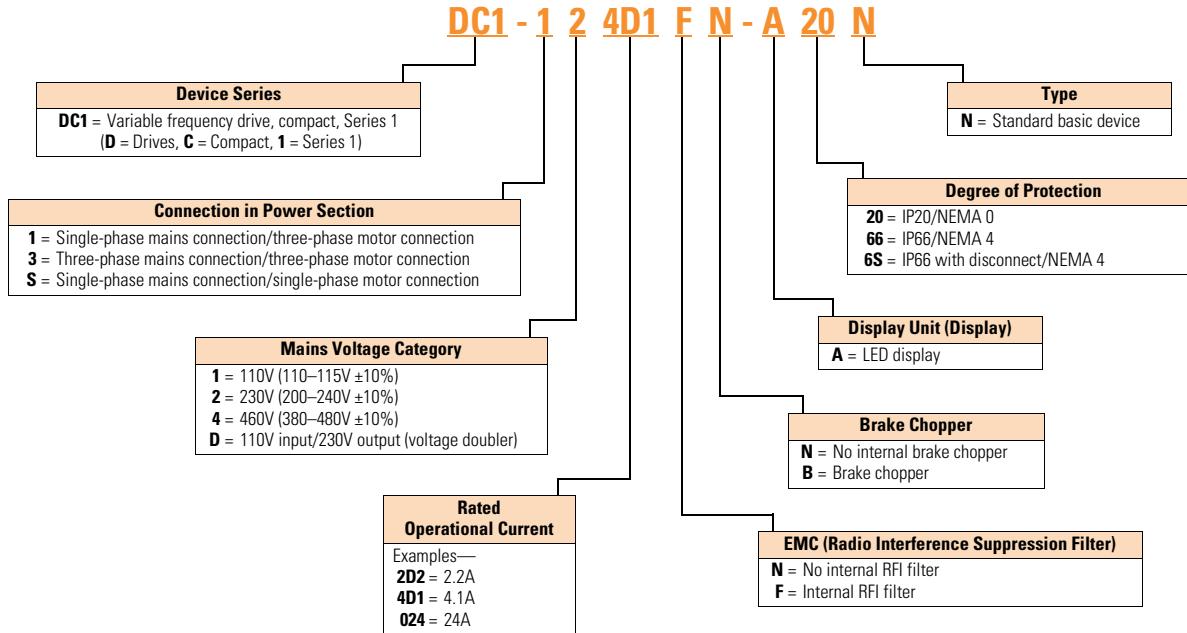
- 61800-5-1
- EN 60529
- CE
- UL
- cUL
- UkrSepro
- c-Tick
- RoHS compliant

**Note**

- ① See unit nameplate for more detailed approvals.

Catalog Number Selection**DC1 Series Adjustable Frequency AC Drives**

2



Product Selection

2

IP20

DC1 Series IP20 Enclosure Drives ^①

hp ^②	kW	Volts	100% Continuous Current In (A)	Frame Size ^③	Catalog Number
0.5	0.37	115V single-phase in/ 115V single-phase out	7	1	DC1-S17D0NN-A20N
0.75	0.55		10.5	2	DC1-S1011NB-A20N
0.5	0.37	200–240V single-phase in/ 200–240V single-phase out	4.3	1	DC1-S24D3NN-A20N ^④
1	0.75		7	1	DC1-S27D0NN-A20N ^④
1.5	1.1		10	2	DC1-S2011NB-A20N ^④
0.5	0.37	115V single-phase in/ 230V three-phase out	2.3	1	DC1-1D2D3NN-A20N ^④
1	0.75		4.3	1	DC1-1D4D3NN-A20N
1.5	1.1		5.8	2	DC1-1D5D8NB-A20N
0.5	0.37	200–240V single-phase in/ 230V three-phase out	2.3	1	DC1-122D3NN-A20N ^④
1	0.75		4.3	1	DC1-124D3NN-A20N ^④
2	1.5		7	1	DC1-127D0NN-A20N ^④
2	1.5		7	2	DC1-127D0NB-A20N ^④
3	2.2		10.5	2	DC1-12011NB-A20N ^④
5	4		15	3	DC1-12015NB-A20N
0.5	0.37	200–240V three-phase in/ 230V three-phase out	2.3	1	DC1-322D3NN-A20N
1	0.75		4.3	1	DC1-324D3NN-A20N
2	1.5		7	1	DC1-327D0NN-A20N
2	1.5		7	2	DC1-327D0NB-A20N ^④
3	2.2		10.5	2	DC1-32011NB-A20N ^④
5	4		18	3	DC1-32018NB-A20N ^④
1	0.75	380–480V three-phase in/ 460V three-phase out	2.2	1	DC1-342D2NN-A20N ^④
2	1.5		4.1	1	DC1-344D1NN-A20N ^④
2	1.5		4.1	2	DC1-344D1NB-A20N ^④
3	2.2		5.8	2	DC1-345D8NB-A20N ^④
5	4		9.5	2	DC1-349D5NB-A20N ^④
7.5	5.5		14	3	DC1-34014NB-A20N ^④
10	7.5		18	3	DC1-34018NB-A20N ^④
15	11		24	3	DC1-34024NB-A20N ^④

Notes

- ① These are constant torque/high overload rated drives.
- ② For all applications, select the unit such that the motor current is less than or equal to the rated continuous output current.
- ③ Brake chopper circuit available as standard in frames 2 and 3.
- ④ RFI version available. Substitute with DC1-*****F*-**** for this option.

IP66

DC1 Series IP66 Enclosure Drives ^①

hp ^②	kW	Volts	100% Continuous Current In (A)	Frame Size ^③	Catalog Number
0.5	0.37	115V single-phase in/ 115V single-phase out	7	1	DC1-S17D0NN-A6SN ^④
0.75	0.55		10.5	2	DC1-S1011NB-A6SN ^④
0.5	0.37	200–240V single-phase in/ 200–240V single-phase out	4.3	1	DC1-S24D3NN-A6SN ^{④⑤}
1	0.75		7	1	DC1-S27D0NN-A6SN ^{④⑤}
1.5	1.1		10	2	DC1-S2011NB-A6SN ^{④⑤}
0.5	0.37	115V single-phase in/ 230V three-phase out	2.3	1	DC1-1D2D3NN-A6SN ^④
1	0.75		4.3	1	DC1-1D4D3NN-A6SN ^④
1.5	1.1		5.8	2	DC1-1D5D8NB-A6SN ^④
0.5	0.37	200–240V single-phase in/ 230V three-phase out	2.3	1	DC1-122D3NN-A6SN ^{④⑤}
1	0.75		4.3	1	DC1-124D3NN-A6SN ^{④⑤}
2	1.5		7	1	DC1-127D0NN-A6SN ^{④⑤}
2	1.5		7	2	DC1-127D0NB-A6SN ^{④⑤}
3	2.2		10.5	2	DC1-12011NB-A6SN ^{④⑤}
5	4		15	3	DC1-12015NB-A6SN ^④
0.5	0.37	200–240V three-phase in/ 230V three-phase out	2.3	1	DC1-322D3NN-A6SN ^④
1	0.75		4.3	1	DC1-324D3NN-A6SN ^④
2	1.5		7	1	DC1-327D0NN-A6SN ^④
2	1.5		7	2	DC1-327D0NB-A6SN ^{④⑤}
3	2.2		10.5	2	DC1-32011NB-A6SN ^{④⑤}
5	4		18	3	DC1-32018NB-A6SN ^{④⑤}
1	0.75	380–480V three-phase in/ 460V three-phase out	2.2	1	DC1-342D2NN-A6SN ^{④⑤}
2	1.5		4.1	1	DC1-344D1NN-A6SN ^{④⑤}
2	1.5		4.1	2	DC1-344D1NB-A6SN ^{④⑤}
3	2.2		5.8	2	DC1-345D8NB-A6SN ^{④⑤}
5	4		9.5	2	DC1-349D5NB-A6SN ^{④⑤}
7.5	5.5		14	3	DC1-34014NB-A6SN ^{④⑤}
10	7.5		18	3	DC1-34018NB-A6SN ^{④⑤}

IP66S

**Notes**

- ① These are constant torque/high overload rated drives.
- ② For all applications, select the unit such that the motor current is less than or equal to the rated continuous output current.
- ③ Brake chopper circuit available as standard in frames 2 and 3.
- ④ Non-disconnect version available. Substitute with **-A6SN**.
- ⑤ RFI version available. Substitute with DC1-*****F*-**** for this option.

Accessories**DC1 Series****PC Communication Kit and Copy/Paste Module**

Description	Catalog Number
Bluetooth copy/paste communication stick	DX-COM-STICK
USB PC connection kit	DX-COM-PCKIT

Encoder Feedback Plug-In Option Module and Miscellaneous Cards

Description	Catalog Number
Local control/test option card	DXC-EXT-LOCSIM
HVACO drive running and tripped relay output card	DXC-EXT-2RO1AO
Dual relay output card	DXC-EXT-2RO
110V logic input card	DXC-EXT-IO110
230V logic input card	DXC-EXT-IO230

Remote Keypad

Description	Catalog Number
LED remote keypad—7-segment display, IP54 rated	DX-KEY-LED ①
OLED remote keypad—full text display, multi-line text, multi-language, IP54	DX-KEY-OLED ①

Extension Cables and Data Cable Splitter

Description	Catalog Number
RJ45 communication cable w/terminating resistor	DX-CBL-TERM
RS-485 data cable, RJ45, 0.5m	DX-CBL-RJ45-0M5
RS-485 data cable, RJ45, 1.0m	DX-CBL-RJ45-1M0
RS-485 data cable, RJ45, 3.0m	DX-CBL-RJ45-3M0
RS-485 three-way data cable splitter, RJ45	DX-SPL-RJ45-3SL
RS-485 data cable splitter, RJ45, (1 connector to 2 socket)	DX-SPL-RJ45-2SL1PL

SmartWire Modules

Description	Catalog Number
SmartWire-DT interface for DC1 IP20	DX-NET-SWD3

Note

① Includes 1m RS-485 data cable.

Technical Data and Specifications

DC1 Series

Ratings

PowerXL DC1 Basic Controller IP20 Standard Ratings

Description	Specification
Protections	
Overload protection	150% for 60s for every 600 seconds
Oversupply protection	Yes
Undervoltage protection	Yes
Ground fault protection	Yes
Overtemperature protection	Yes
Motor overload protection	Yes
Motor stall protection	Yes

Programmable Parameters

Description
Built-in Help card
14 Standard operation parameters
Reference scaling
Programmable start and stop functions
DC-brake at start and stop
Programmable V/Hz curve
Adjustable switching frequency
Autorestart function after fault
Protections and supervisions
Power section fault indication
External fault
Fieldbus communication
Second deceleration time
Analog input range selection, signal scaling and filtering
PI controller
Skip frequencies

Specifications

PowerXL DC1 Series Drives

Description	Specification
Input Ratings	
Input voltage (V_{in})	$\pm 10\%$
Input frequency (f_{in})	50/60 Hz (variation up to 48–62 Hz)
Connection to power	Maximum of one time every 30 seconds
Output Ratings	
Output voltage	0 to V_{in} ^①
Continuous output current	Continuous rated current I_N at ambient temperature max. 122°F (50°C), 150% for 60 seconds, 175% for 2 seconds
Output frequency	0 to 500 Hz
Frequency resolution	0.1 Hz
Initial output current (I_H)	175% for 2s for every 20 seconds Torque depends on motor
Control Characteristics	
Operation mode	U/f control, slip compensation
Switching frequency	4 to 32 kHz
Voltage reference	10 Vdc (max. 10 mA)
Field weakening point	0 to 500 Hz
Acceleration time	0.1 to 600 seconds
Deceleration time	0.1 to 600 seconds
Brake Resistor (Minimum Values) ^②	
230V Series	FS2 and FS3 47 ohms
400V Series	FS2 100 ohms, FS3 47 ohms
Ambient Conditions	
Ambient operating temperature	+14°F (−10°C), no frost to +122°F (+50°C); Rated loadability I_N IP20—NEMA 0
Storage temperature	−40°F (−40°C) to +140°F (+60°C)
Relative humidity	0 to 95% RH, noncondensing, non-corrosive, no dripping water
Enclosure class	IP20 (FS1–FS3)

Notes

① Exception: 115V single-phase in, 230V three-phase out.

② Only FS2 and FS3 drives are equipped with brake chopper circuit.

Standards—DC1 Series

2

I/O Specifications

- Digital inputs DI1–DI4 are programmable
- Digital, relay and analog outputs are programmable

- Includes:
- Four inputs (two digital and two digital/analog)
 - Analog inputs
 - 4–20 mA
 - 0–10V
 - One output (analog or digital)
 - One relay output
 - RS-485 interface

Reliability

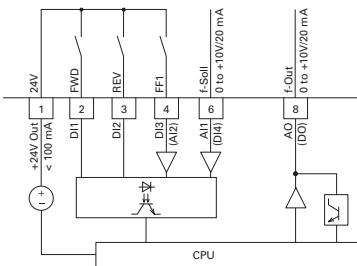
- Pretested components
- Computerized testing
- Final test with full load
- Conformal-coated boards
- Eaton's Electrical Services & Systems: national network of AF drive specialists

DC1 Series I/O Interface

Terminal	Signal	Factory Preset	Description
1	+24 Vdc	Control voltage for DI1–DI4	— Maximum load 100 mA Reference potential V
2	DI1	Digital Input 1	Start Enable FWD 8 to +30V (High, $R_1 > 6 \text{ k}\Omega$)
3	DI2	Digital Input 2	Start Enable REV 8 to +30V (High, $R_1 > 6 \text{ k}\Omega$)
4	DI3	Digital Input 3	Fixed frequency FF1 Digital: 8–30V (high)
	AI2	Analog Input 2	Analog: 0 to +10V ($R_i > 72 \text{ k}\Omega$) 0/4–20 mA ($R_B = 500 \Omega$) Can be switched with parameter P16
5	+10 Vdc	Reference voltage, Output (+10V)	— Maximum load 10 mA Reference potential OV
6	AI1	Analog Input 1	Frequency reference value ① (fixed frequency) Analog: 0 to +10V ($R_i > 72 \text{ k}\Omega$) 0/4–20 mA ($R_B = 500 \Omega$) Can be switched with parameter P16
	DI4	Digital Input 5	Frequency reference value ① (fixed frequency) Digital: 8–30V (high)
7	OV	Reference potential	— OV = connection terminal 9
8	AO1	Analog Output 1	Output frequency Analog: 0 to +10V, maximum 4–20 mA Can be switched with parameter P-25
	DO1	Digital Output 1	Output frequency Digital: 8 to +24V
9	OV	Reference potential	— OV connection terminal 7
10	K13	Relay 1, normally open contact	Active = RUN Maximum switching load: 250 Vac/6A or 30 Vdc/5A
11	K14	Relay 1, normally open contact	Active = RUN Maximum switching load: 250 Vac/6A or 30 Vdc/5A

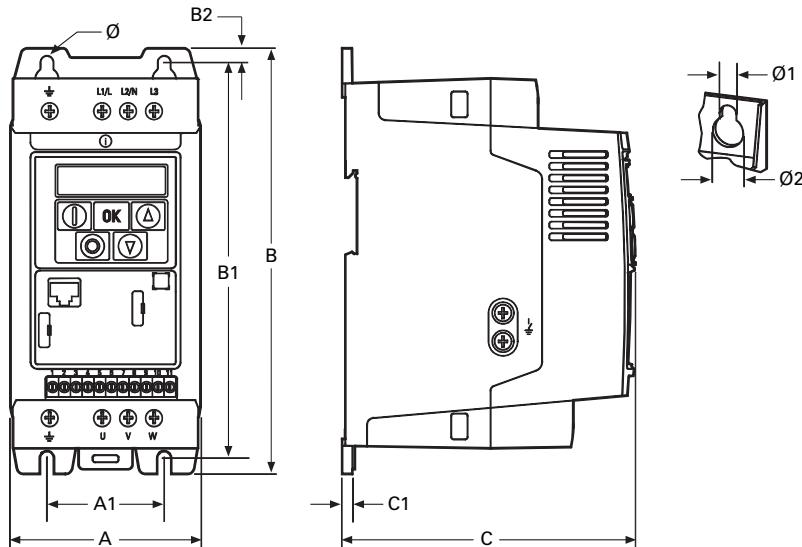
Note

- ① Programmable function.

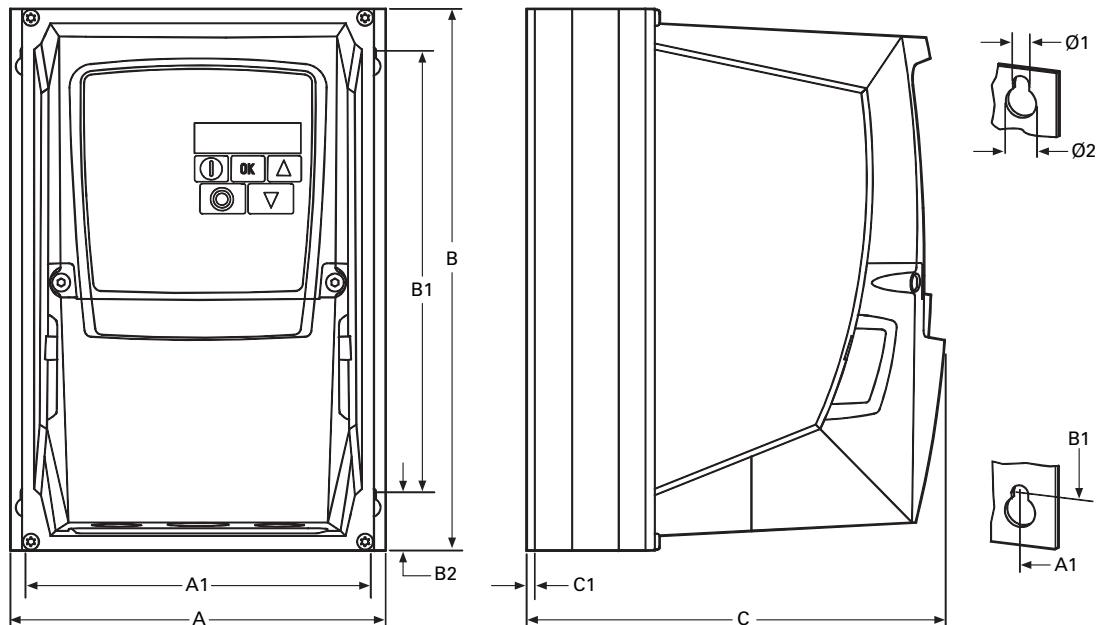


Dimensions

Approximate Dimensions in Inches (mm)

DC1, Sizes FS1–FS3, Degree of Protection IP20/NEMA 0

Frame Size	A	A1	B	B1	B2	C	C1	Ø1	Ø2	Weight lbs (kg)
FS1	3.19 (81.0)	1.97 (50.0)	7.24 (184.0)	6.69 (170.0)	0.28 (7.0)	4.88 (124.0)	0.16 (4.0)	0.24 (6.0)	0.47 (12.0)	2.43 (1.1)
FS2	4.21 (107.0)	2.95 (75.0)	9.09 (231.0)	8.46 (215.0)	0.31 (8.0)	5.98 (152.0)	0.20 (5.0)	0.24 (6.0)	0.47 (12.0)	5.73 (2.6)
FS3	5.16 (131.0)	3.94 (100.0)	10.75 (273.0)	10.04 (255.0)	0.33 (8.5)	6.89 (175.0)	0.20 (5.0)	0.24 (6.0)	0.47 (12.0)	8.82 (4.0)

DC1, Sizes FS1–FS3, Degree of Protection IP66/NEMA 4

Frame Size	A	A1	B	B1	B2	C	C1	Ø1	Ø2	Weight lbs (kg)
FS1	6.34 (161.0)	5.85 (148.5)	9.13 (232.0)	7.44 (189.0)	0.98 (25.0)	7.24 (184.0)	0.14 (3.5)	0.15 (4.0)	0.31 (8.0)	5.51 (2.5)
FS2	7.40 (188.0)	6.93 (176.0)	10.12 (257.0)	7.87 (200.0)	1.12 (28.5)	7.58 (192.0)	0.14 (3.5)	0.16 (4.2)	0.33 (8.5)	10.36 (4.7)
FS3	8.29 (210.5)	7.78 (197.5)	12.20 (310.0)	9.90 (251.5)	1.31 (33.4)	9.21 (234.0)	0.14 (3.5)	0.16 (4.2)	0.33 (8.5)	17.42 (7.9)

2.1

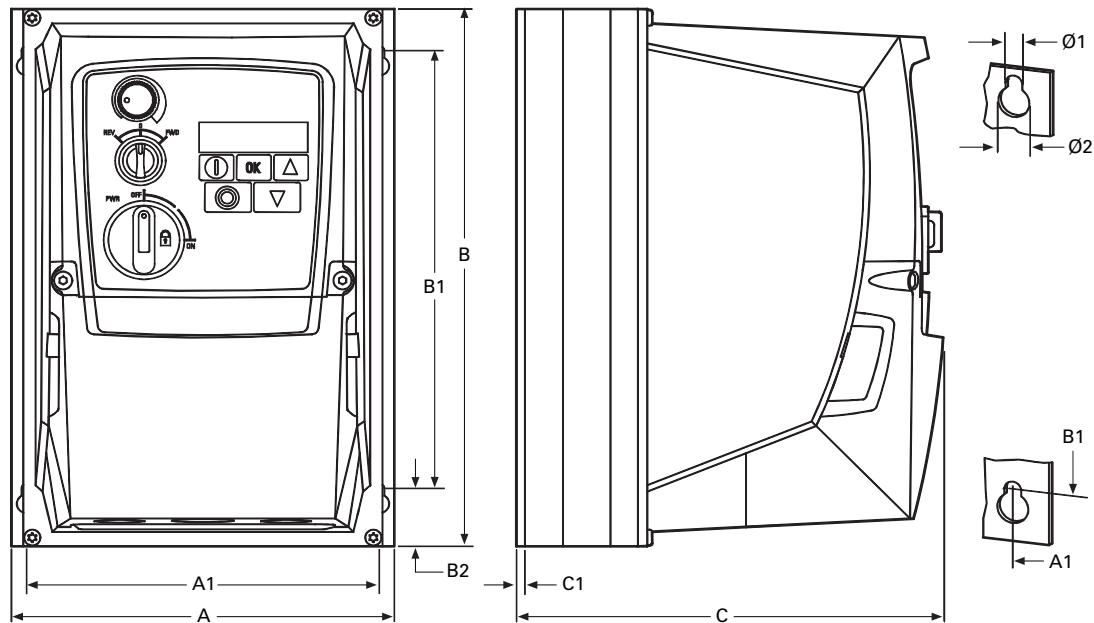
Adjustable Frequency Drives

PowerXL DC1 Series Drives

Approximate Dimensions in Inches (mm)

DC1, Sizes FS1–FS3, Degree of Protection IP66/NEMA 4, with Local Controls

2



Frame Size	A	A1	B	B1	B2	C	C1	Ø1	Ø2	Weight lbs (kg)
FS1	6.34 (161.0)	5.85 (148.5)	9.13 (232.0)	7.44 (189.0)	0.98 (25.0)	7.24 (184.0)	0.14 (3.5)	0.15 (4.0)	0.31 (8.0)	6.17 (2.8)
FS2	7.40 (188.0)	6.93 (176.0)	10.12 (257.0)	7.87 (200.0)	1.12 (28.5)	7.58 (192.0)	0.14 (3.5)	0.16 (4.2)	0.33 (8.5)	11.02 (5.0)
FS3	8.29 (210.5)	7.78 (197.5)	12.20 (310.0)	9.90 (251.5)	1.31 (33.4)	9.21 (234.0)	0.14 (3.5)	0.16 (4.2)	0.33 (8.5)	18.08 (8.2)

PowerXL DA1 Series Drives**Contents****Description**

	Page
PowerXL DA1 Series Drives	2
Catalog Number Selection	V6-T2-12
Product Selection	V6-T2-13
Accessories	V6-T2-15
Technical Data and Specifications	V6-T2-16
Dimensions	V6-T2-18

2

Product Description

Eaton's PowerXL™ DA1 variable frequency drives are the next generation of drives specifically engineered for today's machinery applications.

DA1 is the perfect match for demanding OEM applications. High-performance processor, safe torque off, multiple fieldbus protocols including SmartWire-DT, sensorless vector control and the possibility to operate permanent magnet motors are sure to leave a lasting impression.

Models rated at 480 volts, three-phase, 50/60 Hz are available in sizes ranging from 1 to 15 hp. Models rated at 240 volts, single- or three-phase, 50/60 Hz are available in sizes ranging from 0.5 to 7.5 hp. Models rated at 575 volts, three-phase, 50/60 Hz are available in sizes ranging from 1 to 20 hp.

Features

- Compact, space-saving design
- Rugged and reliable—200% for 4s 50°C rated
- DIN rail and screw mountable (FS1 and FS2)
- Side-by-side installation
- Industry-leading efficiency delivers energy savings to the customer
- Integrated EMC filters make the unit suitable for commercial and industrial networks
- Communication cards that integrate into the drive—
 - EtherNet/IP
 - DeviceNet
 - PROFIBUS-DP
 - EtherCAT
 - PROFINET
 - Modbus TCP
 - BACnet

Standards and Certifications**Product**

- Complies with EN61800-3 (2004)

EMC (At Default Settings)

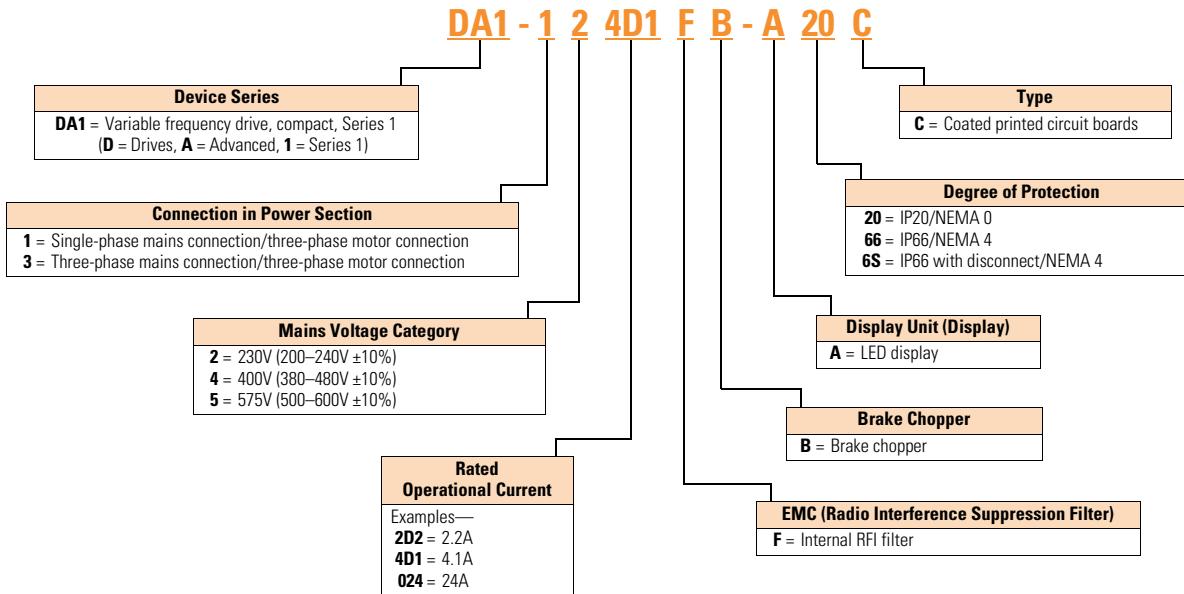
- EMC Category C1, C2 and C3 at default settings (1m, 5m, 25m)

Safety^①

- 61800-5-1
- EN 60529
- CE
- UL
- cUL
- UkrSepro
- c-Tick
- RoHS compliant

**Note**

- ① See unit nameplate for more detailed approvals.

Catalog Number Selection**2****DA1 Series Adjustable Frequency AC Drives**

Product Selection

IP20

DA1 Series IP20 Enclosure Drives ^①

hp ^②	kW	Volts	100% Continuous Current In (A)	Frame Size ^③	Catalog Number
1	0.75	200–240V single-phase in/ 230V three-phase out	4.3	2	DA1-124D3FB-A20C
2	1.5		7	2	DA1-127D0FB-A20C
3	2.2		10.5	2	DA1-12011FB-A20C
1	0.75	200–240V three-phase in/ 230V three-phase out	4.3	2	DA1-324D3FB-A20C
2	1.5		7	2	DA1-327D0FB-A20C
3	2.2		10.5	2	DA1-32011FB-A20C
5	4		18	3	DA1-32018FB-A20C
7.5	5.5		24	3	DA1-32024FB-A20C
1	0.75	380–480V three-phase in/ 460V three-phase out	2.2	2	DA1-342D2FB-A20C
2	1.5		4.1	2	DA1-344D1FB-A20C
3	2.2		5.8	2	DA1-345D8FB-A20C
5	4		9.5	2	DA1-349D5FB-A20C
7.5	5.5		14	3	DA1-34014FB-A20C
10	7.5		18	3	DA1-34018FB-A20C
15	11		24	3	DA1-34024FB-A20C
1	0.75	500–600V three-phase in/ 575V three-phase out	2.1	2	DA1-352D1NB-A20C
2	4.5		3.1	2	DA1-353D1NB-A20C
3	2.2		4.1	2	DA1-354D1NB-A20C
5	4		6.5	2	DA1-356D5NB-A20C
7.5	5.5		9	2	DA1-359D0NB-A20C
10	7.5		12	3	DA1-35012NB-A20C
15	11		17	3	DA1-35017NB-A20C
20	15		22	3	DA1-35022NB-A20C

Notes

- ^① These are constant torque/high overload rated drives.
^② For all applications, select the unit such that the motor current is less than or equal to the rated continuous output current.
^③ Brake chopper circuit available as standard in frames 2 and 3.

IP66

2

DA1 Series IP66 Enclosure Drives ^①

hp ^②	kW	Volts	100% Continuous Current In (A)	Frame Size ^③	Catalog Number
1	0.75	200–240V single-phase in/ 230V three-phase out	4.3	2	DA1-124D3FB-A6SC ^④
2	1.5		7	2	DA1-127D0FB-A6SC ^④
3	2.2		10.5	2	DA1-12011FB-A6SC ^④
1	0.75	200–240V three-phase in/ 230V three-phase out	4.3	2	DA1-324D3FB-A6SC ^④
2	1.5		7	2	DA1-327D0FB-A6SC ^④
3	2.2		10.5	2	DA1-32011FB-A6SC ^④
5	4		18	3	DA1-32018FB-A6SC ^④
1	0.75	380–480V three-phase in/ 460V three-phase out	2.2	2	DA1-342D2FB-A6SC ^④
2	1.5		4.1	2	DA1-344D1FB-A6SC ^④
3	2.2		5.8	2	DA1-345D8FB-A6SC ^④
5	4		9.5	2	DA1-349D5FB-A6SC ^④
7.5	5.5		14	3	DA1-34014FB-A6SC ^④
10	7.5		18	3	DA1-34018FB-A6SC ^④
1	0.75	500–600V three-phase in/ 575V three-phase out	2.1	2	DA1-352D1NB-A6SC
2	4.5		3.1	2	DA1-353D1NB-A6SC
3	2.2		4.1	2	DA1-354D1NB-A6SC
5	4		6.5	2	DA1-356D5NB-A6SC
7.5	5.5		9	2	DA1-359D0NB-A6SC
10	7.5		12	3	DA1-35012NB-A6SC
15	11		17	3	DA1-35017NB-A6SC

IP66S

**Notes**

- ① These are constant torque/high overload rated drives.
- ② For all applications, select the unit such that the motor current is less than or equal to the rated continuous output current.
- ③ Brake chopper circuit available as standard in frames 2 and 3.
- ④ Non-disconnect version available. Substitute with **-A66C**.

Accessories

DA1 Series

PC Communication Kit and Copy/Paste Module

Description	Catalog Number
Bluetooth copy/paste communication stick	DX-COM-STICK
USB PC connection kit	DX-COM-PCKIT

Optional Communication Modules

Description	Catalog Number
DeviceNet plug-in interface module	DX-NET-DEVICENET
PROFIBUS-DP plug-in interface module	DX-NET-PROFIBUS
EtherNet/IP plug-in interface module	DX-NET-ETHERNET-2
EtherCAT plug-in interface module	DX-NET-ETHERCAT-2
PROFINET plug-in interface module	DX-NET-PROFINET-2
Modbus TCP plug-in interface module	DX-NET-MODBUSTCP-2
BACnet plug-in interface module	DX-NET-BACNETIP-2

Encoder Feedback Plug-In Option Module and Miscellaneous Cards

Description	Catalog Number
Relay output option module	DXA-EXT-3RO
Encoder feedback plug-in option module	DXA-EXT-ENCOD

Remote Keypad

Description	Catalog Number
LED remote keypad—7-segment display, IP54 rated	DX-KEY-LED ①
OLED remote keypad—full text display, multi-line text, multi-language, IP54	DX-KEY-OLED ①

Extension Cables and Data Cable Splitter

Description	Catalog Number
RJ45 communication cable w/terminating resistor	DX-CBL-TERM
RS-485 data cable, RJ45, 0.5m	DX-CBL-RJ45-0M5
RS-485 data cable, RJ45, 1.0m	DX-CBL-RJ45-1M0
RS-485 data cable, RJ45, 3.0m	DX-CBL-RJ45-3M0
RS-485 three-way data cable splitter, RJ45	DX-SPL-RJ45-3SL
RS-485 data cable splitter, RJ45, (1 connector to 2 socket)	DX-SPL-RJ45-2SL1PL

SmartWire Modules

Description	Catalog Number
SmartWire-DT interface for DA1 IP20	DX-NET-SWD1

Note

① Includes 1m RS-485 data cable.

Technical Data and Specifications

DA1 Series

2

Ratings

PowerXL DA1 Basic Controller IP20 Standard Ratings

Description	Specification
Protections	
Overload protection	150% for 60s for every 600 seconds
Oversupply protection	Yes
Undervoltage protection	Yes
Ground fault protection	Yes
Overtemperature protection	Yes
Motor overload protection	Yes
Motor stall protection	Yes

Programmable Parameters

Description
Built-in Help card
14 Standard operation parameters
Reference scaling
Programmable start and stop functions
DC-brake at start and stop
Programmable V/Hz curve
Adjustable switching frequency
Autorestart function after fault
Protections and supervisions
Power section fault indication
External fault
Fieldbus communication
Safe torque off (STO) function
Analog input range selection, signal scaling and filtering
PI controller
Skip frequencies

Specifications

PowerXL DA1 Series Drives

Description	Specification
Input Ratings	
Input voltage (V_{in})	$\pm 10\%$
Input frequency (f_{in})	50/60 Hz (variation up to 48–62 Hz)
Connection to power	Maximum of one time every 30 seconds
Output Ratings	
Output voltage	0 to V_{in} ^①
Continuous output current	Continuous rated current I_N at ambient temperature max. 122°F (50°C), 150% for 60 seconds, 200% for 4 seconds
Output frequency	0 to 500 Hz
Frequency resolution	0.1 Hz
Initial output current (I_H)	200% for 4s for every 40 seconds Torque depends on motor
Control Characteristics	
Operation mode	U/f control, slip compensation, sensorless vector control (SLV), vector control with feedback (CLV)
Switching frequency	4 to 32 kHz
Voltage reference	10 Vdc (max. 10 mA)
Field weakening point	0 to 500 Hz
Acceleration time	0.1 to 600 seconds
Deceleration time	0.1 to 600 seconds
Brake Resistor (Minimum Values) ^②	
230V Series	FS2 and FS3 15 ohms
400V Series	FS2 33 ohms, FS3 22 ohms
Ambient Conditions	
Ambient operating temperature	+14°F (−10°C), no frost to +122°F (+50°C); Rated loadability I_N IP20—NEMA 0
Storage temperature	−40°F (−40°C) to +140°F (+60°C)
Relative humidity	0 to 95% RH, noncondensing, non-corrosive, no dripping water
Enclosure class	IP20 (FS1–FS3)

Notes

^① Exception: 115V single-phase in, 230V three-phase out.

^② Only FS2 and FS3 drives are equipped with brake chopper circuit.

Standards—DA1 Series**I/O Specifications**

- Digital inputs DI1–DI5 are programmable
- Digital, relay and analog outputs are programmable

- Includes:
- Five inputs (three digital and two digital/analog)
 - Analog inputs
 - 4–20 mA
 - 0–10V
 - Two outputs (analog or digital)
 - Two relay outputs
 - RS-485 interface

Reliability

- Pretested components
- Computerized testing
- Final test with full load
- Conformal-coated boards
- Eaton's Electrical Services & Systems: national network of AF drive specialists

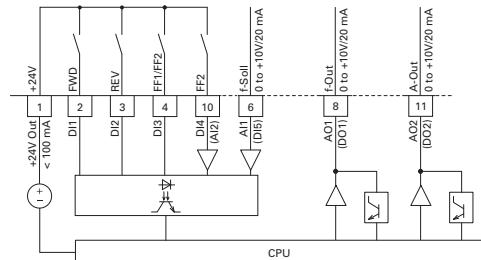
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DA1 Series I/O Interface

Terminal	Signal	Factory Preset	Description
1	+24 Vdc	Control voltage for DI1–DI5	— Maximum load 100 mA Reference potential V
2	DI1	Digital Input 1	Start Enable FWD ① 8 to +30V (High, $R_i > 6 \text{ k}\Omega$)
3	DI2	Digital Input 2	Start Enable REV ① 8 to +30V (High, $R_i > 6 \text{ k}\Omega$)
4	DI3	Digital Input 3	Fixed frequency FF1/FF2 ① 8 to +30V (High, $R_i > 6 \text{ k}\Omega$)
5	+10 Vdc	Reference voltage, Output (+10V)	— Maximum load 10 mA Reference potential 0V
6	AI1	Analog Input 1	Frequency reference value ① Analog: 0 to +10V ($R_i > 72 \text{ k}\Omega$) 0/4–20 mA ($R_i = 500 \Omega$) Can be switched with parameter P2-30
	DI4	Digital Input 5	Frequency reference value ① Digital: 8–30V (high)
7	0V	Reference potential	0V = connection terminal 9
8	A01	Analog Output 1	Output frequency Analog: 0 to +10V, maximum 20 mA Can be switched with parameter P2-11
	DO1	Digital Output 1	Output frequency Digital: 8–24V
9	0V	Reference potential	0V connection terminal 7
10	DI4	Digital Input 4	Fixed frequency FF2 ① Analog: 0 to +10V ($R_i > 72 \text{ k}\Omega$) 0/4–20 mA ($R_i = 500 \Omega$) Can be switched with parameter P2-30
	AI2	Analog Input 2	Digital: 8–30V (high)
11	A02	Analog output 2	Output current ① Analog: 0 to +10V, maximum 4–20 mA Can be switched with parameter P2-11
	DO2	Digital output 2	Output current ① Digital: 8–24V
12	STO+	Safe Torque Off +	— Enable = +24V
13	STO-	Safe Torque Off –	— Enable = 0V
14	K11	Relay 1, changeover contact	Active = FAULT ① Maximum switching load: 250 Vac/6A or 30 Vdc/5A
15	K14	Relay 1, changeover contact (N/O)	Active = FAULT ① Maximum switching load: 250 Vac/6A or 30 Vdc/5A
16	K12	Relay 1, changeover contact (N/C)	Active = FAULT ① Maximum switching load: 250 Vac/6A or 30 Vdc/5A
17	K23	Relay 2, N/O contact	Active = FAULT ① Maximum switching load: 250 Vac/6A or 30 Vdc/5A
18	K24	Relay 2, N/C contact	Active = FAULT ① Maximum switching load: 250 Vac/6A or 30 Vdc/5A

Note

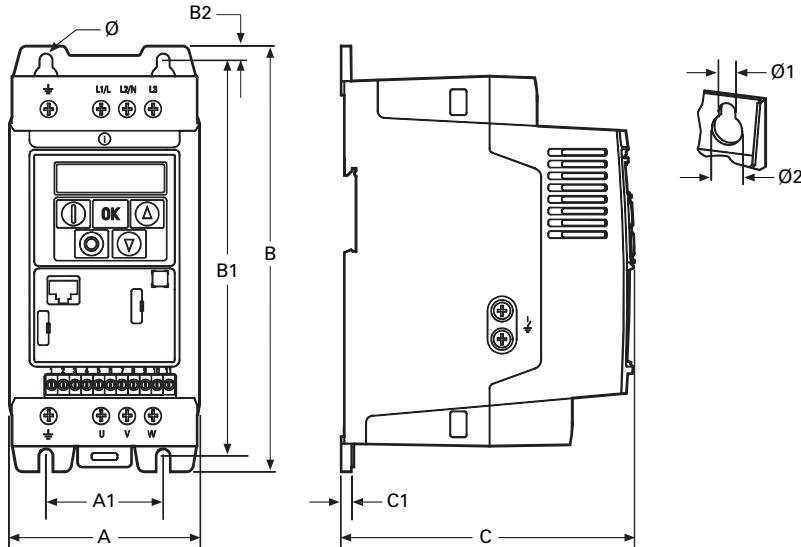
① Programmable function.



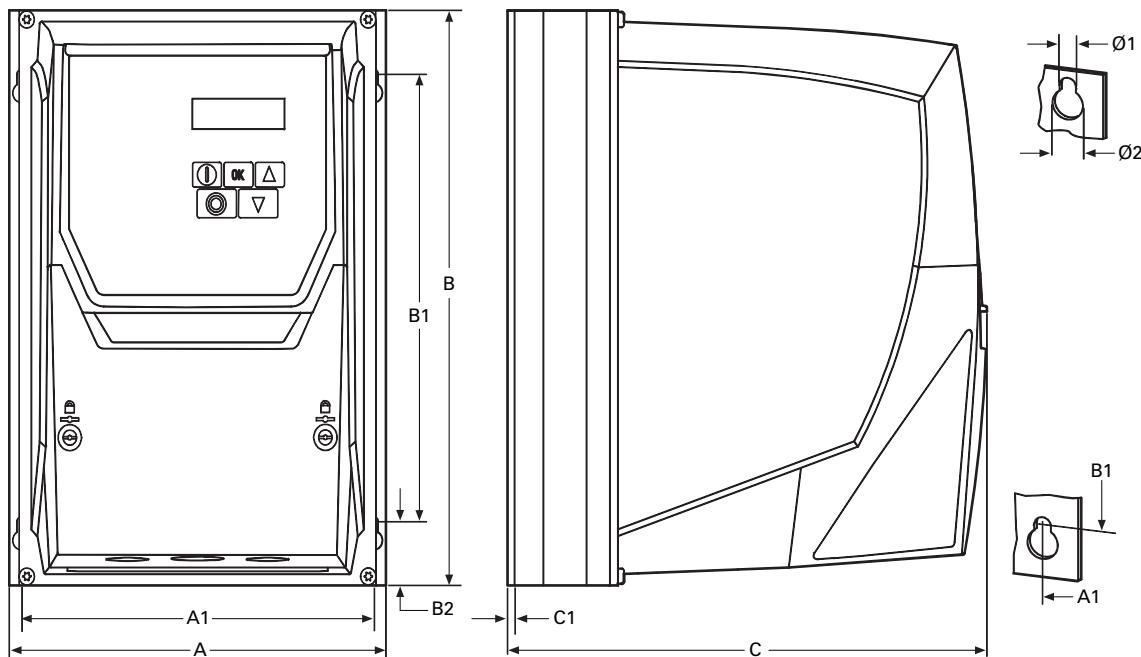
Dimensions

Approximate Dimensions in Inches (mm)

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DA1, Sizes FS2 and FS3, Degree of Protection IP20/NEMA 0

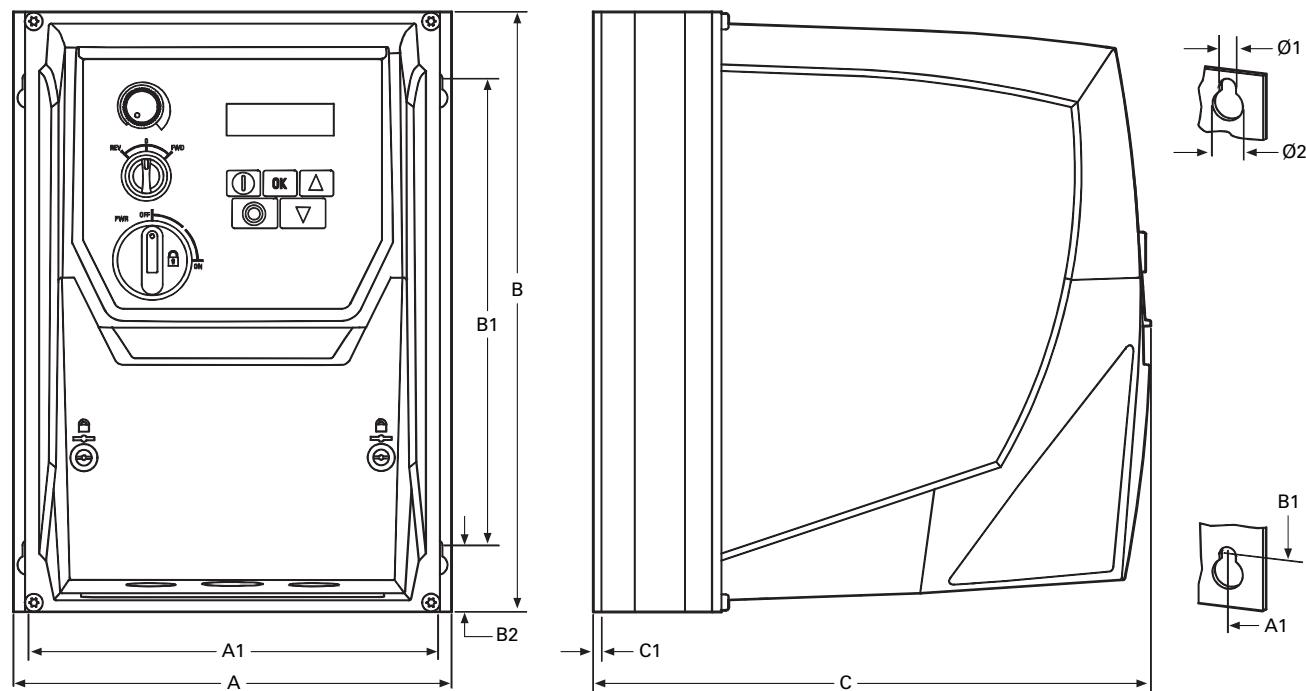
Frame Size	A	A1	B	B1	B2	C	C1	Ø1	Ø2	Weight lbs (kg)
FS2	4.21 (107.0)	2.95 (75.0)	9.09 (231.0)	8.46 (215.0)	0.31 (8.0)	7.32 (186.0)	0.20 (5.0)	0.24 (6.0)	0.47 (12.0)	3.97 (1.8)
FS3	5.16 (131.0)	3.94 (100.0)	10.75 (273.0)	10.04 (255.0)	0.33 (8.5)	8.03 (204.0)	0.20 (5.0)	0.24 (6.0)	0.47 (12.0)	7.72 (3.5)

DA1, Sizes FS2 and FS3, Degree of Protection IP66/NEMA 4

Frame Size	A	A1	B	B1	B2	C	C1	Ø1	Ø2	Weight lbs (kg)
FS2	7.40 (188.0)	6.93 (176.0)	10.12 (257.0)	7.87 (200.0)	0.79 (20.0)	9.42 (239.3)	0.14 (3.5)	0.16 (4.2)	0.33 (8.5)	10.4 (4.5)
FS3	8.29 (211.0)	7.78 (198.0)	12.20 (310.0)	9.90 (252.0)	0.98 (25.0)	10.48 (266.3)	0.14 (3.5)	0.16 (4.2)	0.33 (8.5)	15.9 (7.0)

Approximate Dimensions in Inches (mm)

DA1, Sizes FS2 and FS3, Degree of Protection IP66/NEMA 4, with Local Controls



Frame Size	A	A1	B	B1	B2	C	C1	Ø1	Ø2	Weight lbs (kg)
FS2	7.40 (188.0)	6.93 (176.0)	10.12 (257.0)	7.87 (200.0)	0.79 (20.0)	9.42 (239.3)	0.14 (3.5)	0.16 (4.2)	0.33 (8.5)	10.6 (4.8)
FS3	8.29 (211.0)	7.78 (198.0)	12.20 (310.0)	9.90 (252.0)	0.98 (25.0)	10.48 (266.3)	0.14 (3.5)	0.16 (4.2)	0.33 (8.5)	16.1 (7.3)

M-Max Series Drives for Machinery Applications**2****Product Description**

Eaton's M-Max™ Series Sensorless Vector Adjustable Frequency AC Drives are the next generation of drives specifically engineered for today's machinery applications. These micro-processor-based drives have standard features that can be programmed to tailor the drive's performance to suit a wide variety of application requirements. The M-Max product line uses a 32-bit microprocessor and insulated gate bipolar transistors (IGBTs) that provide quiet motor operation, high motor efficiency, and smooth low-speed performance. The size and simplicity of the M-Max make it ideal for hassle-free installation. Models rated at 575 volts, three-phase, 50/60 Hz are available in sizes ranging from 1 to 7-1/2 hp. Models rated at 480 volts, three-phase, 50/60 Hz are available in sizes ranging from 1/2 to 25 hp. Models rated at 240 volts, single- or three-phase, 50/60 Hz are available in sizes ranging from 1/4 to 15 hp. Models rated at 115 volts, single-phase, 50/60 Hz are available in the 1/4 to 1-1/2 hp size range.

The standard drive includes a digital display, and operating and programming keys on a visually appealing, efficient application programming interface. The display provides drive monitoring, as well as adjustment and diagnostic information. The keys are used for digital adjustment and programming of the drive, as well as for operator control. Separate terminal blocks for control and power wiring are provided for customer connections.

Contents**Description****Page**

M-Max Series Drives	V6-T2-21
Catalog Number Selection	V6-T2-22
Product Selection	V6-T2-23
Accessories	V6-T2-24
Technical Data and Specifications	V6-T2-25
Dimensions	V6-T2-26

Features

- Ease of use—preset application macros, startup wizard, diagnostic capabilities
- Compact, space-saving design
- Rugged and reliable—150% torque for one minute, 50C rated, conformal coated boards
- DIN rail and screw mountable
- Side-by-side installation
- Industry leading efficiency delivers energy savings to the customer
- Integrated 5% DC choke (FS4 and FS5)
- Integrated EMC filters make the unit suitable for commercial and industrial networks
- IP21 as standard, option for NEMA® 1 (FS4 and FS5)
- IP20 as standard, option for IP21 and NEMA 1 (FS1–FS3)
- Brake chopper as standard in three-phase, applications of frames 2 (FS2) and larger
- Temperature-controlled fan
- RS-485/Modbus® as standard
- PID controller as standard
- Several fieldbus options

Standards and Certifications**Product**

- Complies with EN61800-3 (2004)

EMC (At Default Settings)

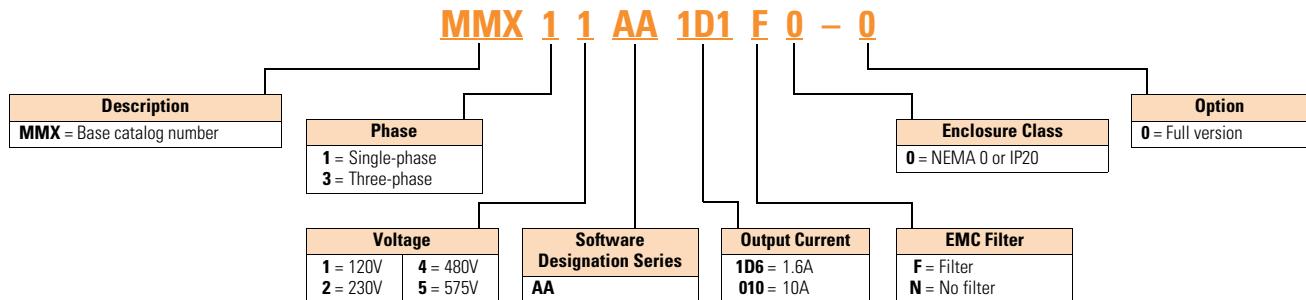
- EMC Category C2, C3, and C4 (Level H): With an internal RFI filter option

Safety^①

- 61800-5-1
- EN60204-1
- CE
- UL
- cUL
- IEC
- RoHS compliant

**Note**

^① See unit nameplate for more detailed approvals.

Catalog Number Selection

Product Selection

2

M-Max



M-Max Basic Controller

hp ⁽¹⁾	Volts ⁽²⁾	100% Continuous Current I _N (A)	Nominal Input Current (A)	Frame Size	Catalog Number
1/4	100–120V single-phase in 230V three-phase out	1.7	9.2	FS2	MMX11AA1D7F0-0
1/2		2.4	11.6		MMX11AA2D4F0-0
3/4		2.8	12.4		MMX11AA2D8F0-0
1		3.7	15		MMX11AA3D7F0-0
1-1/2		4.8	16.5	FS3	MMX11AA4D8F0-0
1/4	200–240V single-phase in 230V three-phase out	1.7	4.2	FS1	MMX12AA1D7F0-0 ⁽³⁾
1/2		2.4	5.7		MMX12AA2D4F0-0 ⁽³⁾
3/4		2.8	6.6		MMX12AA2D8F0-0 ⁽³⁾
1		3.7	8.3	FS2	MMX12AA3D7F0-0 ⁽³⁾
1-1/2		4.8	11.2		MMX12AA4D8F0-0 ⁽³⁾
2		7	14.1		MMX12AA7D0F0-0 ⁽³⁾
3		9.6	15.8	FS3	MMX12AA9D6F0-0 ⁽³⁾
1/4	200–240V three-phase in 230V three-phase out	1.7	2.7	FS1	MMX32AA1D7F0-0
1/2		2.4	3.5		MMX32AA2D4F0-0
3/4		2.8	3.8		MMX32AA2D8F0-0
1		3.7	4.3	FS2	MMX32AA3D7F0-0
1-1/2		4.8	6.8		MMX32AA4D8F0-0
2		7	8.4		MMX32AA7D0N0-0
3		11	13.4	FS3	MMX32AA011N0-0
5		17	17	FS4	MMX32AA017F0-0 ⁽⁴⁾
7-1/2		25	25		MMX32AA025F0-0 ⁽⁴⁾
10		31	31	FS5	MMX32AA031F0-0 ⁽⁴⁾
15		38	38		MMX32AA038F0-0 ⁽⁴⁾
1/2	380–480V three-phase in 460V three-phase out	1.3	2.2	FS1	MMX34AA1D3F0-0 ⁽³⁾
3/4		1.9	2.8		MMX34AA1D9F0-0 ⁽³⁾
1		2.4	3.2		MMX34AA2D4F0-0 ⁽³⁾
1-1/2		3.3	4	FS2	MMX34AA3D3F0-0 ⁽³⁾
2		4.3	5.6		MMX34AA4D3F0-0 ⁽³⁾
3		5.6	7.3		MMX34AA5D6F0-0 ⁽³⁾
4		7.6	9.6	FS3	MMX34AA7D6F0-0 ⁽³⁾
5		9	11.5		MMX34AA9D0F0-0 ⁽³⁾
7-1/2		12	14.9		MMX34AA012F0-0 ⁽³⁾
10		14	18.7		MMX34AA014F0-0 ⁽³⁾
10		16	16	FS4	MMX34AA016F0-0 ⁽⁴⁾
15		23	23		MMX34AA023F0-0 ⁽⁴⁾
20		31	31	FS5	MMX34AA031F0-0 ⁽⁴⁾
25		38	38		MMX34AA038F0-0 ⁽⁴⁾
1	575V three-phase in	1.7	2.0	FS3	MMX35AA1D7F0-0
2	575V three-phase out	2.7	3.6		MMX35AA2D7F0-0
3		3.9	5.0		MMX35AA3D9F0-0
5		6.1	7.6		MMX35AA6D1N0-0
7-1/2		9.0	10.4		MMX35AA9D0N0-0

Notes

⁽¹⁾ Horsepower ratings are based on the use of a 240V, 460V, and 575V NEMA B, four- or six-pole squirrel cage induction motor and are for reference only.

Units are to be selected such that the motor current is less than or equal to the MMX rated continuous output current.

⁽²⁾ For 208V, 380V, or 415V applications, select the unit such that the motor current is less than or equal to the MMX rated continuous output current.

⁽³⁾ Units are also available without EMC filters. Substitute -NO-0 for this option.

⁽⁴⁾ Units are also available without EMC filters and 5% DC choke. Substitute -NO-0 for this option.

Accessories

M-Max Copy/Paste Module

Description	Catalog Number
Module is plugged onto the front of the drive to provide: upload/download of all parameters, direct link to a PC via USB interface for parameter assignment via MaxConnect software, and copying of parameters for a series of devices or when exchanging devices. No PC required	MMX-COM-PC

PC Cable

Description	Catalog Number
Remote download USB to RJ-45 cable with software driver disk	REM-USB-DOWN

NEMA Type 1 Kits ^①

Description	Catalog Number
NEMA Type 1 and IP21 kit for frame 1	MMX-IP21-FS1
NEMA Type 1 and IP21 kit for frame 2	MMX-IP21-FS2
NEMA Type 1 and IP21 kit for frame 3	MMX-IP21-FS3
NEMA Type 1 for frame 4	MMX-CKIT-FS4
NEMA Type 1 for frame 5	MMX-CKIT-FS5

Optional Communication Modules ^②

Description	Catalog Number
Communication adapter kit (FS1–FS3)	MMX-NET-XA
Communication adapter kit (FS4 and FS5)	MMX-NET-XA-45
PROFIBUS DP network card with serial connection	XMX-NET-PS-A
PROFIBUS DP network card with Sub-D connection	XMX-NET-PD-A
DeviceNet network card	XMX-NET-DN-A

Remote Keypad ^③

Description	Catalog Number
Keypad, bezel and cable	OPTRMT-BP-HMAX
Remote copy/paste keypad	MMX-REMKEY-TEXT
VFD adapter	MMX-ADAPTER-RJ45

Notes

- ① NEMA Type 1 kit provides conduit entry plate.
- ② Additional input and output reactors are available. Consult Eaton representative for a complete listing.
- ③ All three components are required for remote keypad operation.

Technical Data and Specifications

Ratings

M-Max Basic Controller IP20 Standard Ratings

Description	Specification
Protections	
Overscurrent protection	Trip limit $4.0 \times I_H$ instantaneously
Oversupply protection	115/230V series: 437 Vdc; 400V series: 874 Vdc; 575V series: 1048 Vdc trip level
Undervoltage protection	115/230V series: 183 Vdc; 400V series: 333 Vdc; 575V series: 460 Vdc trip level
Ground fault protection	Ground fault is tested before every start. In case of ground fault in motor or motor cable, only the frequency converter is protected
Overtemperature protection	Yes
Motor overload protection	Yes
Motor stall protection	Yes
Motor underload protection	Yes

Programmable Parameters

Description
Application macros: basic, pump, fan and high load (hoist)
Programmable start/stop and reverse signal logic (sinking or sourcing)
Reference scaling
Programmable start and stop functions
DC-brake at start and stop
Programmable V/Hz curve
Adjustable switching frequency
Autorestart function after fault
Protections and supervisions (all fully programmable; off, warning, fault)
Current signal input fault
External fault
Fieldbus communication
Eight preset speeds
Analog input range selection, signal scaling and filtering
PID controller
Skip frequencies

Specifications

M-Max Series Drives

Description	Specification
Input Ratings	
Input voltage (V_{in})	+10%/-15%
Input frequency (f_{in})	50/60 Hz (variation up to 45–66 Hz)
Connection to power	Once per minute or less (typical operation)
Output Ratings	
Output voltage	0 to V_{in} ①
Continuous output current	Continuous rated current I_N at ambient temperature max. 122°F (50°C), overload $1.5 \times I_N$ max. 1 min/10 min
Output frequency	0 to 320 Hz
Frequency resolution	0.01 Hz
Initial output current (I_H)	Current $2 \times I_H$ for 2 seconds in every 20-second period Torque depends on motor
Control Characteristics	
Control method	Frequency control (V/Hz) open loop or sensorless vector control
Switching frequency	1.5 to 16 kHz; default 4 kHz
Frequency reference	Analog input: resolution 0.1% (10-bit), accuracy $\pm 1\%$ V/Hz Panel reference: resolution 0.01 Hz
Field weakening point	30 to 320 Hz
Acceleration time	0 to 3000 sec
Deceleration time	0 to 3000 sec
Braking torque	DC brake: $30\% \times T_n$ (without brake option)
Brake Resistor (Minimum Values) ②	
230V Series	FS2 35 ohms and FS3 26 ohms, FS4 14 ohms, FS5 9 ohms
400V Series	FS2 75 ohms and FS3 54 ohms, FS4 28 ohms, FS5 17 ohms
575V Series	FS3 103 ohms
Ambient Conditions	
Ambient operating temperature	14°F (-10°C), no frost to 122°F (+50°C); Rated loadability I_N
Storage temperature	-40°F (-40°C) to 158°F (70°C)
Relative humidity	0 to 95% RH, noncondensing, non-corrosive, no dripping water
Air quality	Chemical vapors: IEC 721-3-3, unit in operation, Class 3C2; Mechanical particles: IEC 721-3-3, unit in operation, Class 3S2
Altitude	100% load capacity (no derating) up to 3280 ft (1000m); 1% derating for each 328 ft (100m) above 3280 ft (1000m); max. 6560 ft (2000m)
Vibration	EN 60068-2-6; 3 to 150 Hz, displacement amplitude 1 mm (peak) at 3 to 15.8 Hz, max. acceleration amplitude 1G at 15.8 to 150 Hz
Shock	EN 50178, IEC 68-2-27 UPS Drop test (for applicable UPS weights); storage and shipping: max. 15G, 11 ms (in package)
Enclosure class	IP20 (FS1–FS3) IP21 (FS4 and FS5)

Notes

① Exception: 115V single-phase in, 230V three-phase out.

② Only three-phase FS2 and FS3 drives are equipped with brake chopper circuit.

Standards

I/O Specifications

- Digital inputs DI1–DI6 are freely programmable. The user can assign multiple functions to a single input
- Digital, relay, and analog outputs are freely programmable

- Includes:
- Six digital inputs
 - Two analog inputs
 - 4–20 mA
 - 0–10V
 - One analog output
 - One digital output
 - Two relay outputs
 - RS-485 interface

Reliability

- Pretested components
- Computerized testing
- Final test with full load
- Conformal-coated boards
- Eaton's Electrical Services & Systems: national network of AF drive specialists

M-Max I/O Interface

Terminal	Signal	Factory Preset	Description
1	+10V	Ref. output voltage	— Maximum load 10 mA
2	AI1	Analog signal in 1	Freq. reference ^{P)} 0–10V Ri = 200k ohms [min.]
3	GND	I/O signal ground	—
6	24V	24V output for DIs	±20%, max. load 50 mA
7	GND	I/O signal ground	—
8	DI1	Digital input 1	Start forward ^{P)} 0–30V Ri = 12k ohms min.
9	DI2	Digital input 2	Start reverse ^{P)} —
10	DI3	Digital input 3	Preset speed ^{P)} —
A	A	RS-485 signal A	FB communication
B	B	RS-485 signal B	FB communication
4	AI2	Analog signal in 2	PI actual value ^{P)} 0[4]–20 mA, Ri = 200k ohms
5	GND	I/O signal ground	—
13	GND	I/O signal ground	—
14	DI4	Digital input 4	Preset speed B1 ^{P)} 0–30V Ri = 12k ohms min.
15	DI5	Digital input 5	Fault reset ^{P)} 0–30V Ri = 12k ohms min.
16	DI6	Digital input 6	Disable PI contr. ^{P)} 0–30V Ri = 12k ohms min.
18	AO	Analog output	Output frequency ^{P)} 0(2)–10V, RL = 500 ohms
20	DO	Digital signal out	Active = READY ^{P)} Open collector, max. load 48V/50 mA
22	R011	Relay out 1	Active = RUN ^{P)} Max. switching load: 250 Vac/2A or 250 Vdc/0.4A
23	R012	Relay out 2	Active = FAULT ^{P)} Max. switching load: 250 Vac/2A or 250 Vdc/0.4A
24	R021	Relay out 3	—
25	R022	Relay out 4	—
26	R023	Relay out 5	—

Note

P) Parameter-selectable function.

2.3

Adjustable Frequency Drives

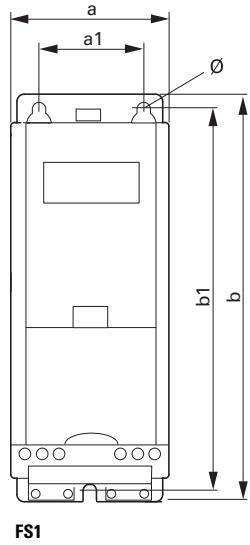
M-Max Series Drives

Dimensions

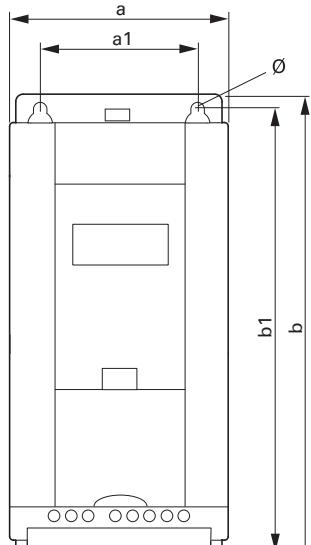
Approximate Dimensions in Inches (mm)

2

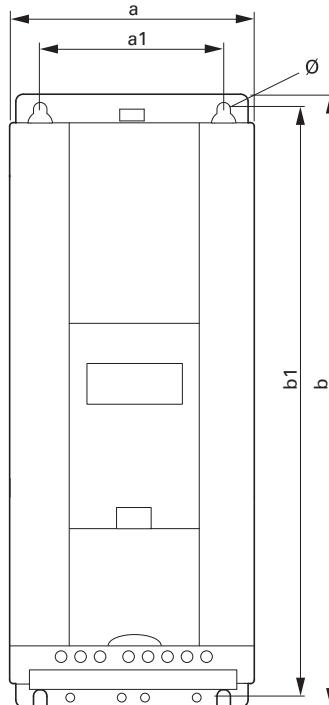
Dimensions and Frame Sizes, FS1-FS3 (FS = Frame Size)



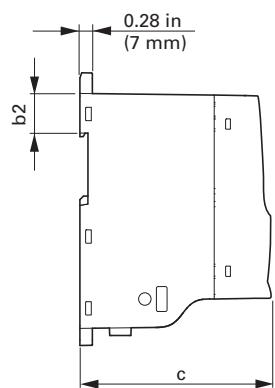
FS1



FS2

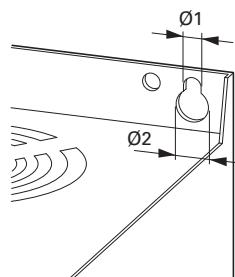
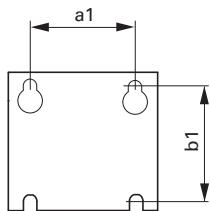
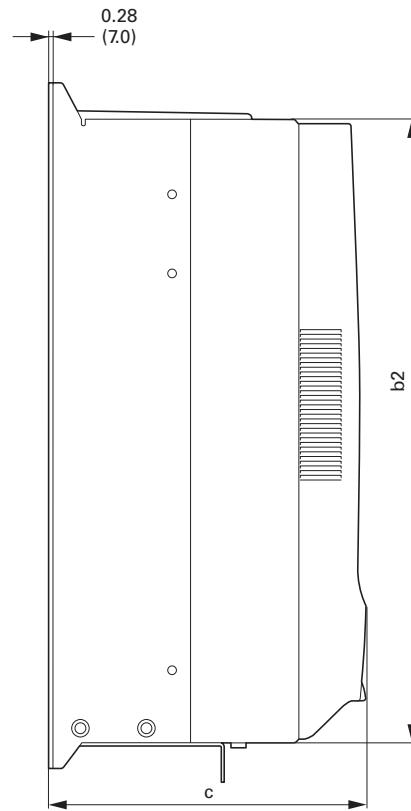
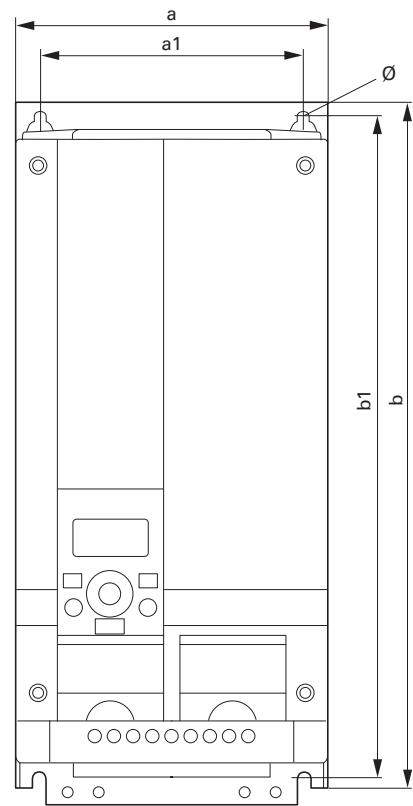


FS3



Approximate Dimensions in Inches (mm)

Dimensions and Frame Sizes, FS4 and FS5 (FS = Frame Size)



Dimensions and Frame Sizes

Part Number	Approximate Dimensions in inches (mm)								Installation Size
	a	a1	b	b1	b2	c	θ, θ_1	θ_2	
MMX12AA1D7	2.60 (66)	1.50 (38)	6.30 (160)	5.79 (147)	1.26 (32)	4.02 (102)	0.18 (4.5)	—	FS1
MMX12AA2D4									
MMX12AA2D8									
MMX32AA1D7									
MMX32AA2D4									
MMX32AA2D8									
MMX34AA1D3									
MMX34AA1D9									
MMX34AA2D4									
MMX11AA1D7	3.54 (90)	2.46 (62.5)	7.68 (195)	7.17 (182)	1.26 (32)	4.14 (105)	2.17 (5.5)	—	FS2
MMX11AA2D4									
MMX11AA2D8									
MMX11AA3D7									
MMX12AA3D7									
MMX12AA4D8									
MMX12AA7D0									
MMX32AA3D7									
MMX32AA4D8									
MMX32AA7D0									
MMX34AA3D3									
MMX34AA4D3									
MMX34AA5D6									
MMX11AA4D8	3.94 (100)	2.95 (75)	9.96 (253)	9.53 (242)	1.34 (34)	4.41 (112)	2.17 (5.5)	—	FS3
MMX12AA9D6									
MMX32AA011									
MMX34AA7D6									
MMX34AA9D0									
MMX34AA012									
MMX34AA014									
MMX35AA1D7									
MMX35AA2D7									
MMX35AA3D9									
MMX35AA6D1									
MMX35AA9D0									
MMX32AA012	6.50 (165.0)	5.51 (140.0)	14.57 (370.0)	13.82 (351.0)	13.27 (337.0)	6.61 (168.0)	0.28 (7.0)	0.55 (14.0)	FS4
MMX32AA017									
MMX32AA025									
MMX34AA016									
MMX34AA023									
MMX32AA031	6.50 (165.0)	5.51 (140.0)	14.57 (414.0)	13.82 (398.0)	15.08 (383.0)	8.07 (205.0)	0.28 (7.0)	0.55 (14.0)	FS5
MMX34AA031									
MMX34AA038									

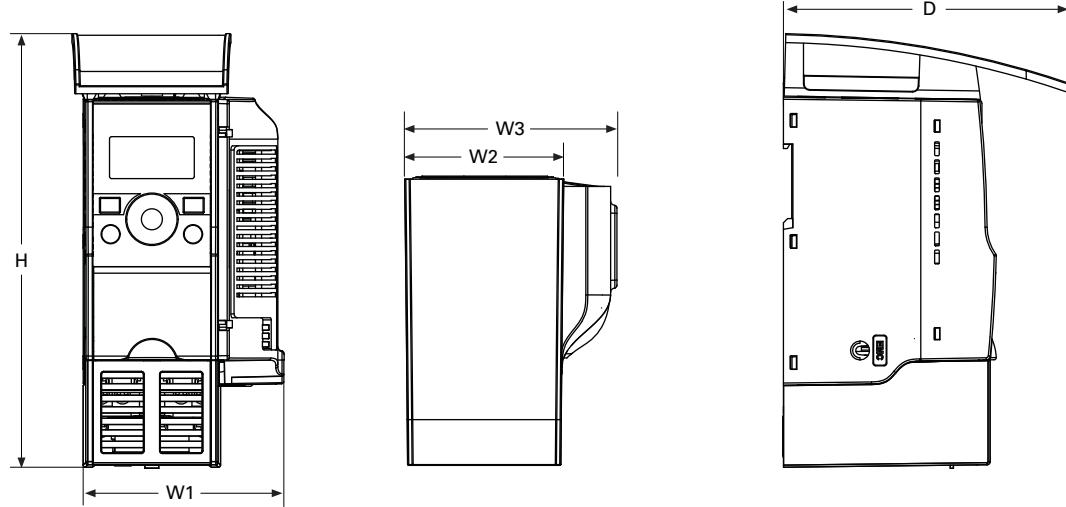
Note

1 in = 25.4 mm, 1 mm = 0.0394 in

Approximate Dimensions in Inches (mm)

NEMA 1/IP21 M-Max Drives and Communication Adapter Kit

2



Frame Type	H	W1	W2	W3	D
FS1	8.14 (206.7)	3.77 (95.7)	2.99 (75.9)	3.98 (101.2)	5.41 (137.5)
FS2	9.90 (251.5)	4.72 (120.0)	3.97 (100.8)	4.94 (125.5)	5.68 (144.2)
FS3	12.26 (311.5)	5.12 (130.1)	4.36 (110.8)	5.33 (135.3)	6.32 (160.5)

DG1 General Purpose Drive

2

**Product Description**

The DG1 general purpose drives are part of Eaton's next generation PowerXL Series of adjustable frequency drives specifically engineered for today's more demanding commercial and industrial applications. The power unit makes use of the most sophisticated semiconductor technology and a highly modular construction that can be flexibly adapted to meet the customer's needs.

The control module was designed to include today's standard communication protocols and I/O while still having the modularity to add additional option cards.

Eaton's patented Active Energy Control is also a standard feature on DG1 drives, offering customers increased efficiency, safety and reliability.

These drives continue the tradition of robust performance and raise the bar on features and functionality, ensuring the best solution at the right price.

Product Range

- 230V to 125 hp, 310A, 90 kW
- 480V to 250 hp, 310A, 160 kW
- 575V to 250 hp, 250A, 160 kW

Contents**Description****Page**

PowerXL DG1 Series Drives	V6-T2-31
Standards and Certifications	V6-T2-31
Catalog Number Selection	V6-T2-31
Product Selection	V6-T2-32
Accessories	V6-T2-34
Replacement Parts	V6-T2-38
Technical Data and Specifications	V6-T2-40
Dimensions	V6-T2-44

Features and Benefits**Hardware**

- Brake chopper standard on Frames 1, 2, 3
- Dual overload ratings
 - 110% variable torque (I_L)
 - 150% constant torque (I_H)
- Type 1/IP21 and Type 12/ IP54 enclosures available
- Integrated common mode reduction 5% DC link choke with input surge protection
- EMI/RFI filters standard on all drives—meets EMC Category C2
- Real-time clock—supports calendaring and PLC functionality
- Graphic LCD display and keypad—supports simple menu navigation as well as on-screen diagnostics and troubleshooting
- LOCAL/REMOTE operation from keypad and two configurable soft keys
- Control logic can be powered from an external auxiliary control panel—internal drive functions and fieldbus if necessary
- Standard I/O:
 - 8DI, 1DO
 - 2AI, 2AO
 - Three relays
 - Meets needs of most communication requirements
- Standard communications:
 - EtherNet/IP, Modbus TCP
 - RS-485: Modbus RTU, BACnet MS/TP
 - Meets the needs of most communication requirements
- Seamless integration into EtherNet/IP networks via EIP-Assist I/O tag-generation tool
- Two expansion slots—intended to support additional I/O or communication protocols as necessary
- Quick disconnect terminals for I/O connections—supports fast easy installation

Software

- Active energy control—minimizes energy losses in your motor, resulting in industry-leading energy efficiency for your application
- Quick Start Wizard upon initial power-up supports fast, easy installation
- Standard applications:
 - Standard
 - Multi-pump and fan Control
 - Multi-PID
 - Multi-purpose
- Copy/paste functionality on drive keypad—allows for fast setup of multiple drives
- Pre-programmed I/O—supports fast, easy installation for most applications
- Dynamic motor regenerative energy management
- Advanced PC Tool with diagnostic capabilities
- Two configurable keypad soft keys

Standards and Certifications

Product

- IEC/EN 61800-5-1
- IEC/EN 61800-5-2
- UL 508C
- IEC 61508
- EN 62061
- EN ISO 13849-1

EMC

- Immunity: IEC/EN 61800-3
- Category C2

Certification

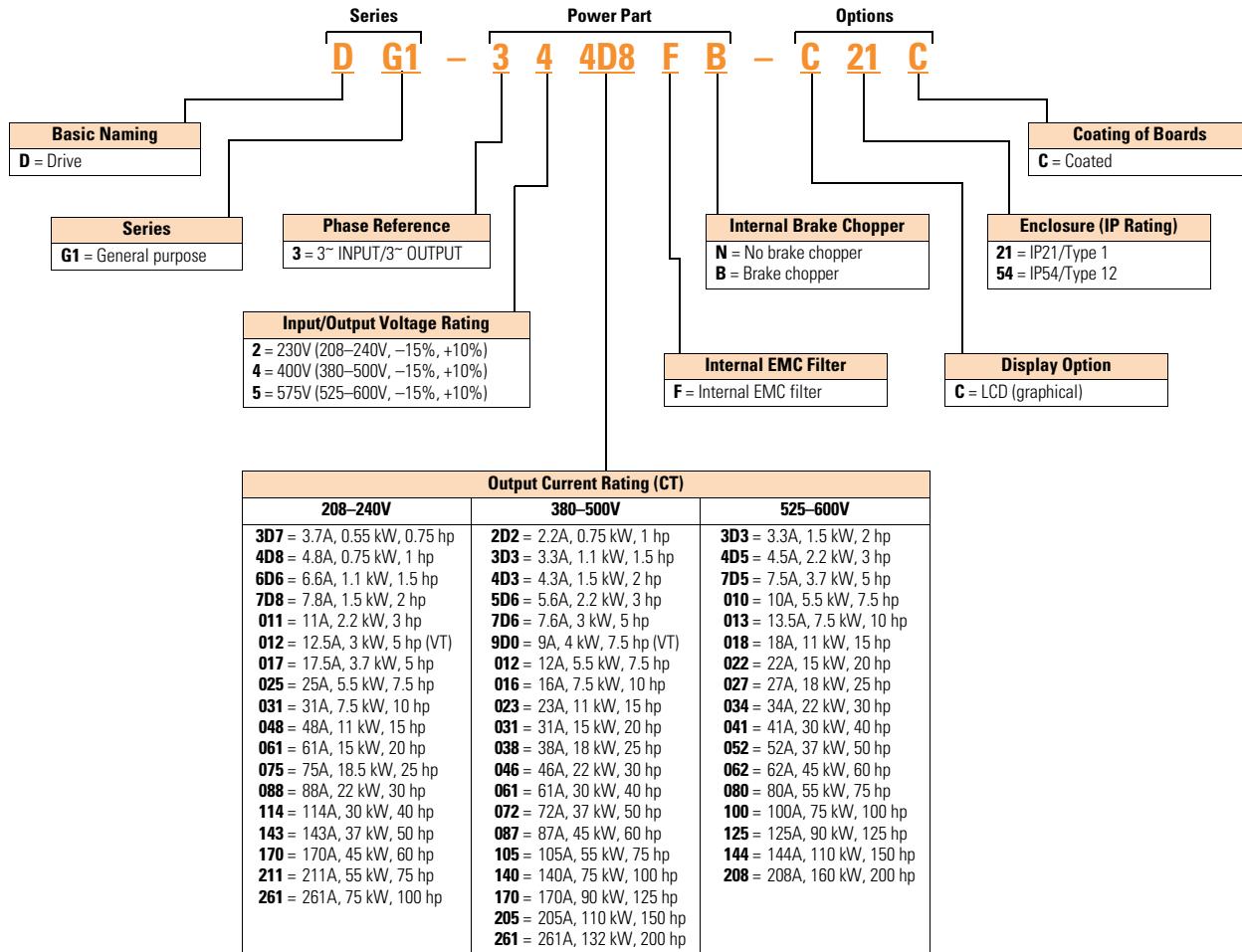
- UL
- cUL
- CE
- C-Tick
- RoHS



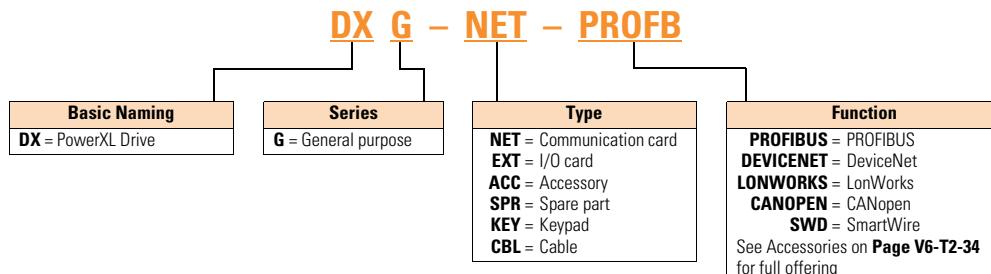
2

Catalog Number Selection

PowerXL Series—DG1 General Purpose Drive



PowerXL Series—DG1 General Purpose Drive Option Boards



Product Selection

2

DG1 Series Drives—208–240 Volt**PowerXL Series—DG1****Type 1/IP21**

Frame Size	230V, 50 Hz kW Rating (CT/I _H)	230V, 50 Hz kW Rating (VT/I _L)	230V, 60 Hz hp (CT/I _H)	230V, 60 Hz hp (VT/I _L)	Current A (CT/I _H)	Current A (VT/I _L)	Catalog Number
FR1	0.55	0.75	0.75	1	3.7	4.8	DG1-323D7FB-C21C
	0.75	1.1	1	1.5	4.8	6.6	DG1-324D8FB-C21C
	1.1	1.5	1.5	2	6.6	7.8	DG1-326D6FB-C21C
	1.5	2.2	2	3	7.8	11	DG1-327D8FB-C21C
	2.2	3	3	—	11	12.5	DG1-32011FB-C21C
FR2	3	3.7	—	5	12.5	17.5	DG1-32012FB-C21C
	3.7	5.5	5	7.5	17.5	25	DG1-32017FB-C21C
	5.5	7.5	7.5	10	25	31	DG1-32025FB-C21C
FR3	7.5	11	10	15	31	48	DG1-32031FB-C21C
	11	15	15	20	48	61	DG1-32048FB-C21C
FR4	15	18.5	20	25	61	75	DG1-32061FN-C21C
	18.5	22	25	30	75	88	DG1-32075FN-C21C
	22	30	30	40	88	114	DG1-32088FN-C21C
FR5	30	37	40	50	114	143	DG1-32114FN-C21C
	37	45	50	60	143	170	DG1-32143FN-C21C
	45	55	60	75	170	211	DG1-32170FN-C21C
FR6 ①	55	75	75	100	211	261	DG1-32211FN-C21C
	75	90	100	125	261	312	DG1-32261FN-C21C

PowerXL Series—DG1**Type 12/IP54**

Frame Size	230V, 50 Hz kW Rating (CT/I _H)	230V, 50 Hz kW Rating (VT/I _L)	230V, 60 Hz hp (CT/I _H)	230V, 60 Hz hp (VT/I _L)	Current A (CT/I _H)	Current A (VT/I _L)	Catalog Number
FR1	0.55	0.75	0.75	1	3.7	4.8	DG1-323D7FB-C54C
	0.75	1.1	1	1.5	4.8	6.6	DG1-324D8FB-C54C
	1.1	1.5	1.5	2	6.6	7.8	DG1-326D6FB-C54C
	1.5	2.2	2	3	7.8	11	DG1-327D8FB-C54C
	2.2	3	3	—	11	12.5	DG1-32011FB-C54C
FR2	3	3.7	—	5	12.5	17.5	DG1-32012FB-C54C
	3.7	5.5	5	7.5	17.5	25	DG1-32017FB-C54C
	5.5	7.5	7.5	10	25	31	DG1-32025FB-C54C
FR3	7.5	11	10	15	31	48	DG1-32031FB-C54C
	11	15	15	20	48	61	DG1-32048FB-C54C
FR4	15	18.5	20	25	61	75	DG1-32061FN-C54C
	18.5	22	25	30	75	88	DG1-32075FN-C54C
	22	30	30	40	88	114	DG1-32088FN-C54C
FR5	30	37	40	50	114	143	DG1-32114FN-C54C
	37	45	50	60	143	170	DG1-32143FN-C54C
	45	55	60	75	170	211	DG1-32170FN-C54C
FR6 ①	55	75	75	100	211	261	DG1-32211FN-C54C
	75	90	100	125	261	312	DG1-32261FN-C54C

Note

① FR6 available in 2015.

DG1 Series Drives—380–500 Volt**PowerXL Series—DG1 Type 1/IP21**

Frame Size	400V, 50 Hz kW Rating (CT/I _H)	400V, 50 Hz kW Rating (VT/I _L)	460V, 60 Hz hp (CT/I _H)	460V, 60 Hz hp (VT/I _L)	Current A (CT/I _H)	Current A (VT/I _L)	Catalog Number
FR1	0.75	1.1	1	1.5	2.2	3.3	DG1-342D2FB-C21C
	1.1	1.5	1.5	2	3.3	4.3	DG1-343D3FB-C21C
	1.5	2.2	2	3	4.3	5.6	DG1-344D3FB-C21C
	2.2	3	3	5	5.6	7.6	DG1-345D6FB-C21C
	3	4	5	—	7.6	9	DG1-347D6FB-C21C
	4	5.5	—	7.5	9	12	DG1-349D0FB-C21C
FR2	5.5	7.5	7.5	10	12	16	DG1-34012FB-C21C
	7.5	11	10	15	16	23	DG1-34016FB-C21C
	11	15	15	20	23	31	DG1-34023FB-C21C
FR3	15	18.5	20	25	31	38	DG1-34031FB-C21C
	18.5	22	25	30	38	46	DG1-34038FB-C21C
	22	30	30	40	46	61	DG1-34046FB-C21C
FR4	30	37	40	50	61	72	DG1-34061FN-C21C
	37	45	50	60	72	87	DG1-34072FN-C21C
	45	55	60	75	87	105	DG1-34087FN-C21C
FR5	55	75	75	100	105	140	DG1-34105FN-C21C
	75	90	100	125	140	170	DG1-34140FN-C21C
	90	110	125	150	170	205	DG1-34170FN-C21C
FR6 ①	110	132	150	200	205	261	DG1-34205FN-C21C
	132	160	200	250	261	310	DG1-34261FN-C21C

PowerXL Series—DG1 Type 12/IP54

Frame Size	400V, 50 Hz kW Rating (CT/I _H)	400V, 50 Hz kW Rating (VT/I _L)	460V, 60 Hz hp (CT/I _H)	460V, 60 Hz hp (VT/I _L)	Current A (CT/I _H)	Current A (VT/I _L)	Catalog Number
FR1	0.75	1.1	1	1.5	2.2	3.3	DG1-342D2FB-C54C
	1.1	1.5	1.5	2	3.3	4.3	DG1-343D3FB-C54C
	1.5	2.2	2	3	4.3	5.6	DG1-344D3FB-C54C
	2.2	3	3	5	5.6	7.6	DG1-345D6FB-C54C
	3	4	5	—	7.6	9	DG1-347D6FB-C54C
	4	5.5	—	7.5	9	12	DG1-349D0FB-C54C
FR2	5.5	7.5	7.5	10	12	16	DG1-34012FB-C54C
	7.5	11	10	15	16	23	DG1-34016FB-C54C
	11	15	15	20	23	31	DG1-34023FB-C54C
FR3	15	18.5	20	25	31	38	DG1-34031FB-C54C
	18.5	22	25	30	38	46	DG1-34038FB-C54C
	22	30	30	40	46	61	DG1-34046FB-C54C
FR4	30	37	40	50	61	72	DG1-34061FN-C54C
	37	45	50	60	72	87	DG1-34072FN-C54C
	45	55	60	75	87	105	DG1-34087FN-C54C
FR5	55	75	75	100	105	140	DG1-34105FN-C54C
	75	90	100	125	140	170	DG1-34140FN-C54C
	90	110	125	150	170	205	DG1-34170FN-C54C
FR6 ①	110	132	150	200	205	261	DG1-34205FN-C54C
	132	160	200	250	261	310	DG1-34261FN-C54C

Note

① FR6 available in 2015.

Accessories

2

The PowerXL Series—DG1 drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of two additional option boards.

The PowerXL Series—DG1 drives come with a factory-installed standard board configuration including the following:

- Standard I/O:
 - 8DI, 1DO
 - 2AI, 2AO
 - Three relays
- Standard communications:
 - EtherNet/IP, Modbus TCP
 - RS-485: Modbus RTU, BACnet MS/TP

PowerXL Series—DG1 I/O Card Kits

Description	Catalog Number
3 x DI, 3 x DO, 1 x thermistor, 24 Vdc/EXT option card	DXG-EXT-3DI3DO1T
1 x AI, 2 x AO (isolated to control board) option card	DXG-EXT-1AI2AO
3 x relay dry contact (2NO + 1NO/NC) option card	DXG-EXT-3RO
3 x PT100 RTD thermistor input option card	DXG-EXT-THER1
6 x DI 240 Vac input option card	DXG-EXT-6DI

PowerXL Series—DG1 Communication Card Kits

Description	Catalog Number
PROFIBUS-DP communication card	DXG-NET-PROFIBUS
CANopen communication card	DXG-NET-CANOPEN
DeviceNet communication card	DXG-NET-DEVICENET
PROFIBUS DB9 to 5-pin adapter card	DXG-MNT-PROFIBUS
SmartWire communication card and module	DXG-NET-SWD
LonWorks communication card	DXG-NET-LONWORKS

PowerXL Series—DG1 Keypad Kits

Description	Catalog Number
Standard keypad	DXG-KEY-LCD
Remote keypad kit (0.5m cable)	DXG-KEY-RMTKIT
1m remote keypad cable	DXG-CBL-1M0
3m remote keypad cable	DXG-CBL-3M0
Remote keypad mounting holder only	DXG-KEY-HOLDER
Type 12/IP54 keypad hole plug (maintain rating without keypad)	DXG-KEY-N12PLUG

PowerXL Series—DG1 Conversion and Flange Kits

The Type 12/IP54 option kit is used to convert a Type 1/IP21 to a Type 12/IP54 drive. The kit includes cover, fan and grommets.

Type 12/IP54 Conversion Kits

Description	Catalog Number
Frame 1 230V Type 12/IP54 kit	DXG-ACC-2FR1N12KIT
Frame 1 480V Type 12/IP54 kit	DXG-ACC-4FR1N12KIT
Frame 2 Type 12/IP54 kit	DXG-ACC-FR2N12KIT
Frame 3 Type 12/IP54 kit	DXG-ACC-FR3N12KIT

The flange kit is used when the power section heat sink is mounted through the back panel of an enclosure. The kit includes hardware, top flange plate, bottom flange plate and two side flange plates.

Flange Kits

Description	Catalog Number
Frame 1 flange kit Type 12/IP54	DXG-ACC-FR1N12FK
Frame 2 flange kit Type 12/IP54	DXG-ACC-FR2N12FK
Frame 3 flange kit Type 12/IP54	DXG-ACC-FR3N12FK
Frame 4 flange kit Type 12/IP54	DXG-ACC-FR4N12FK
Frame 5 flange kit Type 12/IP54	DXG-ACC-FR5N12FK

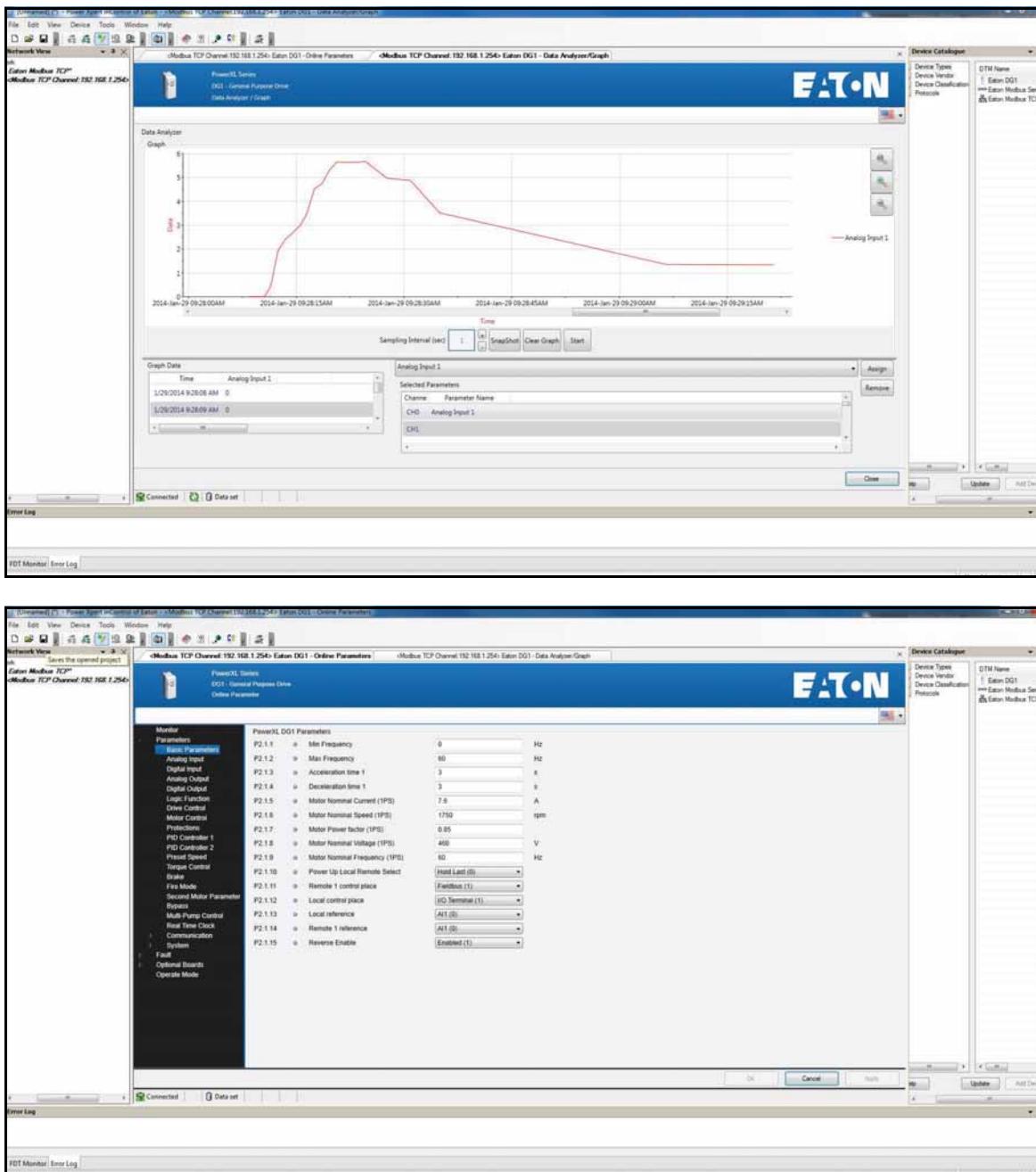
PowerXL Series—DG1 Demo Units

Demo Units

Description	Catalog Number
DG1 control module demo stand	DG1-DEMO1
DG1 full drive demo case	DG1-DEMO2

PowerXpert *inControl* Software

The PowerXL Series PC Tool is designed for programming, controlling and monitoring of the DG1 drives. Features include loading parameters that can be saved to a file or printed, setting references, starting and stopping the motor, monitoring signals in graphical or text form, and real-time display.



PowerXpert *inControl* Software

Description	Catalog Number
Software kit (software, cable, manual)	DXG-ACC-SOFTWARE
Software cable (USB to RJ45 [RS-485])	DXG-CBL-PCCABLE
Real-time clock battery	DXG-ACC-RTBATT

Brake Chopper Options

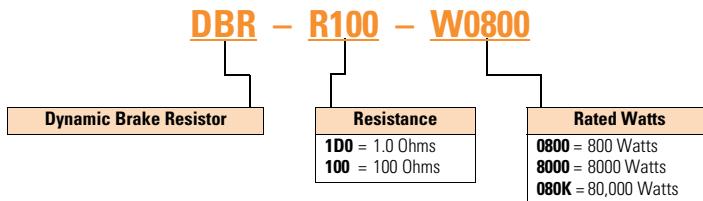
The brake chopper circuit option is used for applications that require dynamic braking. Dynamic braking resistors are not included with drive purchase. Consult the factory for additional dynamic braking resistor selections that are supplied separately. A list of common resistors are listed below and are complete indoor assemblies, include a pre-wired terminal block and a thermal switch, and are not UL Listed.

Duty Cycle

The duty cycle rating is based on a 60-second period. For example, the 20% duty cycle resistor can carry 100% current for 12 seconds out of every 60 seconds, while the 50% duty cycle resistor can carry 150% current for 30 seconds out of every 60 seconds.

Torque

If the braking torque required is less than 15%, dynamic braking is not required because the regenerated energy will be dissipated in the drive and motor losses.

Dynamic Brake Resistor—Catalog Number Selection**230V Brake Resistors**

Drive hp (CT/IH)	Minimum Ohms	20% Duty Cycle, 100% Torque		50% Duty Cycle, 150% Torque	
		Catalog Number	Dimensions	Catalog Number	Dimensions
0.75	15.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1	15.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1.5	15.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R036-W1200	12W x 10D x 5H
2	15.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R036-W1200	12W x 10D x 5H
3	15.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R036-W2000	12W x 16D x 5H
4	9.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R012-W2400	19W x 10D x 5H
5	9.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R020-W2800	19W x 13D x 5H
7.5	9.0	DBR-R020-W1200	12W x 10D x 5H	DBR-R012-W4800	26.5W x 10D x 5H
10	7.0	DBR-R015-W1600	12W x 13D x 5H	DBR-R112-W6000	26.5W x 13D x 5H
15	7.0	DBR-R012-W2400	19W x 10D x 5H	DBR-R7D8-W9000	28W x 10D x 10H
20	2.0	DBR-R9D3-W3200	19W x 10D x 5H	DBR-R3D4-W012K	28W x 10D x 10H
25	2.0	DBR-R5D5-W4000	26.5W x 10D x 5H	DBR-R5D1-W015K	28W x 16D x 10H
30	2.0	DBR-R4D8-W4800	26.5W x 10D x 5H	DBR-R4D1-W020K	28W x 16D x 10H
40	2.0	DBR-R004-W6000	26.5W x 13D x 5H	DBR-R3D4-W025K	30W x 18D x 16H
50	2.0	DBR-R3D1-W7500	26.5W x 16D x 5H	DBR-R2D1-W030K	30W x 18D x 24H
60	2.0	DBR-R2D8-W9000	26.5W x 16D x 5H	DBR-R002-W036K	30W x 18D x 24H
75	2.0	DBR-R2D6-W012K	28W x 10D x 10H	DBR-R002-W045K	30W x 18D x 32H
100	2.0	DBR-R002-W015K	28W x 16D x 10H	DBR-R002-W060K	30W x 18D x 48H

480V Brake Resistors

Drive hp (CT/I _H)	Minimum Ohms	20% Duty Cycle, 100% Torque		50% Duty Cycle, 150% Torque	
		Catalog Number	Dimensions	Catalog Number	Dimensions
1	36.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1.5	36.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W1200	12W x 10D x 5H
2	36.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W1200	12W x 10D x 5H
3	36.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2000	12W x 16D x 5H
5	36.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2800	19W x 13D x 5H
6	36.0	DBR-R100-W1200	12W x 10D x 5H	DBR-R070-W4000	19W x 16D x 5H
7.5	18.0	DBR-R100-W1200	12W x 10D x 5H	DBR-R020-W4800	26.5W x 13D x 5H
10	18.0	DBR-R063-W1600	12W x 13D x 5H	DBR-R030-W6000	26.5W x 16D x 5H
15	18.0	DBR-R030-W2400	19W x 10D x 5H	DBR-R030-W9000	28W x 10D x 10H
20	13.0	DBR-R030-W3200	19W x 13D x 5H	DBR-R023-W012K	28W x 13D x 10H
25	13.0	DBR-R030-W4000	19W x 16D x 5H	DBR-R013-W015K	28W x 16D x 10H
30	13.0	DBR-R020-W4800	26.5W x 13D x 5H	DBR-R014-W020K	30W x 18D x 24H
40	2.0	DBR-R112-W6000	26.5W x 13D x 5H	DBR-R007-W025K	30W x 18D x 16H
50	2.0	DBR-R013-W7500	26.5W x 16D x 5H	DBR-R8D5-W030K	30W x 18D x 24H
60	2.0	DBR-R010-W9000	28W x 10D x 10H	DBR-R7D3-W036K	30W x 18D x 24H
75	2.0	DBR-R009-W012K	28W x 13D x 10H	DBR-R002-W045K	30W x 18D x 32H
100	2.0	DBR-R5D1-W015K	28W x 16D x 10H	DBR-R004-W060K	30W x 18D x 40H
125	2.0	DBR-R4D1-W020K	28W x 16D x 10H	DBR-R004-W070K	30W x 18D x 48H
150	2.0	DBR-R3D4-W025K	30W x 18D x 16H	DBR-R3D5-W085K	30W x 18D x 56H
200	2.0	DBR-R3D3-W030K	30W x 18D x 24H	DBR-R2D6-W110K	30W x 18D x 64H

Replacement Parts

2

Frame 1

Description	Catalog Number 230V	Catalog Number 480V	Catalog Number 575V
Standard keypad ①	DXG-KEY-LCD	DXG-KEY-LCD	DXG-KEY-LCD
Main control board ①	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD
Control board cover	DXG-SPR-BCOVER	DXG-SPR-BCOVER	DXG-SPR-BCOVER
Type 1/IP21 standard cover	DXG-SPR-FR1CVR	DXG-SPR-FR1CVR	②
Main fan kit ①	DXG-SPR-FR1FAN	DXG-SPR-FR1FAN	②
Control fan	DXG-SPR-2FR1CF	DXG-SPR-4FR1CF	②
Main power board	DXG-SPR-2FR1MPB	DXG-SPR-4FR1MPB	②
EMI board	DXG-SPR-2FR1EB	DXG-SPR-4FR1EB	②
Middle chassis cover	DXG-SPR-FR1MCC	DXG-SPR-FR1MCC	②
Outer housing	DXG-SPR-FR1OH	DXG-SPR-FR1OH	②
UL conduit plate	DXG-SPR-FR1CPUL	DXG-SPR-FR1CPUL	②
IEC conduit plate	DXG-SPR-FR1CPIEC	DXG-SPR-FR1CPIEC	②

Frame 2

Description	Catalog Number 230V	Catalog Number 480V	Catalog Number 575V
Standard keypad ①	DXG-KEY-LCD	DXG-KEY-LCD	DXG-KEY-LCD
Main control board ①	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD
Control board cover	DXG-SPR-BCOVER	DXG-SPR-BCOVER	DXG-SPR-BCOVER
Type 1/IP21 standard cover	DXG-SPR-FR2CVR	DXG-SPR-FR2CVR	②
Main fan kit ①	DXG-SPR-FR2FAN	DXG-SPR-FR2FAN	②
Control fan	DXG-SPR-FR2CF	DXG-SPR-FR2CF	②
Bus capacitor	DXG-SPR-2FR2BC	DXG-SPR-4FR24BC	②
Main power board	DXG-SPR-2FR2MPB	DXG-SPR-4FR2MPB	②
EMI board	DXG-SPR-2FR2EB	DXG-SPR-4FR2EB	②
IGBT module	DXG-SPR-FR2IGBT	DXG-SPR-FR2IGBT	②
Middle chassis cover	DXG-SPR-FR2MCC	DXG-SPR-FR2MCC	②
Outer housing	DXG-SPR-FR2OH	DXG-SPR-FR2OH	②
UL conduit plate	DXG-SPR-FR2CPUL	DXG-SPR-FR2CPUL	②
IEC conduit plate	DXG-SPR-FR2CPIEC	DXG-SPR-FR2CPIEC	②

Frame 3

Description	Catalog Number 230V	Catalog Number 480V	Catalog Number 575V
Standard keypad ①	DXG-KEY-LCD	DXG-KEY-LCD	DXG-KEY-LCD
Main control board ①	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD
Control board cover	DXG-SPR-BCOVER	DXG-SPR-BCOVER	DXG-SPR-BCOVER
Type 1/IP21 standard cover	DXG-SPR-FR3CVR	DXG-SPR-FR3CVR	②
Main fan kit ①	DXG-SPR-FR3FAN	DXG-SPR-FR3FAN	②
Control fan	DXG-SPR-FR34CF	DXG-SPR-FR34CF	②
Bus capacitor	DXG-SPR-FR3BC	DXG-SPR-FR3BC	②
Main power board	DXG-SPR-2FR3MPB	DXG-SPR-4FR3MPB	②
EMI board	DXG-SPR-2FR3EB	DXG-SPR-4FR3EB	②
Drive board	DXG-SPR-2FR3DB	DXG-SPR-4FR3DB	②
Output board	DXG-SPR-FR3OB	DXG-SPR-FR3OB	②
Middle chassis cover	DXG-SPR-FR3MCC	DXG-SPR-FR3MCC	②
Outer housing	DXG-SPR-FR3OH	DXG-SPR-FR3OH	②
UL conduit plate	DXG-SPR-FR3CPUL	DXG-SPR-FR3CPUL	②
IEC conduit plate	DXG-SPR-FR3CPIEC	DXG-SPR-FR3CPIEC	②

Notes

① Factory recommended spare parts.

② 575V available in 2015.

Frame 4

Description	230V Catalog Number	480V Catalog Number	575V Catalog Number
Standard keypad ①	DXG-KEY-LCD	DXG-KEY-LCD	DXG-KEY-LCD
Main control board ①	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD
Control board cover	DXG-SPR-BCOVER	DXG-SPR-BCOVER	DXG-SPR-BCOVER
Type 1/IP21 standard cover	DXG-SPR-FR4CVR	DXG-SPR-FR4CVR	②
Main fan kit ①	DXG-SPR-FR4FAN	DXG-SPR-FR4FAN	②
Control fan	DXG-SPR-FR34CF	DXG-SPR-FR34CF	②
Bus capacitor	DXG-SPR-2FR4BC	DXG-SPR-4FR24BC	②
Main power board	DXG-SPR-2FR4MPB	DXG-SPR-4FR4MPB	②
EMI board	DXG-SPR-2FR4EB	DXG-SPR-4FR4EB	②
Softstart board	DXG-SPR-2FR4SB	DXG-SPR-4FR4SB	②
IGBT module	DXG-SPR-2FR4IGBT	DXG-SPR-4FR4IGBT	②
Rectifier module	DXG-SPR-2FR4RM	DXG-SPR-4FR4RM	②
Brake chopper module	DXG-SPR-2FR4BCM	DXG-SPR-4FR4BCM	②
Middle chassis cover	DXG-SPR-FR4MCC	DXG-SPR-FR4MCC	②
Outer housing	DXG-SPR-FR4OH	DXG-SPR-FR4OH	②
UL conduit plate	DXG-SPR-FR4CPUL	DXG-SPR-FR4CPUL	②
IEC conduit plate	DXG-SPR-FR4CPIEC	DXG-SPR-FR4CPIEC	②

2

Frame 5

Description	230V Catalog Number	480V Catalog Number	575V Catalog Number
Standard keypad ①	DXG-KEY-LCD	DXG-KEY-LCD	DXG-KEY-LCD
Main control board ①	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD	DXG-SPR-CTRLBOARD
Control board cover	DXG-SPR-BCOVER	DXG-SPR-BCOVER	DXG-SPR-BCOVER
Type 1/IP21 standard cover	DXG-SPR-FR5CVR	DXG-SPR-FR5CVR	②
Main fan kit ①	DXG-SPR-FR5FAN	DXG-SPR-FR5FAN	②
Control fan	DXG-SPR-FR5CF	DXG-SPR-FR5CF	②
Bus capacitor	DXG-SPR-FR5BC	DXG-SPR-FR5BC	②
Main power board	DXG-SPR-2FR5MPB	DXG-SPR-4FR5MPB	②
EMI-1 board	DXG-SPR-2FR5E1B	DXG-SPR-4FR5E1B	②
EMI-2 board	DXG-SPR-2FR5E2B	DXG-SPR-4FR5E2B	②
EMI-3 board	DXG-SPR-FR5E3B	DXG-SPR-FR5E3B	②
IGBT module	DXG-SPR-FR5IGBT	DXG-SPR-FR5IGBT	②
Rectifier module	DXG-SPR-2FR5RM	DXG-SPR-4FR5RM	②
Brake chopper module	DXG-SPR-2FR5BCM	DXG-SPR-4FR5BCM	②
Middle chassis cover	DXG-SPR-FR5MCC	DXG-SPR-FR5MCC	②
Outer housing	DXG-SPR-FR5OH	DXG-SPR-FR5OH	②
UL conduit plate	DXG-SPR-FR5CPUL	DXG-SPR-FR5CPUL	②
IEC conduit plate	DXG-SPR-FR5IECCP	DXG-SPR-FR5IECCP	②

Notes

- ① Factory recommended spare parts.
 ② 575V available in 2015.

Technical Data and Specifications

2

PowerXL Series—DG1 Technical Data and Specifications

Attribute	Description	Specification
Input ratings	Input voltage U_{in}	208V to 240V, 380V to 500V, 525V to 600V, -15 to 10%
	Input frequency	50 Hz to 60 Hz (variation up to 45 Hz to 66 Hz)
	Connection to power	Once per minute or less
	Starting delay	3s (FR1 to FR2), 4s (FR3), 5s (FR4), 6s (FR5)
	Short-circuit withstand rating	100 kAIC
Output ratings	Output voltage	0 to U_{in}
	Continuous output current	IL: ambient temperature maximum 40°C, up to 60°C with derating, overload 1.1 x IL (1 min./10 min.) IH: ambient temperature maximum 50°C, up to 60°C with derating, overload 1.5 x IH (1 min./10 min.)
	Overload current	150% respectively 110% (1 min./10 min.)
	Initial output current	200% (2s/20s)
	Output frequency	0–400 Hz (standard)
Control characteristics	Control methods	Frequency control Speed control Open-loop speed control Open-loop torque control
	Switching frequency	Range: FR1–3: 1 kHz to 12 kHz FR4–5: 1 kHz to 10 kHz Defaults: FR1–3: 4 kHz (IH), 6 kHz (IL) FR4–5: 3.6 kHz Automatic switching frequency derating in case of overload.
	Frequency reference	Analog input: resolution 0.1% (10-bit), accuracy +1% Panel reference: resolution 0.01 Hz
	Field weakening point	20 Hz to 400 Hz
	Acceleration time	0.1s to 3000s
Ambient conditions	Deceleration time	0.1s to 3000s
	Braking torque	DC brake: 30% x Motor Rated Torque (T_n) (without brake chopper) Dynamic braking (with optional brake chopper using an external brake resistor): 100% continuous maximum rating
	Ambient operating temperature	-10°C (no frost) to +50°C, up to +60°C with derating (CT) -10°C (no frost) to +40°C, up to +60°C with derating (VT)
	Storage temperature	-40°C to +70°C
	Relative humidity	0–95% RH, noncondensing, non-corrosive
Air quality:	Chemical vapors	Tested according to IEC 60068-2-60 Test Key: Flowing mixed gas corrosion test, Method 1 (H ₂ S [hydrogen sulfide] and SO ₂ [sulfur dioxide])
	Mechanical particles	Designed according to: IEC 60721-3-3, unit in operation, class 3C2 IEC 60721-3-3, unit in operation, class 3S2
	Altitude	100% load capacity (no derating) up to 3280 ft (1000m); 1% derating for each 328 ft (100m) above 3280 ft (1000m); max. 9842 ft (3000m) (2000m for corner grounded earth main systems)

PowerXL Series—DG1 Technical Data and Specifications, continued

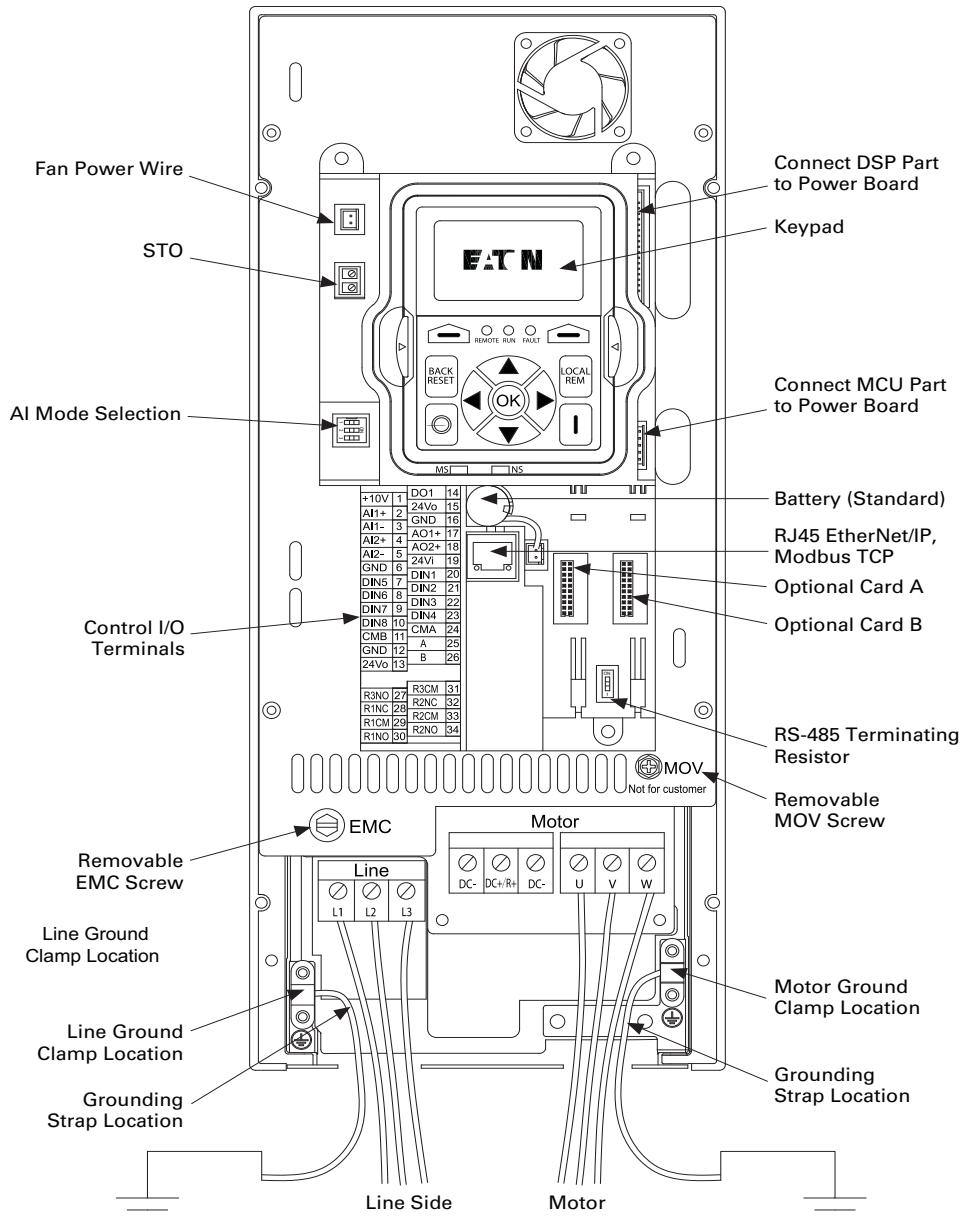
Attribute	Description	Specification
Ambient conditions, continued	Vibration: • EN 61800-5-1 • EN 60068-2-6	5–150 Hz Displacement amplitude: 1 mm (peak) at 5 Hz to 15.8 Hz (FR1–FR5) Maximum acceleration amplitude: 1g at 15.8 Hz to 150 Hz (FR1–FR5)
	Shock: • ISTA 1 A • EN 60068-2-27	Storage and shipping: maximum 15g, 11 ms (in package)
	Oversupply	Oversupply Category III
	Pollution degree	Pollution Degree 2
	Enclosure class	IP21/Type 1 standard in entire kW/hp range IP54/Type 12 option Note: Keypad required to be mounted in drive for IP54/Type 12 rating
	Immunity	Fulfils EN 61800-3 (2004), first and second environment
	MTBF	FR1: 165,457 hours FR2: 134,833 hours FR3: 102,515 hours FR4: 121,567 hours FR5: 108,189 hours FR6: Available in 2015
Standards	Safety	UL 508C, CSA C22.2 No. 274-13 and EN 61800-5-1
	EMC	+EMC2: EN 61800-3 (2004), Category C2 The drive can be modified for IT networks and corner grounding TN system
	Electrostatic discharge	Second environment, IEC 61000-4-2, 4 kV CD or 8 kV AD, Criterion B
	Fast transient burst	Second environment, IEC 61000-4-4, 2 kV/5 kHz, Criterion B
	Dielectrical strength	Primary to secondary: 3600 Vac/5100 Vdc Primary to earth: 2000 Vac/2828 Vdc
	Approvals	EN 61800-5-1 (2007), CE, UL and cUL (see nameplate for more detailed approvals)
Fieldbus connections		Onboard: EtherNet/IP, Modbus® TCP, Modbus RTU, BACnet
Safety/protections	Oversupply protection	Yes
	Oversupply trip limit	240V drives: 456V 480V drives: 911V
	Undervoltage protection	Yes
	Undervoltage trip limit	240V drives: 211V 480V drives: 370V
	Earth fault protection	Yes
	Input phase supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes
	Motor stall protection	Yes
	Motor underload protection	Yes
	DC bus oversupply control	Yes
	Short-circuit protection of 24V reference voltages	Yes
	Surge protection	Yes (differential mode 2 kV; common mode 4 kV)
	Common coated boards	Yes (prevents corrosion)

Wiring Diagram

2

PowerXL Series—DG1 Control Wiring Diagram

Pin	Signal Name	Signal	Default Setting	Description
1	+10V	Ref. Output Voltage	—	10 Vdc Supply Source
2	AI1+	Analog Input 1	0–10V	Voltage Speed Reference (Programmable to 4 mA to 20 mA)
3	AI1–	Analog Input 1 Ground	—	Analog Input 1 Common (Ground)
4	AI2+	Analog Input 2	4 mA to 20 mA	Current Speed Reference (Programmable to 0–10V)
5	AI2–	Analog Input 2 Ground	—	Analog Input 2 Common (Ground)
6	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
7	DIN5	Digital Input 5	Preset Speed B0	Sets frequency output to Preset Speed 1
8	DIN6	Digital Input 6	Preset Speed B1	Sets frequency output to Preset Speed 2
9	DIN7	Digital Input 7	Emergency Stop (TI–)	Input forces VFD output to shut off
10	DIN8	Digital Input 8	Force Remote (TI+)	Input takes VFD from Local to Remote
11	CMB	DI5 to DI8 Common	Grounded	Allows source input
12	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
13	24V	+24 Vdc Output	—	Control voltage output (100 mA max.)
14	D01	Digital Output 1	Ready	Shows the drive is ready to run
15	24Vo	+24 Vdc Output	—	Control voltage output (100 mA max.)
16	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
17	A01+	Analog Output 1	Output Frequency	Shows Output frequency to motor 0–60 Hz (4 mA to 20 mA)
18	A02+	Analog Output 2	Motor Current	Shows Motor current of motor 0–FLA (4 mA to 20 mA)
19	24Vi	+24 Vdc Input	—	External control voltage input
20	DIN1	Digital Input 1	Run Forward	Input starts drive in forward direction (start enable)
21	DIN2	Digital Input 2	Run Reverse	Input starts drive in reverse direction (start enable)
22	DIN3	Digital Input 3	External Fault	Input causes drive to fault
23	DIN4	Digital Input 4	Fault Reset	Input resets active faults
24	CMA	DI1 to DI4 Common	Grounded	Allows source input
25	A	RS-485 Signal A	—	Fieldbus Communication (Modbus, BACnet)
26	B	RS-485 Signal B	—	Fieldbus Communication (Modbus, BACnet)
27	R3NO	Relay 3 Normally Open	At Speed	Relay output 3 shows VFD is at Ref. Frequency
28	R1NC	Relay 1 Normally Closed	Run	Relay output 1 shows VFD is in a run state
29	R1CM	Relay 1 Common		
30	R1NO	Relay 1 Normally Open		
31	R3CM	Relay 3 Common	At Speed	Relay output 3 shows VFD is at Ref. Frequency
32	R2NC	Relay 2 Normally Closed	Fault	Relay output 2 shows VFD is in a fault state
33	R2CM	Relay 2 Common		
34	R2NO	Relay 2 Normally Open		

Control Board Layout**PowerXL Series—DG1 Control Board Layout**

2.4

Adjustable Frequency Drives

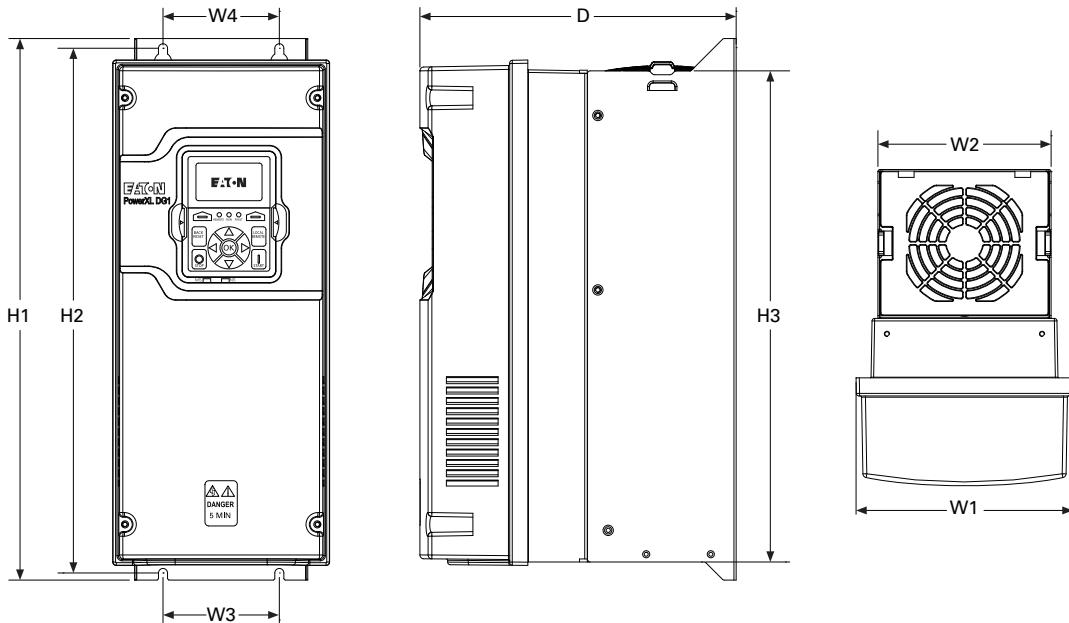
PowerXL DG1 Series Drives

Dimensions

Approximate Dimensions in Inches (mm)

2

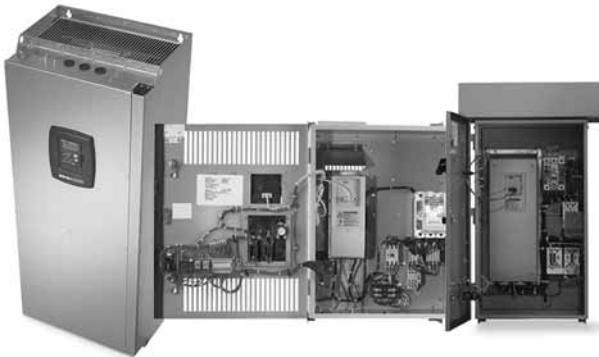
PowerXL Series—DG1 Dimensions



Frame Size	Voltage	hp (CT/I _H)	kW	Amperes (CT/I _H)	Approximate Dimensions in Inches (mm)										Weight Lb (kg)
					D	H1	H2	H3	W1	W2	W3	W4	Ø		
FR1	230 Vac	0.75–3	0.55–2.2	3.5–11	7.89 (200.4)	12.87 (326.9)	12.28 (311.9)	11.50 (292.1)	6.02 (153.0)	4.80 (121.9)	3.94 (100.1)	3.94 (100.1)	0.28 (7.0)	14.33 (6.5)	
	480 Vac	1–5	0.75–3.7	2.3–7.6											
	575 Vac ①	2–5	1.5–3.7	3.3–7.5											
FR2	230 Vac	5–7.5	3–5.5	12.5–25	9.63 (244.7)	16.50 (419.1)	15.98 (405.9)	14.96 (380.0)	6.61 (167.8)	5.28 (134.1)	3.54 (90.0)	3.54 (90.0)	0.28 (7.0)	23.37 (10.6)	
	480 Vac	7.5–15	5.5–11	12–23											
	575 Vac ①	7.5–15	5.5–11	10–18											
FR3	230 Vac	10–15	7.5–11	31–48	10.44 (265.1)	21.97 (558.0)	21.46 (545.0)	20.43 (518.9)	8.06 (204.6)	7.24 (183.9)	4.92 (125.0)	4.92 (125.0)	0.35 (9.0)	49.82 (22.6)	
	480 Vac	20–30	15–22	31–46											
	575 Vac ①	20–30	15–22	22–34											
FR4	230 Vac	20–30	15–22	61–88	11.57 (294.0)	24.80 (629.9)	34.31 (617.5)	23.27 (591.1)	9.36 (237.7)	9.13 (231.9)	8.07 (205.0)	8.07 (205.0)	0.35 (9.0)	77.60 (35.2)	
	480 Vac	40–60	30–45	61–87											
	575 Vac ①	40–60	30–45	41–62											
FR5	230 Vac	40–60	30–45	114–170	13.41 (340.7)	34.98 (888.5)	29.65 (753.1)	27.83 (706.9)	11.34 (288.0)	11.10 (281.9)	8.66 (220.0)	8.66 (220.0)	0.35 (9.0)	154.32 (70.0)	
	480 Vac	75–125	55–90	105–170											
	575 Vac ①	75–125	55–90	80–125											
FR6 ①	230 Vac	75–100	55–75	211–261	①	①	①	①	①	①	①	①	①	①	
	480 Vac	150–200	110–150	205–261											
	575 Vac ①	150–200	110–160	144–208											

Note

① FR6 and 575 Vac available in 2015.

SVX9000 Drives**Product Overview**

With the SVX9000 Series Sensorless Vector Control, Eaton's expanded Eaton drive offering now covers a complete line of PWM adjustable frequency (speed) drives in ratings from:

- 208V—3/4 to 100 hp I_H ; 1 to 100 hp I_L
- 230V—3/4 to 100 hp I_H ; 1 to 125 hp I_L
- 480V—1 to 1900 hp I_H ; 1-1/2 to 2200 hp I_L
- 575V—2 to 2000 hp I_H ; 3 to 2300 hp I_L

The Eaton family of drives includes DA1, DC1, H-Max, M-Max, SVX9000 and SPX9000. 9000X Series drive ratings are rated for either high overload (I_H) or low overload (I_L). I_L indicates 110% overload capacity for 1 minute out of 10 minutes. I_H indicates 150% overload capacity for 1 minute out of 10 minutes.

A full range of enclosure types and options are available to meet a wide array of applications—from simple variable torque to more complex industrial applications such as conveyors, mixers and machine controls.

Application Description**Application Engineering**

Proper selection and application of all drive system components is essential to assure that an adjustable frequency drive system will safely and reliably provide the performance required for any given application. The party responsible for the overall design and operation of the facility must make sure that qualified personnel are employed to select all components of the drive system, including appropriate safety devices. Eaton's AF Drives Application Engineering Department is prepared to provide assistance to answer any questions about the technical capabilities of Eaton drives.

Motor Selection

The basic requirement of motor selection is to match the torque vs. speed capability of the motor to the torque vs. speed requirement of the driven load.

Contents**Description**

	Page
SVX9000 Drives	V6-T2-48
SVX9000 Drives	V6-T2-87
SVX9000 Enclosed Drives	V6-T2-111
SVX9000 VFD Pump Panels	V6-T2-111

Motor Torque vs. Speed Capability

As the speed of a motor is reduced below its 60 Hz base speed, motor cooling becomes less effective because of the reduced speed of the self-cooling fan. This limitation determines the maximum torque for continuous operation at any operating speed. The maximum intermittent operating torque is determined by the motor's torque vs. current characteristics and the output current capability of the adjustable frequency controller.

Multiple Motor Operation

A number of motors can be connected in parallel to a single controller. Since the frequency of the power supplied by the controller is the same for each motor, the motors will always operate at the same speed. Application Engineering assistance must be requested for all multiple motor applications to assure compliance with all controller design limitations.

Special Types of Motors

Standard NEMA Designs A and B three-phase motors are the only motors recommended for use in the majority of applications, but other types of motors are occasionally used. If the existing motor used in the application or the motor proposed for use with the drive system is a type other than NEMA Design A or B, Application Engineering assistance must be requested to make certain that the drive is properly applied.

Product Selection Guide

Controller Selection

The basic requirement of controller selection is to match the output current, voltage and frequency capabilities of the controller with the requirements of the connected motor.

Output Current

The controller must be selected and applied such that the average operating motor current and horsepower do not exceed the continuous current and horsepower ratings of the controller. The intermittent operating current must not exceed the intermittent current rating of the controller.

Motor Protection

Eaton adjustable frequency drives include electronic motor overload protection circuits that are designed to meet the requirements of NEC article 430-2 provided that only one motor is connected to the output of the controller.

Output Voltage and Frequency

When they are shipped, AF controllers are adjusted to provide a maximum output voltage and frequency equivalent to the input line voltage and frequency. The controllers can be adjusted to operate above line frequency, but a hazard of personal injury or equipment damage may exist when the motor is operated above base speed. Before adjusting the drive to operate above line frequency, make sure that the motor and the driven machinery can safely be operated at the resulting speed.

Features

Controller Features

Operator Control and Interface Requirements

Since there are many possible configurations and many ways of achieving a specific end result, it pays to consider the operator control and interface requirements carefully. A simplified and more economical drive package can often be achieved by selecting from standard product offerings rather than specifying a custom designed configuration.

Installation Compatibility

The successful application of an AC drive requires the assurance that the drive will be compatible with the environment in which it will be installed. In planning the installation, be sure to carefully consider the heat produced by the drive, the altitude and temperature limits and the need for clean cooling air. Other important considerations include acoustical noise, vibration, electromagnetic compatibility, power quality, controller input harmonic current and power distribution equipment requirements.

Auxiliary Equipment and Accessories

Adjustable drives are generally designed to have a motor directly connected to the controller output terminals with no other equipment connected in series or parallel. Motor starters, disconnect switches, surge absorbers, DV/DT suppression circuits, output chokes, output transformers and any other equipment under consideration for installation on the output of the controller should not be installed without first requesting Application Engineering assistance. Power factor correction capacitors must never, under any circumstances, be connected at the output of the controller. They would serve no useful purpose, and they may damage the controller.

Enclosure Definitions

- **NEMA Type 1/IP21**—

Enclosures are intended for indoor use primarily to provide a degree of protection against contact with enclosed equipment and provide a degree of protection against a limited amount of falling dirt in locations where unusual service conditions do not exist. Top or side openings in the NEMA Type 1/IP21 enclosure allow for the free exchange of inside and outside air while meeting the UL rod entry and rust resistance design tests.

- **NEMA Type 12/IP54**—

Enclosures are intended for indoor use primarily to provide a degree of protection against circulating dust, falling dirt and dripping noncorrosive liquids. To meet UL drip, dust and rust resistance tests, NEMA Type 12/IP54 enclosures have no openings to allow for the exchange of inside and outside air.

- **Chassis IP00**—Similar to Protected Chassis IP20 except power terminals are protected by plastic shielding only. Primarily intended to be mounted inside a surrounding protective enclosure.

- **NEMA Type 3R**—Similar in design to NEMA Type 12/

IP54 except with more stringent design and test requirements.

Motor Protection

DV/DT and Peak Motor Voltage Solutions

Today's AFD products offer significantly improved performance, but at the potential cost of motor insulation stress. The fast switching time of the IGBT devices used in newer AFDs can cause a transmission line effect in the output power leads to the motor, leading to possibly damaging voltage levels. To meet this need,

NEMA has introduced a motor in MG1, Part 31, which provides an insulation system designed to maintain normal motor life in AFD applications. For existing motors, a motor protection scheme is required for longer cable runs. Eaton offers three standard solutions for existing systems.

- **MotoRx** This solution provides an energy recovery system which clamps the peak motor voltage to a safe level for standard motors. This option is used when the distance between a single motor and the drive is 600 ft or less.
- **Output Line Reactor** This option provides an output line reactor, reducing the DV/DT of the AFD output voltage and lessening the transmission line effect, to lower the peak voltage at the motor terminals.

SVX9000 Drives**2****SVX9000 Drives****Product Description**

SVX9000 Series Adjustable Frequency Drives from Eaton's Electrical Sector are the next generation of drives specifically engineered for today's commercial and industrial applications. The power unit makes use of the most sophisticated semiconductor technology and a highly modular construction that can be flexibly adapted to the customer's needs.

The input and output configuration (I/O) is designed with modularity in mind. The I/O is comprised of option cards, each with its own input and output configuration. The control module is designed to accept a total of five of these cards. The cards contain not only normal analog and digital inputs but also fieldbus cards.

These drives continue the tradition of robust performance, and raise the bar on features and functionality, ensuring the best solution at the right price.

Features

- Robust design—proven 500,000 hours MTBF
- Integrated 3% line reactors standard on drives from FR4 through FR9
- EMI/RFI Filters H standard up to 200 hp I_H 480V, 100 hp I_H 230V
- Simplified operating menu allows for typical programming changes, while programming mode provides control of everything
- Quick Start Wizard built into the programming of the drive ensures a smooth start-up
- Keypad can display up to three monitored parameters simultaneously
- LOCAL/REMOTE operation from keypad
- Copy/paste function allows transfer of parameter settings from one drive to the next
- Standard NEMA Type 12/IP54 keypad on all drives
- The SVX can be flexibly adapted to a variety of needs using our pre-installed "Seven in One" precision application programs consisting of:
 - Basic
 - Standard
 - Local/remote
 - Multi step speed control
 - PID control
 - Multi-purpose control
 - Pump and fan control with auto change
- Hand-held auxiliary 24V power supply allows programming/monitoring of control module without applying full power to the drive
- Control logic can be powered from an external auxiliary control panel, internal drive functions and fieldbus if necessary
- Brake chopper standard from: 1–30 hp/380–500V 3/4–15 hp/208–230V
- NEMA Type 1/IP21 and NEMA Type 12/IP54 enclosures available, Frame Sizes FR4–FR9
- Open chassis FR10 and greater
- Standard option board configuration includes an A9 I/O board and an A2 relay output board installed in slots A and B

Contents**Description****Page**

SVX9000 Drives	Standards and Certifications	V6-T2-49
	Catalog Number Selection	V6-T2-49
	Product Selection	V6-T2-50
	Accessories	V6-T2-54
	Options	V6-T2-55
	Replacement Parts	V6-T2-61
	Technical Data and Specifications	V6-T2-70
	Dimensions	V6-T2-71
SVX9000 Enclosed Drives	V6-T2-87
SVX9000 VFD Pump Panels	V6-T2-111

Standards and Certifications**Product**

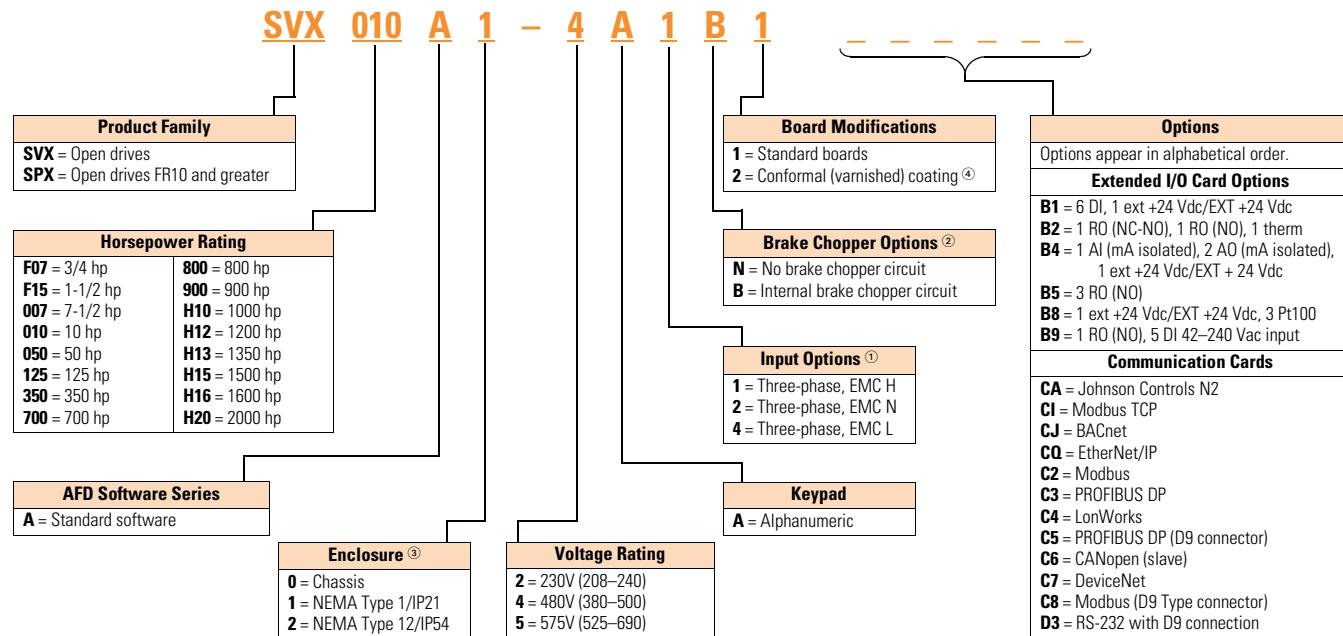
- IEC 61800-2

EMC (At Default Settings)

- Immunity: Fulfils all EMC immunity requirements; Emissions: EN 61800-3, LEVEL H

Safety

- UL 508C
- CE

**Catalog Number Selection****SVX9000 Adjustable Frequency Drives****Notes**

① All 230V drives and 480V drives up to 200 hp (IH) are only available with input option **1** (EMC Level H). 480V drives 250 hp (IH) or larger are available with input option **2** (EMC Level N). 480V drives are available with input option **4** (EMC Level L). 575V drives 200 hp (IH) or larger are only available with input option **2**. 575V drives up to 150 hp (IH) are only available with input option **4** (EMC Level L).

② 480V drives up to 30 hp (IH) are only available with brake chopper option **B**. 480V drives 40 hp (IH) or larger come standard with brake chopper option **N**. 230V drives up to 15 hp (IH) are only available with brake chopper option **B**. 230V drives 20 hp or larger come standard with brake chopper option **N**. All 575V drives come standard without brake chopper option (N). **N** = **No** brake chopper.

③ 480V drives 250 hp (IH) and larger are available with enclosure style **0** (chassis); 690V drives 200 hp (IH) and larger are available with enclosure style **0** (chassis).

④ Factory promise delivery. Consult sales office for availability.

Product Selection**2****230V SVX9000 Drives****SVX9000 Open Drives****208–240V, NEMA Type 1/IP21 Drives**

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR4	3/4	3.7	1	4.8	SVXF07A1-2A1B1
	1	4.8	1-1/2	6.6	SVX001A1-2A1B1
	1-1/2	6.6	2	7.8	SVXF15A1-2A1B1
	2	7.8	3	11	SVX002A1-2A1B1
	3	11	—	12.5	SVX003A1-2A1B1
FR5	—	12.5	5	17.5	SVX004A1-2A1B1
	5	17.5	7-1/2	25	SVX005A1-2A1B1
	7-1/2	25	10	31	SVX007A1-2A1B1
FR6	10	31	15	48	SVX010A1-2A1B1
	15	48	20	61	SVX015A1-2A1B1
FR7	20	61	25	75	SVX020A1-2A1N1
	25	75	30	88	SVX025A1-2A1N1
	30	88	40	114	SVX030A1-2A1N1
FR8	40	114	50	140	SVX040A1-2A1N1
	50	140	60	170	SVX050A1-2A1N1
	60	170	75	205	SVX060A1-2A1N1
FR9	75	205	100	261	SVX075A1-2A1N1
	100	261	125	300	SVX100A1-2A1N1

208–240V, NEMA Type 12/IP54 Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR4	3/4	3.7	1	4.8	SVXF07A2-2A1B1
	1	4.8	1-1/2	6.6	SVX001A2-2A1B1
	1-1/2	6.6	2	7.8	SVXF15A2-2A1B1
	2	7.8	3	11	SVX002A2-2A1B1
	3	11	—	12.5	SVX003A2-2A1B1
FR5	—	12.5	5	17.5	SVX004A2-2A1B1
	5	17.5	7-1/2	25	SVX005A2-2A1B1
	7-1/2	25	10	31	SVX007A2-2A1B1
FR6	10	31	15	48	SVX010A2-2A1B1
	15	48	20	61	SVX015A2-2A1B1
FR7	20	61	25	75	SVX020A2-2A1N1
	25	75	30	88	SVX025A2-2A1N1
	30	88	40	114	SVX030A2-2A1N1
FR8	40	114	50	140	SVX040A2-2A1N1
	50	140	60	170	SVX050A2-2A1N1
	60	170	75	205	SVX060A2-2A1N1
FR9	75	205	100	261	SVX075A2-2A1N1
	100	261	125	300	SVX100A2-2A1N1

480V SVX9000 Drives**SVX9000 Open Drives****380–500V, NEMA Type 1/IP21 Drives**

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR4	1	2.2	1-1/2	3.3	SVX001A1-4A1B1
	1-1/2	3.3	2	4.3	SVXF15A1-4A1B1
	2	4.3	3	5.6	SVX002A1-4A1B1
	3	5.6	5	7.6	SVX003A1-4A1B1
	5	7.6	—	9	SVX005A1-4A1B1
	—	9	7-1/2	12	SVX006A1-4A1B1
FR5	7-1/2	12	10	16	SVX007A1-4A1B1
	10	16	15	23	SVX010A1-4A1B1
	15	23	20	31	SVX015A1-4A1B1
FR6	20	31	25	38	SVX020A1-4A1B1
	25	38	30	46	SVX025A1-4A1B1
	30	46	40	61	SVX030A1-4A1B1
FR7	40	61	50	72	SVX040A1-4A1N1
	50	72	60	87	SVX050A1-4A1N1
	60	87	75	105	SVX060A1-4A1N1
FR8	75	105	100	140	SVX075A1-4A1N1
	100	140	125	170	SVX100A1-4A1N1
	125	170	150	205	SVX125A1-4A1N1
FR9	150	205	200	261	SVX150A1-4A1N1
	200	245	250	300	SVX200A1-4A1N1

380–500V, NEMA Type 12/IP54 Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR4	1	2.2	1-1/2	3.3	SVX001A2-4A1B1
	1-1/2	3.3	2	4.3	SVXF15A2-4A1B1
	2	4.3	3	5.6	SVX002A2-4A1B1
	3	5.6	5	7.6	SVX003A2-4A1B1
	5	7.6	—	9	SVX005A2-4A1B1
	—	9	7-1/2	12	SVX006A2-4A1B1
FR5	7-1/2	12	10	16	SVX007A2-4A1B1
	10	16	15	23	SVX010A2-4A1B1
	15	23	20	31	SVX015A2-4A1B1
FR6	20	31	25	38	SVX020A2-4A1B1
	25	38	30	46	SVX025A2-4A1B1
	30	46	40	61	SVX030A2-4A1B1
FR7	40	61	50	72	SVX040A2-4A1N1
	50	72	60	87	SVX050A2-4A1N1
	60	87	75	105	SVX060A2-4A1N1
FR8	75	105	100	140	SVX075A2-4A1N1
	100	140	125	170	SVX100A2-4A1N1
	125	170	150	205	SVX125A2-4A1N1
FR9	150	205	200	261	SVX150A2-4A1N1
	200	245	250	300	SVX200A2-4A1N1

SVX9000 Open Drives**2****380–500V, Open Chassis Drives**

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR10 ①	250	330	300	385	SPX250A0-4A2N1
	300	385	350	460	SPX300A0-4A2N1
	350	460	400	520	SPX350A0-4A2N1
FR11	400	520	500	590	SPX400A0-4A2N1
	500	590	—	650	SPX500A0-4A2N1
	—	650	600	730	SPX550A0-4A2N1
FR12	600	730	—	820	SPX600A0-4A2N1
	—	820	700	920	SPX650A0-4A2N1
	700	920	800	1030	SPX700A0-4A2N1
FR13	800	1030	900	1150	SPX800A0-4A2N1
	900	1150	1000	1300	SPX900A0-4A2N1
	1000	1300	1200	1450	SPXH10A0-4A2N1
FR14	1200	1600	1500	1770	SPXH12A0-4A2N1
	1600	1940	1800	2150	SPXH16A0-4A2N1
	1900	2300	2200	2700	SPXH19A0-4A2N1

575V SVX9000 Drives**525–690V, NEMA Type 1/IP21 Drives**

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR6	2	3.3	3	4.5	SVX002A1-5A4N1
	3	4.5	—	5.5	SVX003A1-5A4N1
	—	5.5	5	7.5	SVX004A1-5A4N1
	5	7.5	7-1/2	10	SVX005A1-5A4N1
	7-1/2	10	10	13.5	SVX007A1-5A4N1
	10	13.5	15	18	SVX010A1-5A4N1
	15	18	20	22	SVX015A1-5A4N1
	20	22	25	27	SVX020A1-5A4N1
FR7	25	27	30	34	SVX025A1-5A4N1
	30	34	40	41	SVX030A1-5A4N1
FR8	40	41	50	52	SVX040A1-5A4N1
	50	52	60	62	SVX050A1-5A4N1
FR9	60	62	75	80	SVX060A1-5A4N1
	75	80	100	100	SVX075A1-5A4N1
FR9	100	100	125	125	SVX100A1-5A4N1
	125	125	150	144	SVX125A1-5A4N1
	150	144	—	170	SVX150A1-5A4N1
	—	170	200	208	SVX175A1-5A4N1

Note

① FR10–FR14 includes 3% line reactor, but it is not integral to chassis.

SVX9000 Open Drives**525–690V, NEMA Type 12/IP54 Drives**

Frame Size	hp (I_H)	Current (I_H)	hp (I_L)	Current (I_L)	Catalog Number
FR6	2	3.3	3	4.5	SVX002A2-5A4N1
	3	4.5	—	5.5	SVX003A2-5A4N1
	—	5.5	5	7.5	SVX004A2-5A4N1
	5	7.5	7-1/2	10	SVX005A2-5A4N1
	7-1/2	10	10	13.5	SVX007A2-5A4N1
	10	13.5	15	18	SVX010A2-5A4N1
	15	18	20	22	SVX015A2-5A4N1
	20	22	25	27	SVX020A2-5A4N1
	25	27	30	34	SVX025A2-5A4N1
FR7	30	34	40	41	SVX030A2-5A4N1
	40	41	50	52	SVX040A2-5A4N1
FR8	50	52	60	62	SVX050A2-5A4N1
	60	62	75	80	SVX060A2-5A4N1
	75	80	100	100	SVX075A2-5A4N1
FR9	100	100	125	125	SVX100A2-5A4N1
	125	125	150	144	SVX125A2-5A4N1
	150	144	—	170	SVX150A2-5A4N1
	—	170	200	208	SVX175A2-5A4N1

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525–690V, Open Chassis Drives

Frame Size	hp (I_H)	Current (I_H)	hp (I_L)	Current (I_L)	Catalog Number
FR10	200	208	250	261	SPX200A0-5A2N1
	250	261	300	325	SPX250A0-5A2N1
	300	325	400	385	SPX300A0-5A2N1
FR11	400	385	450	460	SPX400A0-5A2N1
	450	460	500	502	SPX450A0-5A2N1
	500	502	—	590	SPX500A0-5A2N1
FR12	—	590	600	650	SPX550A0-5A2N1
	600	650	700	750	SPX600A0-5A2N1
	700	750	800	820	SPX700A0-5A2N1
FR13	800	820	900	920	SPX800A0-5A2N1
	900	920	1000	1030	SPX900A0-5A2N1
	1000	1030	1250	1180	SPXH10A0-5A2N1
FR14	1350	1300	1500	1500	SPXH13A0-5A2N1
	1500	1500	2000	1900	SPXH15A0-5A2N1
	2000	1900	2300	2250	SPXH20A0-5A2N1

Accessories**2****Demo Drive and Power Supply****Demo Drive and Power Supply**

Description	Catalog Number
9000X demo drive	9000XDEMO

NEMA Type 12/IP54 Conversion Kit

The NEMA Type 12/IP54 kit option is used to convert a NEMA Type 1/IP21 to a NEMA Type 12/IP54 drive. The NEMA Type 12/IP54

kit consists of a metal drive shroud, fan kit for some frames, adaptor plate and plugs.

NEMA Type 12/IP54 Conversion Kit

Frame Size	Delivery Code	Approximate Dimensions in Inches (mm)			Approximate Weight Lb (kg)	Catalog Number
		Length	Width	Height		
FR4	W	13 (330)	7 (178)	4 (102)	4 (1.8)	OPTN12FR4
FR5		16 (406)	8 (203)	7 (178)	5 (2.3)	OPTN12FR5
FR6		21 (533)	10 (254)	5 (127)	7 (3.2)	OPTN12FR6

Flange Kits**Flange Kit NEMA Type 12/ IP54**

The flange kit is utilized when the power section is mounted through the back panel of an enclosure. Includes flange mount brackets and NEMA Type 12/IP54 fan components. Metal shroud not included.

Flange kits for NEMA Type 12/IP54 enclosure drive rating are determined by rating of drive.

Flange Kit NEMA Type 12/ IP54—Frames 4, 5 and 6^①

Frame Size	Delivery Code	Catalog Number
FR4	W	OPTTHRFR4
FR5		OPTTHRFR5
FR6		OPTTHRFR6

Flange Kit NEMA Type 12/ IP54—Frames 4–9

Frame Size	Delivery Code	Catalog Number
FR4	FP	OPTTHR4
FR5		OPTTHR5
FR6		OPTTHR6
FR7		OPTTHR7
FR8		OPTTHR8
FR9		OPTTHR9

Note

^① For installation of an SVX9000 NEMA Type 1/IP21 drive into a NEMA Type 12/IP54 oversized enclosure.

Options

9000X Series Option Board Kits

The 9000X Series drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of five option boards.

The 9000X Series factory installed standard board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B.

Option Boards		Option Board Kits		Field Installed	Factory Installed	SVX Ready Programs				
Option Kit Description ^①	Allowed Slot Locations ^②	Catalog Number	Option Designator	Basic	Local/ Remote	Standard	MSS	PID	Multi-P.	PFC
Standard I/O Cards										
6 DI, 1 DO, 2 AI, 1AO, 1 +10 Vdc ref, 2 ext +24 Vdc/EXT +24 Vdc	A	OPTA9	—	■	■	■	■	■	■	■
2 RO (NC-NO)	B	OPTA2	—	■	■	■	■	■	■	■
Extended I/O Cards										
2 RO, therm—SPX only	B	OPTA3	A3	—	■	■	■	■	■	■
Encoder low volt +5V/15V/24V—SPX only	C	OPTA4	A4	—	■	■	■	■	■	■
Encoder high volt +15V/24V—SPX only	C	OPTA5	A5	—	■	■	■	■	■	■
Double encoder—SPX only	C	OPTA7	A7	■	■	■	■	■	■	■
6 DI, 1 DO, 2 AI, 1 AO—SPX only	A	OPTA8	A8	—	■	■	■	■	■	■
3 DI (encoder 10–24V, out +15V/+24V, 2 DO (pulse+direction)—SPX only	C	OPTAE	AE	■	■	■	■	■	■	■
6 DI, 1 ext +24 Vdc/EXT +24 Vdc	B, C, D , E	OPTB1	B1	—	—	—	—	—	■	■
1 RO (NC-NO), 1 RO (NO), 1 therm	B, C, D , E	OPTB2	B2	—	—	—	—	—	■	■
1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24 Vdc/EXT +24 Vdc	B, C, D , E	OPTB4	B4	■	■	■	■	■	■	■
3 RO (NO)	B, C, D , E	OPTB5	B5	—	—	—	—	—	■	■
1 ext +24 Vdc/EXT +24 Vdc, 3 Pt100	B, C, D , E	OPTB8	B8	—	—	—	—	—	—	—
1 RO (NO), 5 DI 42–240 Vac input	B, C, D , E	OPTB9	B9	—	—	—	—	—	■	■
Communication Cards										
Modbus ^③	D, E	OPTC2	C2	■	■	■	■	■	■	■
Johnson Controls N2 ^③	D, E	OPTC2	CA	—	—	—	—	—	—	—
Modbus TCP	D, E	OPTCI	CI	■	■	■	■	■	■	■
BACnet	D, E	OPTCJ	CJ	■	■	■	■	■	■	■
EtherNet/IP	D, E	OPTCQ	CQ	■	■	■	■	■	■	■
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■	■	■
LonWorks	D, E	OPTC4	C4	■	■	■	■	■	■	■
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■	■	■
CANopen (slave) ^④	D, E	OPTC6	C6	■	■	■	■	■	■	■
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■	■	■
Modbus (D9 type connector)	D, E	OPTC8	C8	■	■	■	■	■	■	■
Adapter—SPX only	D, E	OPTD1	D1	■	■	■	■	■	■	■
Adapter—SPX only	D, E	OPTD2	D2	■	■	■	■	■	■	■
RS-232 with D9 connection	D, E	OPTD3	D3	■	■	■	■	■	■	■

Notes

① AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

② Option card must be installed in one of the slots listed for that card. Slot indicated in bold is the preferred location.

③ OPC2 is a multi-protocol option card.

④ SPX9000 drives only (FR10 and larger).

Modbus RTU Network Communications

The Modbus Network Card OPTC2 is used for connecting the 9000X Drive as a slave on a Modbus network. The interface is connected by a 9-pin DSUB connector (female) and the baud rate ranges from 300 to 19200 baud. Other communication parameters include an address range from 1 to 247; a parity of None, Odd or Even; and the stop bit is 1.

PROFIBUS Network Communications

The PROFIBUS Network Card OPTC3 is used for connecting the 9000X Drive as a slave on a PROFIBUS-DP network. The interface is connected by a 9-pin DSUB connector (female). The baud rates range from 9.6K baud to 12M baud, and the addresses range from 1 to 127.

LonWorks Network Communications

The LonWorks Network Card OPTC4 is used for connecting the 9000X Drive on a LonWorks network. This interface uses Standard Network Variable Types (SNVT) as data types. The channel connection is achieved using a FTT-10A Free Topology transceiver via a single twisted transfer cable. The communication speed with LonWorks is 78 kBits/s.

CANopen (Slave) Communications

The CANopen (Slave) Network Card OPTC6 is used for connecting the 9000X Drive to a host system. According to ISO11898 standard cables to be chosen for CAN bus should have a nominal impedance of 120 ohms, and specific line delay of nominal 5 nS/m. 120 ohms line termination resistors required for installation.

DeviceNet Network Communications

The DeviceNet Network Card OPTC7 is used for connecting the 9000X Drive on a DeviceNet Network. It includes a 5.08 mm pluggable connector. Transfer method is via CAN using a two-wire twisted shielded cable with two-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud.

Johnson Controls Metasys N2 Network Communications

The OPTC2 fieldbus board provides communication between the 9000X Drive and a Johnson Controls Metasys™ N2 network. With this connection, the drive can be controlled, monitored and programmed from the Metasys system. The N2 fieldbus is available as a factory installed option and as a field installable kit.

Modbus/TCP Network Communications

The Modbus/TCP Network Card OPTC1 is used for connecting the 9000X Drive to Ethernet networks utilizing Modbus protocol. It includes an RJ-45 pluggable connector. This interface provides a selection of standard and custom register values to communicate drive parameters. The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable over Ethernet using a supplied software tool.

BACnet Network Communications

The BACnet Network Card OPTCJ is used for connecting the 9000X Drive to BACnet networks. It includes a 5.08 mm pluggable connector. Data transfer is Master-Slave/Token Passing (MS/TP) RS-485. This interface uses a collection of 30 Binary Value Objects (BVOs) and 35 Analog Value Objects (AVOs) to communicate drive parameters. The card supports 9.6, 19.2 and 38.4 Kbaud communication speeds and supports network addresses 1-127.

EtherNet/IP Network Communications

The EtherNet/IP Network Card OPTCK is used for connecting the 9000X Drive to Ethernet/Industrial Protocol networks. It includes an RJ-45 pluggable connector. The interface uses CIP objects to communicate drive parameters (CIP is "Common Industrial Protocol", the same protocol used by DeviceNet). The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable by Static, BOOTP and DHCP methods.

Control Panel Options**Factory Options**

Description	Factory Installed Option Code	Field Installed NEMA Type 1/IP21 Catalog Number
Local/Remote Keypad SVX9000 Control Panel —This option is standard on all drives and consists of an RS-232 connection, backlit alphanumeric LCD display with nine indicators for the RUN status and two indicators for the control source. The nine pushbuttons on the panel are used for panel programming and monitoring of all SVX9000 parameters. The panel is detachable and isolated from the input line potential. Include LOC/REM key to choose control location.	A	KEYPAD-LOC/REM
Keypad Remote Mounting Kit —This option is used to remote mount the SVX9000 keypad. The footprint is compatible to the SV9000 remote mount kit. Includes 10 ft cable, keypad holder and mounting hardware.	—	OPTRMT-KIT-9000X

Miscellaneous Options

Description	Catalog Number
9000XDrive —A PC-based tool for controlling and monitoring of the SVX9000. Features include: loading parameters that can be saved to a file or printed, setting references, starting and stopping the motor, monitoring signals in graphical or text form, and real-time display. To avoid damage to the drive or computer, SVDriveable must be used.	9000XDRIVE
SVDriveable —6 ft (1.8m) RS-232 cable (22 gauge) with a 7-pin connector on each end. Should be used in conjunction with the 9000XDrive option to avoid damage to the SVX9000 or computer. The same cable can be used for downloading specialized applications to the drive.	SVDRIVECABLE
External Dynamic Braking Resistors —Used with the dynamic braking chopper circuit to absorb motor regenerative energy for stopping the load and to dissipate the energy flowing back into the drive. Resistors are separated into standard duty and heavy-duty. Standard duty is defined as 20% duty or less with 100% braking torque, while heavy-duty is defined as 50% duty or less with 150% braking torque.	See Page V6-T2-58

Open Drive Options**Brake Chopper Options****2**

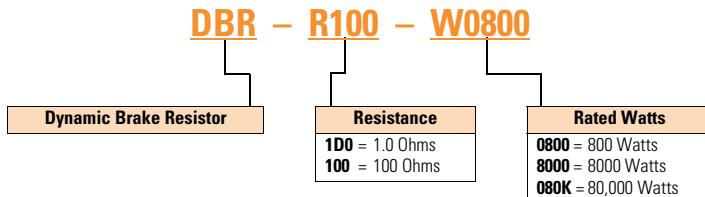
The brake chopper circuit option is used for applications that require dynamic braking. Dynamic braking resistors are not included with drive purchase. Consult the factory for additional dynamic braking resistor selections that are supplied separately. A list of common resistors are listed below and are complete indoor assemblies, include a pre-wired terminal block and a thermal switch, and are not UL Listed.

Duty Cycle

The duty cycle rating is based on a 60-second period. For example, the 20% duty cycle resistor can carry 100% current for 12 seconds out of every 60 seconds, while the 50% duty cycle resistor can carry 150% current for 30 seconds out of every 60 seconds.

Torque

If the braking torque required is less than 15%, dynamic braking is not required because the regenerated energy will be dissipated in the drive and motor losses.

Dynamic Brake Resistor—Catalog Number Selection**230V Brake Resistors**

Drive hp (CT/I _H)	Minimum Ohms	20% Duty Cycle, 100% Torque		50% Duty Cycle, 150% Torque	
		Catalog Number	Dimensions (Inches)	Catalog Number	Dimensions (Inches)
0.75	30.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1	30.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1.5	30.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R036-W1200	12W x 10D x 5H
2	30.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R036-W1200	12W x 10D x 5H
3	30.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R036-W2000	12W x 16D x 5H
4	30.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R030-W2400	19W x 10D x 5H
5	30.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R030-W2800	19W x 13D x 5H
7.5	20.0	DBR-R020-W1200	12W x 10D x 5H	DBR-R020-W4800	26.5W x 13D x 5H
10	10.0	DBR-R015-W1600	12W x 13D x 5H	DBR-R112-W6000	26.5W x 13D x 5H
15	10.0	DBR-R012-W2400	19W x 10D x 5H	DBR-R010-W9000	28W x 10D x 10H
20	3.3	DBR-R9D3-W3200	19W x 10D x 5H	DBR-R3D4-W012K	28W x 10D x 10H
25	3.3	DBR-R5D5-W4000	26.5W x 10D x 5H	DBR-R5D1-W015K	28W x 16D x 10H
30	3.3	DBR-R4D8-W4800	26.5W x 10D x 5H	DBR-R4D1-W020K	28W x 16D x 10H
40	1.4	DBR-R004-W6000	26.5W x 13D x 5H	DBR-R3D4-W025K	30W x 18D x 16H
50	1.4	DBR-R3D1-W7500	26.5W x 16D x 5H	DBR-R2D1-W030K	30W x 18D x 24H
60	1.4	DBR-R2D8-W9000	26.5W x 16D x 5H	DBR-R002-W036K	30W x 18D x 24H
75	1.4	DBR-R2D6-W012K	28W x 10D x 10H	DBR-R1D5-W045K	30W x 18D x 32H
100	1.4	DBR-R002-W015K	28W x 16D x 10H	DBR-R1D4-W060K	30W x 18D x 40H

480V Brake Resistors

Drive hp (CT/I _H)	Minimum Ohms	20% Duty Cycle, 100% Torque		50% Duty Cycle, 150% Torque	
		Catalog Number	Dimensions (Inches)	Catalog Number	Dimensions (Inches)
1	63.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1.5	63.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W1200	12W x 10D x 5H
2	63.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W1200	12W x 10D x 5H
3	63.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2000	12W x 16D x 5H
5	63.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2800	19W x 13D x 5H
6	63.0	DBR-R100-W1200	12W x 10D x 5H	DBR-R070-W4000	19W x 16D x 5H
7.5	63.0	DBR-R100-W1200	12W x 10D x 5H	DBR-R063-W4800	26.5W x 13D x 5H
10	63.0	DBR-R063-W1600	12W x 13D x 5H	DBR-R063-W6000	26.5W x 16D x 5H
15	42.0	DBR-R042-W2400	19W x 10D x 5H	DBR-R042-W9000	28W x 10D x 10H
20	21.0	DBR-R030-W3200	19W x 13D x 5H	DBR-R023-W012K	28W x 13D x 10H
25	21.0	DBR-R030-W4000	19W x 16D x 5H	DBR-R021-W015K	28W x 13D x 10H
30	14.0	DBR-R020-W4800	26.5W x 13D x 5H	DBR-R014-W020K	30W x 18D x 24H
40	6.5	DBR-R112-W6000	26.5W x 13D x 5H	DBR-R007-W025K	30W x 18D x 16H
50	6.5	DBR-R013-W7500	26.5W x 16D x 5H	DBR-R8D5-W030K	30W x 18D x 24H
60	6.5	DBR-R010-W9000	28W x 10D x 10H	DBR-R7D3-W036K	30W x 18D x 24H
75	3.3	DBR-R009-W012K	28W x 13D x 10H	DBR-R3D3-W045K	30W x 18D x 32H
100	3.3	DBR-R5D1-W015K	28W x 16D x 10H	DBR-R004-W060K	30W x 18D x 40H
125	3.3	DBR-R4D1-W020K	28W x 16D x 10H	DBR-R004-W070K	30W x 18D x 48H
150	3.3	DBR-R3D4-W025K	30W x 18D x 16H	DBR-R3D5-W085K	30W x 18D x 56H
200	3.3	DBR-R3D3-W030K	30W x 18D x 24H	DBR-R3D3-W110K	30W x 18D x 72H
250	1.4	DBR-R2D5-W036K	30W x 18D x 24H	①	—
300	1.4	DBR-R1D5-W045K	30W x 18D x 32H	①	—
350	1.4	DBR-R1D4-W060K	30W x 18D x 40H	①	—
400	0.9	DBR-R1D4-W060K	30W x 18D x 40H	①	—
500	0.9	DBR-R0D9-W080K	30W x 18D x 48H	①	—
550	0.9	DBR-R001-W085K	30W x 18D x 56H	①	—

Note

① Consult factory.

575V Brake Resistors

2

Drive hp (CT/I _H)	Minimum Ohms	20% Duty Cycle, 100% Torque		50% Duty Cycle, 150% Torque	
		Catalog Number	Dimensions (Inches)	Catalog Number	Dimensions (Inches)
2	100.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W1200	12W x 10D x 5H
3	100.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2000	12W x 16D x 5H
4	100.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2400	19W x 10D x 5H
5	100.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2800	19W x 13D x 5H
7.5	100.0	DBR-R100-W1200	12W x 10D x 5H	DBR-R100-W4800	26.5W x 13D x 5H
10	30.0	DBR-R063-W1600	12W x 13D x 5H	DBR-R063-W6000	26.5W x 16D x 5H
15	30.0	DBR-R042-W2400	19W x 10D x 5H	DBR-R042-W9000	28W x 10D x 10H
20	30.0	DBR-R030-W3200	19W x 13D x 5H	DBR-R030-W012K	28W x 13D x 10H
25	30.0	DBR-R030-W4000	19W x 16D x 5H	DBR-R030-W015K	28W x 16D x 10H
30	18.0	DBR-R020-W4800	26.5W x 13D x 5H	DBR-R020-W020K	30W x 18D x 16H
40	18.0	DBR-R030-W6000	26.5W x 16D x 5H	DBR-R184-W025K	30W x 18D x 16H
50	9.0	DBR-R013-W7500	26.5W x 16D x 5H	DBR-R012-W030K	30W x 18D x 24H
60	9.0	DBR-R010-W9000	28W x 10D x 10H	DBR-R010-W036K	30W x 18D x 24H
75	9.0	DBR-R009-W012K	28W x 13D x 10H	DBR-R009-W045K	30W x 18D x 24H
100	7.0	DBR-R013-W015K	28W x 16D x 10H	DBR-R8D4-W060K	30W x 18D x 40H
125	7.0	DBR-R8D2-W020K	30W x 18D x 10H	DBR-R007-W070K	30W x 18D x 40H
150	7.0	DBR-R007-W025K	30W x 18D x 16H	DBR-R006-W085K	30W x 18D x 56H
175	7.0	DBR-R007-W030K	30W x 18D x 24H	DBR-R007-W100K	30W x 18D x 72H
200	2.5	DBR-R3D3-W030K	30W x 18D x 24H	DBR-R2D6-W110K	30W x 18D x 64H
250	2.5	DBR-R2D5-W036K	30W x 18D x 24H	DBR-R003-W140K	30W x 18D x 72H
300	2.5	DBR-R3D3-W045K	30W x 18D x 32H	①	—
400	1.7	DBR-R002-W060K	30W x 18D x 48H	①	—
450	1.7	DBR-R1D8-W070K	30W x 18D x 48H	①	—
500	1.7	DBR-R002-W080K	30W x 18D x 56H	①	—

Note

① Consult factory.

Replacement Parts**FR4 Spare Parts**

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	PP01086	PP01086	—
Control module ②	SVX control module	1	CSBS0000000000	CSBS0000000000	—
	Standard slot A I/O card	1	OPTA9	OPTA9	—
	Standard slot B I/O card	1	OPTA2	OPTA2	—
Converter	Power board ③	1	VB00308-0004-2	VB00208-0003-5	—
		1	VB00308-0007-2	VB00208-0004-5	—
		1	VB00308-0008-2	VB00208-0005-5	—
		1	—	VB00208-0007-5	—
		1	—	VB00208-0009-5	—
		1	—	VB00410-0012-5-ARV	—
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	—
Main fan ②	DC fan (main)	1	PP01060	PP01060	—
Other	Mounting kit, fixing kit	1	FR00040	FR00040	—
	Mounting kit, fixing kit, N12 ①	1	FR00079	FR00079	—
	Control cover, plastic, N1	1	FR00006	FR00006	—

FR5 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	PP01088	PP01088	—
Control module ②	SVX control module	1	CSBS0000000000	CSBS0000000000	—
	Standard slot A I/O card	1	OPTA9	OPTA9	—
	Standard slot B I/O card	1	OPTA2	OPTA2	—
Converter	Power board ③	1	VB00313-0017-2	VB00213-0016-5	—
		1	VB00313-0025-2	VB00213-0022-5	—
		1	VB00313-0031-2	VB00213-0031-5	—
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	—
Main fan ②	DC fan (main)	1	PP01061	PP01061	—
Other	Mounting kit, fixing kit	1	FR00050	FR00050	—
	Mounting kit, fixing kit, N12 ①	1	FR00081	FR00081	—
	Control cover, plastic, N1	1	FR05011	FR05011	—

Notes

- ① Only for NEMA Type 12/IP54 Type drives.
 ② Factory recommended spare parts.
 ③ Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR6 Spare Parts

2

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	PP01049	PP01049	—
Control module ②	SVX control module	1	CSBS0000000000	CSBS0000000000	CSBS0000000000
	Standard slot A I/O card	1	OPTA9	OPTA9	OPTA9
	Standard slot B I/O card	1	OPTA2	OPTA2	OPTA2
Converter	Power board ③	1	VB00316-0048-2	VB00416-0038-5	VB00404-0004-6
		1	VB00316-0061-2	VB00416-0045-5	VB00404-0005-6
		1	—	VB00416-0061-5	VB00404-0007-6
		1	—	—	VB00404-0010-6
		1	—	—	VB00404-0013-6
		1	—	—	VB00404-0018-6
		1	—	—	VB00404-0022-6
		1	—	—	VB00404-0027-6
		1	—	—	VB00404-0034-6
DC section	Bus capacitor	2	—	—	S00930
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main fan ②	DC fan (main)	1	PP01062	PP01062	—
Other	Mounting kit, fixing kit	1	FR00060	FR00060	FR00060
	Mounting kit, fixing kit, N12 ①	1	FR00082	FR00082	FR00082
	Control cover, plastic, N1	1	FR06011	FR06011	FR06011

FR7 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	PP01049	PP01049	PP01049
Control module ②	SVX control module	1	CSBS0000000000	CSBS0000000000	CSBS0000000000
	Standard slot A I/O card	1	OPTA9	OPTA9	OPTA9
	Standard slot B I/O card	1	OPTA2	OPTA2	OPTA2
Converter	Power board ③	1	VB00319-0075-2	VB00619-0072-5	VB00419-0041-6
		1	VB00319-0088-2	VB00619-0087-5	VB00419-0052-6
		1	VB00319-0114-2	VB00619-0105-5	—
DC section	Bus capacitor	2	—	—	PP01041
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main fan ②	DC fan (main)	1	PP01063	PP01063	PP01063
Other	Mounting kit, fixing kit	1	FR07071	FR07071	FR07071
	Mounting kit, fixing kit, N12 ①	1	FR07072	FR07072	FR07072
	Control cover, plastic, N1	1	FR07011	FR07011	FR07011

Notes

- ① Only for NEMA Type 12/IP54 Type drives.
- ② Factory recommended spare parts.
- ③ Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR8 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	CP01180	CP01180	CP01180
Control module ②	SVX control module	1	CSBS0000000000	CSBS0000000000	CSBS0000000000
	Standard slot A I/O card	1	OPTA9	OPTA9	OPTA9
	Standard slot B I/O card	1	OPTA2	OPTA2	OPTA2
Converter	Power board ③	1	VB00722-0140-2-ANV	VB00636-0140-4-ANV	VB00422-0062-5-ANV
		1	VB00722-0170-2-ANV	VB00636-0168-4-ANV	VB00422-0080-5-ANV
		1	VB00722-0205-2-ANV	VB00636-0205-4-ANV	VB00422-0100-5-ANV
	IGBT	2	PP01175	PP01175	PP01127
DC section	Bus capacitor	4	S00335	S00335	PP01041
Inverter	Diode	3	CP01268	CP01268	CP01373
	Rectifier board	1	VB00227	VB00227	VB00427
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan AC	1	PP01123	PP01123	PP01123
	Fan fuse	2	PP20202	PP20202	PP20202
	Starting cap	1	S00734	S00734	S00734
	Fan driver board AC	1	VB00599	VB00799	VB00799
	Isolation transformer (fan)	1	S0000113	S0000113	S0000113
Main DC fan ②	DC fan	1	PP00071	PP00071	PP00071
	DC power supply	1	S01016	S01016	S01016
Other	Front cover, N12 ①	1	FR08079	FR08079	FR08079
	Conduit plate, N12	1	FR08082	FR08082	FR08082
	Front cover, N1	1	FR08106	FR08106	FR08106

Notes

- ① Only for NEMA Type 12/IP54 Type drives.
 ② Factory recommended spare parts.
 ③ Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR9 Spare Parts

2

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	50 mm fan	1	PP09041	PP09041	PP09041
	80 mm fan	1	PP01068	PP01068	PP01068
Control module ①	SVX control module	1	CSBS0000000000	CSBS0000000000	CSBS0000000000
	Standard slot A I/O card	1	OPTA9	OPTA9	OPTA9
	Standard slot B I/O card	1	OPTA2	OPTA2	OPTA2
Converter	Power module ②	1	FR09-0261-2-ANV	FR09-0261-4-ANV	FR09-0125-5-ANV
		1	FR09-0300-2-ANV	FR09-0300-4-ANV	FR09-0144-5-ANV
		1	—	—	FR09-0170-5-ANV
	Driver board	1	S00583	S00583	S00583
	Shunt board ②	6	—	VB00535	VB00537
		6	—	VB00536	VB00542
		6	—	—	VB00543
DC section	Balancing resistor	3	PP00052	PP00052	PP00052
	Bus capacitor	8	S00335	S00335	PP01041
	DC busbars DC-	1	FR09043	FR09043	FR09043
	DC busbars DC+	1	FR09044	FR09044	FR09044
	DC busbars connection	1	FR09045	FR09045	FR09045
	DC busbars +/- insulator	1	FR09046	FR09046	FR09046
	DC busbars -/con insulator	1	FR09047	FR09047	FR09047
Inverter	Rectifier module	1	FR09826	FR09822	FR09823
	Diode	3	CP01268	CP01268	CP01268
	Rectifier board	1	—	VB00459	VB00460
Keypad ①	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan AC	1	PP01080	PP01080	PP01080
	Fan fuse	2	PP20202	PP20202	PP20202
	Starting cap	1	S00465	S00465	S00465
	Fan driver board AC	1	VB00899	VB00399	VB00299
	Isolation transformer (fan)	1	PP09056	PP09055	PP09055
Main DC fan ①	DC fan	1	PP00072	PP00072	PP00072
	DC power supply	1	S01017	S01017	S01017
Other	Front cover power	1	FR09012	FR09012	FR09012
	Front cover connection	1	FR09013	FR09013	FR09013
	Front power conduit	1	FR09014	FR09014	FR09014

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR10 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	Fiber board	1	—	S00451	S00451
	ASIC board	1	—	S00457	S00457
Control fan	ASIC fan	1	—	PP01096	PP01096
Control module ①	SVX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	1	—	FR10-0385-4-ANV	FR10-0261-5-ANV
		1	—	FR10-0460-4-ANV	FR10-0325-5-ANV
		1	—	FR10-0520-4-ANV	FR10-0385-5-ANV
		1	—	—	FR10-0416-5-ANV
	Driver board	1	—	S00450	S00450
	Driver adapter board	1	—	VB00330	VB00330
	Shunt board ②	6	—	VB00497	VB00510
		6	—	VB00498	VB00511
		6	—	VB00537	VB00545
Covers	Top cover	1	—	FR10340	FR10340
	Side cover	2	—	FR10341	FR10341
DC section	Balancing resistor	2	—	PP13027	PP13028
	DC busbars kit (right)	1	—	S0000005	S0000005
	Bus capacitor	12	—	S00335	S00336
Inverter	Rectifier module	1	—	FR10823	FR10823
	Charging resistor	1	—	PP00066	PP00066
	Diode	3	—	PP01177	PP01177
	Rectifier board	1	—	S00591	S00592
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (left)	1	—	FR10846	FR10846
	Fan assembly (right)	1	—	FR10847	FR10847
	Fan AC	2	—	PP01080	PP01080
	Fan fuse	4	—	PP20202	PP20202
	Starting cap	2	—	S00528	S00528
	Fan driver board AC	2	—	VB00299	VB00299
	Isolation transformer (left)	1	—	FR10844	FR10844
	Isolation transformer (right)	1	—	FR10845	FR10845
Main DC fan ①	DC fan	2	—	PP00072	PP00072
	DC power supply	2	—	S01017	S01017

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR11 Spare Parts

2

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	Fiber board	1	—	S00451	S00451
	ASIC board	1	—	S00457	S00457
Control fan	ASIC fan	1	—	PP01096	PP01096
Control module ①	SVX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	1	—	FR11-0590-4-ANV	FR11-0460-5-ANV
		1	—	FR11-0650-4-ANV	FR11-0502-5-ANV
		1	—	FR11-0730-4-ANV	FR11-0590-5-ANV
	Driver board	1	—	S00452	S00452
	Driver adapter board	1	—	VB00330	VB00330
	Shunt board ②	9	—	VB00513	VB00512
		9	—	VB00514	VB00546
		9	—	VB00538	VB00547
Covers	Top cover	1	—	FR11345	FR11345
DC section	Balancing resistor	3	—	PP13027	PP13027
	DC busbars kit (right)	3	—	S0000005	S0000005
	Bus capacitor	18	—	S00335	S00335
Inverter	Rectifier module	1	—	FR10823	FR10823
	Diode	3	—	PP01177	PP01177
	Rectifier board	1	—	S00591	S00591
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (right)	3	—	FR10847	FR10847
	Fan AC	3	—	PP01080	PP01080
	Fan fuse	4	—	PP20202	PP20202
	Starting cap	3	—	S00530	S00530
	Fan driver board AC	3	—	VB00299	VB00299
	Isolation transformer (right)	3	—	FR10845	FR10845
Main DC fan ①	DC fan	2	—	PP00072	PP00072
	DC power supply	2	—	S01017	S01017

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR12 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	Fiber board	2	—	S00451	S00451
	ASIC board	2	—	S00457	S00457
	Star coupler	1	—	S00593	S00593
Control fan	ASIC fan	2	—	PP01096	PP01096
Control module ①	SVX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	1	—	FR12-0820-4-ANV	FR12-0650-5-ANV
		1	—	FR12-0920-4-ANV	FR12-0750-5-ANV
		1	—	FR12-1030-4-ANV	FR12-0820-5-ANV
	Driver board	2	—	S00450	S00450
	Driver adapter board	2	—	VB00330	VB00330
	Shunt board	12	—	VB00498	VB00511
Covers	Top cover	2	—	FR10340	FR10340
	Side cover	4	—	FR10341	FR10341
DC section	Balancing resistor	4	—	PP13027	PP13027
	DC busbars kit (right)	2	—	S000005	S000005
	Bus capacitor	24	—	S00335	S00336
Inverter	Rectifier module	2	—	FR10823	FR10823
	Diode	3	—	PP01177	PP01177
	Rectifier board	2	—	S00591	S00591
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (left)	2	—	FR10846	FR10846
	Fan assembly (right)	2	—	FR10847	FR10847
	Fan AC	4	—	PP01080	PP01080
	Fan fuse	8	—	PP20202	PP20202
	Starting cap	4	—	S00528	S00528
	Fan driver board AC	4	—	VB00299	VB00299
	Isolation transformer (left)	2	—	FR10844	FR10844
	Isolation transformer (right)	2	—	FR10845	FR10845
Main DC fan ①	DC fan	4	—	PP00072	PP00072
	DC power supply	4	—	S01017	S01017

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR13 Spare Parts

2

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	ASIC board	1	—	S00457	S00457
	ASIC assembly	1	—	60S01030	60S01030
Control fan	ASIC fan	1	—	PP01096	PP01096
Control module ①	SVX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	3	—	FI13-1150-4-ANV	FR13-1030-5-ANV
		3	—	FI13-1300-4-ANV	FR13-1180-5-ANV
		3	—	FI13-1450-4-ANV	FR13-920-5-ANV
	Driver board	3	—	S00454	S00454
	Driver adapter board	2	—	VB00330	VB00330
	Shunt board ②	18	—	VB00505	VB00516
		18	—	VB00514	VB00517
		18	—	VB00541	VB00547
Covers	Top cover	3	—	FI10001	FI10001
	Side cover	3	—	FI10003	FI10003
DC section	Balancing resistor	6	—	PP13034	PP13034
	Bus capacitor	36	—	S00335	S00336
	DC busbars kit	3	—	FI13329	FI13329
Inverter	Rectifier module	2	—	FR10823	FR10823
	Diode	3	—	PP01177	PP01177
	Rectifier board	2	—	S00591	S00591
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (left)	3	—	FI13301	FI13301
	Fan AC	3	—	PP01080	PP01080
	Fan fuse	6	—	PP20202	PP20202
	Starting cap	3	—	S00520	S00520
	Fan driver board AC	3	—	VB00299	VB00299
	Isolation transformer	3	—	PP10057	PP10057
Main DC fan ①	DC fan	4	—	PP00072	PP00072
	DC power supply	4	—	S01017	S01017

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR14 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	ASIC board	2	—	S00457	S00457
	Star coupler	1	—	S00593	S00593
	ASIC assembly	2	—	60S01030	60S01030
	Star coupler kit	1	—	FR10860	FR10860
Control fan	ASIC fan	2	—	PP01096	PP01096
Control module ①	SVX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	1	—	FR14-1770-4-ANV	FR14-1500-5-ANV
		1	—	FR14-2150-4-ANV	FR14-1900-5-ANV
		1	—	FR14-2700-4-ANV	FR14-2250-5-ANV
	Driver board	6	—	S00454	S00454
	Driver adapter board	2	—	VB00330	VB00330
	Shunt board ②	36	—	VB00541	VB00516
		36	—	—	VB00517
Covers	Top cover	6	—	FI10001	FI10001
	Side cover	6	—	FI10003	FI10003
DC section	Balancing resistor	6	—	PP13034	PP13034
	Bus capacitor	72	—	S00335	S00336
	DC busbars kit	6	—	FI13329	FI13329
Inverter	Rectifier module	2	—	FR10823	FR10823
	Diode	3	—	PP01177	PP01177
	Rectifier board	2	—	S00591	S00591
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (left)	6	—	FI13301	FI13301
	Fan AC	6	—	PP01080	PP01080
	Fan fuse	12	—	PP20202	PP20202
	Starting cap	6	—	S00520	S00520
	Fan driver board AC	6	—	VB00299	VB00299
	Isolation transformer	6	—	PP10057	PP10057
Main DC fan ①	DC fan	6	—	PP00072	PP00072
	DC power supply	6	—	S01017	S01017

Notes

- ① Factory recommended spare parts.
 ② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

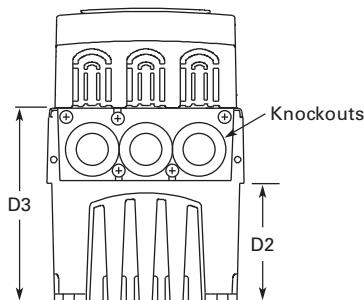
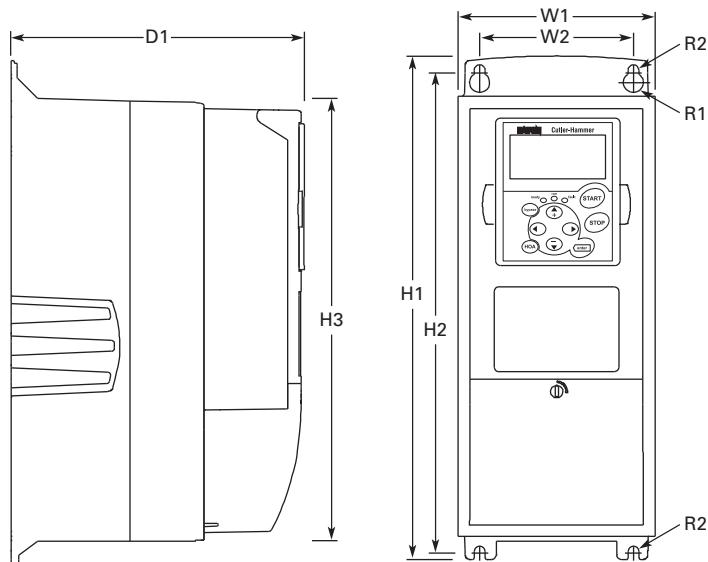
Technical Data and Specifications**SVX9000 Drives**

2

Description	Specification	Description	Specification
Input Ratings			
Input voltage (V_{in})	+10%/-15%	Analog input voltage	0 to 10V, $R = 200$ kohms (-10 to 10V joystick control) resolution 0.1%; accuracy ±1%
Input frequency (f_{in})	50/60 Hz (variation up to 45–66 Hz)	Analog input current	0(4) to 20 mA; $R_t = 250$ ohms differential
Connection to power	Once per minute or less (typical operation)	Digital inputs (6)	Positive or negative logic; 18 to 30 Vdc
High withstand rating	100 kAIC	Auxiliary voltage	+24V ±15%, max. 250 mA
Output Ratings			
Output voltage	0 to V_{in}	Output reference voltage	+10V +3%, max. load 10 mA
Continuous output current	I_H rated 100% at 122°F (50°C), FR9 and below I_L rated 100% at 104°F (40°C), FR9 and below I_H/I_L 100% at 104°F (40°C), FR10 and above	Analog output	0(4) to 20 mA; R_t max. 500 ohms; resolution 10 bit; accuracy ±2%
Overload current (I_H/I_L)	150% I_H , 110% I_L for 1 min.	Digital outputs	Open collector output, 50 mA/48V
Output frequency	0 to 320 Hz	Relay outputs	Two programmable Form C relay outputs switching capacity: 24 Vdc/8A, 250 Vac/8A, 125 Vdc/0.4A
Frequency resolution	0.01 Hz		
Initial output current (I_H)	250% for 2 seconds		
Control Characteristics			
Control method	Frequency control (V/f) Open loop: Sensorless vector control Closed loop: SPX9000 drives only	Protections	
Switching frequency	Adjustable with parameter 2.6.9	Overcurrent protection	Trip limit 4.0 x I_H instantaneously
Frame 4–6	1–16 kHz; default 10 kHz	Oversupply protection	Yes
Frame 7–12	1–10 kHz; default 3.6 kHz	Undervoltage protection	Yes
Frequency reference	Analog input: Resolution 0.1% (10-bit), accuracy ±1% V/Hz Panel reference: Resolution 0.01 Hz	Earth fault protection	In case of earth fault in motor or motor cable, only the frequency converter is protected
Field weakening point	30–320 Hz	Input phase supervision	Trips if any of the input phases are missing
Acceleration time	0–3000 sec.	Motor phase supervision	Trips if any of the output phases are missing
Deceleration time	0–3000 sec.	Overtemperature protection	Yes
Braking torque	DC brake: 30% x T_n (without brake option)	Motor overload protection	Yes
Ambient Conditions			
Ambient operating temperature	14°F (−10°C), no frost to 122°F (50°C) I_H (FR4–FR9) 14°F (−10°C), no frost to 104°F (40°C) I_H (FR10 and up) 14°F (−10°C), no frost to 104°F (40°C) I_L (all frames)	Motor stall protection	Yes
Storage temperature	−40° to 158°F (−40° to 70°C)	Motor underload protection	Yes
Relative humidity	0 to 95% RH, noncondensing, non-corrosive, no dripping water	Short-circuit protection	Yes (+24V and +10V reference voltages)
Air quality	Chemical vapors: IEC 721-3-3, unit in operation, class 3C2; Mechanical particles: IEC 721-3-3, unit in operation, class 3S2		
Altitude	100% load capacity (no derating) up to 3280 ft (1000m); 1% derating for each 328 ft (100m) above 3280 ft (1000m); max. 9842 ft (3000m)		
Vibration	EN 50178, EN 60068-2-6; 5 to 50 Hz, displacement amplitude 1 mm (peak) at 3 to 15.8 Hz, max. acceleration amplitude 1G at 15.8 to 150 Hz		
Shock	EN 50178, EN 60068-2-27 UPS Drop test (for applicable UPS weights) Storage and shipping: max. 15G, 11 ms (in package)		
Enclosure class	NEMA 1/IP21 or NEMA 12/IP54, open chassis/IP20		
Standard I/O Specifications			
Description		Specification	
Six-digital input programmable		24V: "0" ≤10V, "1" ≥18V, $R_t > 5$ kohms	
Two-analog input configurable w/jumpers		Voltage: 0–±10V, $R_t > 200$ kohms Current: 0(4)–20 mA, $R_t = 250$ ohms	
Two-digital output programmable		Form C relays 250 Vac 30 Vdc 2 amp resistive	
One-analog output programmable configurable w/jumper		0–20 mA, R_L max. 500 ohms 10 bits ±2%	
One digital output programmable		Open collector 48 Vdc 50 mA	

Dimensions

Approximate Dimensions in Inches (mm)

9000X Open Drives**NEMA Type 1/IP21 and NEMA Type 12/IP54, FR4, FR5 and FR6**

Voltage	hp (l _H)	H1	H2	H3	D1	D2	D3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)	Knockouts at Inches (mm) N1 (O.D.)
FR4													
230V	3/4-3	12.9 (327)	12.3 (313)	11.5 (292)	7.5 (190)	3.0 (77)	4.9 (126)	5.0 (128)	3.9 (100)	0.5 (13)	0.3 (7)	11.0 (5)	3 @ 1.1 (28)
480V	1-5												
FR5													
230V	5-7-1/2	16.5 (419)	16.0 (406)	15.3 (389)	8.4 (214)	3.9 (100)	5.8 (148)	5.6 (143)	3.9 (100)	0.5 (13)	0.3 (7)	17.9 (8)	2 @ 1.5 (37) 1 @ 1.1 (28)
480V	7-1/2-15												
FR6													
230V	10-15	22.0 (558)	21.3 (541)	20.4 (519)	9.3 (237)	4.2 (105)	6.5 (165)	7.6 (195)	5.8 (148)	0.6 (15.5)	0.4 (9)	40.8 (19)	3 @ 1.5 (37)
480V	20-30												
575V	2-25												

2.5

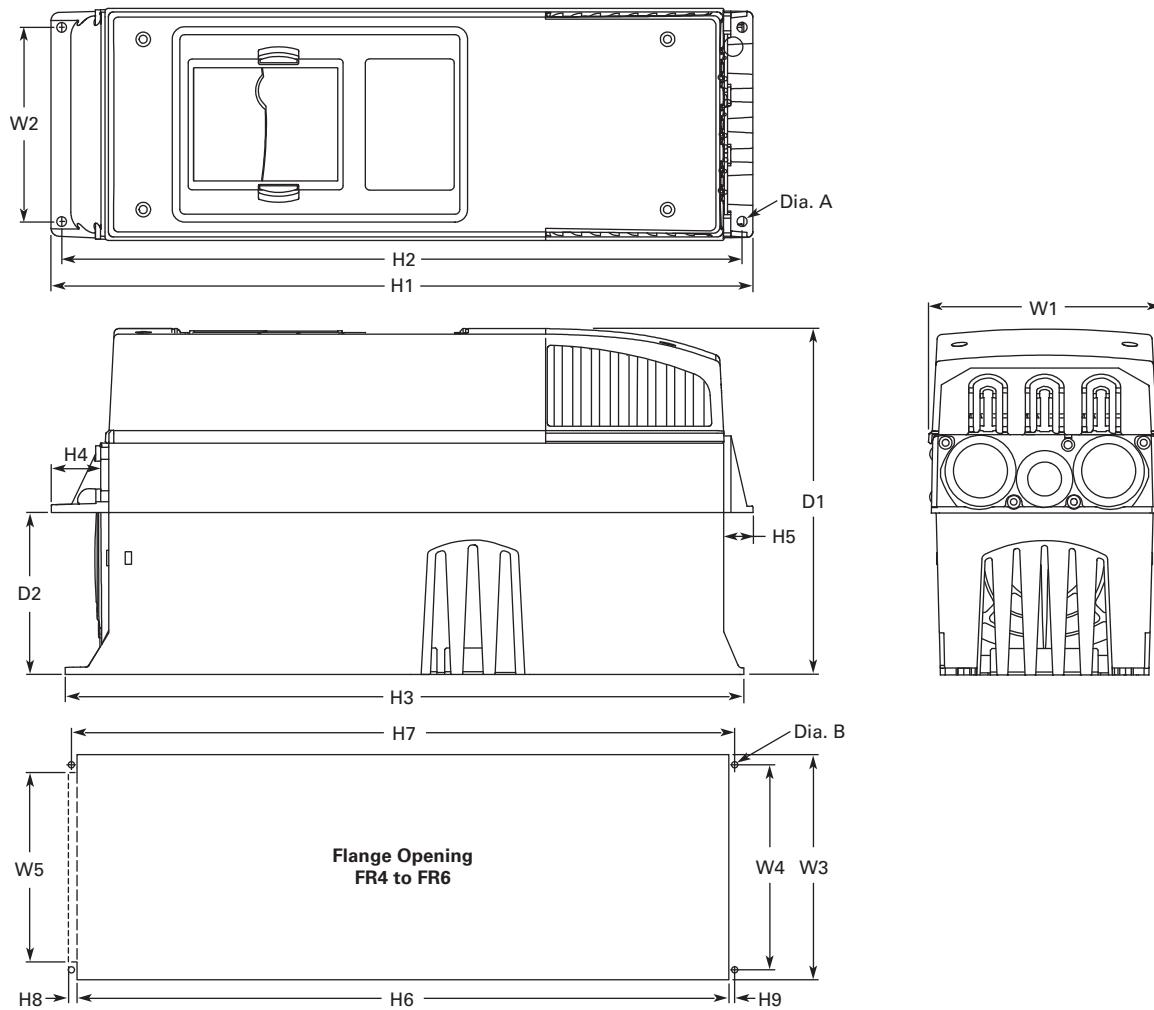
Adjustable Frequency Drives

SVX9000 Drives

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54 with Flange Kit, FR4, FR5 and FR6

2



FR4, FR5 and FR6 with Flange Kit

W1	W2	H1	H2	H3	H4	H5	D1	D2	Dia. A
FR4									
5.0 (128)	4.5 (113)	13.3 (337)	12.8 (325)	12.9 (327)	1.2 (30)	0.9 (22)	7.5 (190)	3.0 (77)	0.3 (7)
FR5									
5.6 (143)	4.7 (120)	17.0 (434)	16.5 (420)	16.5 (419)	1.4 (36)	0.7 (18)	8.4 (214)	3.9 (100)	0.3 (7)
FR6									
7.7 (195)	6.7 (170)	22.0 (560)	21.6 (549)	22.0 (558)	1.2 (30)	0.8 (20)	9.3 (237)	4.2 (106)	0.3 (7)

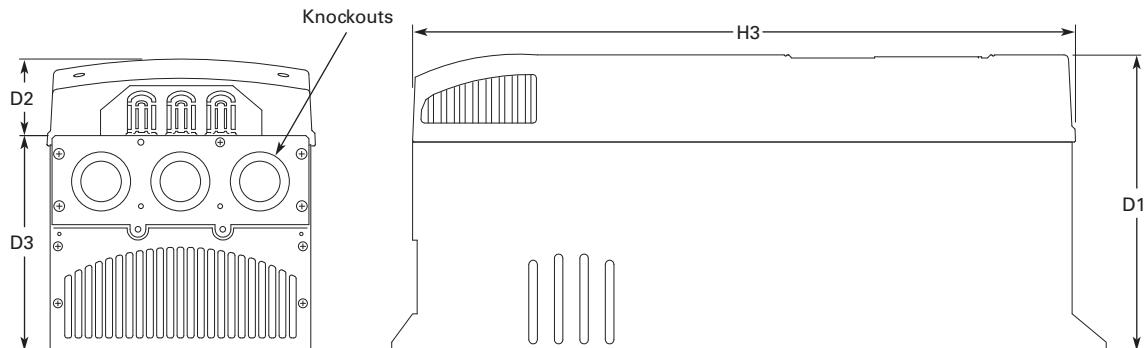
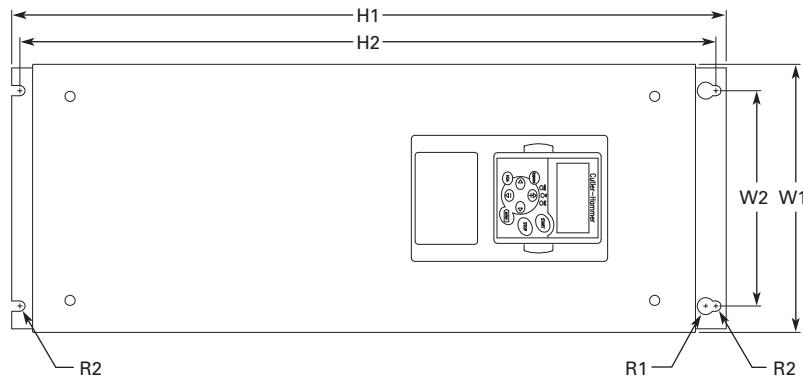
Flange Opening, FR4 to FR6

W3	W4	W5	H6	H7	H8	H9	Dia. B
FR4							
4.8 (123)	4.5 (113)	—	12.4 (315)	12.8 (325)	—	0.2 (5)	0.3 (7)
FR5							
5.3 (135)	4.7 (120)	—	16.2 (410)	16.5 (420)	—	0.2 (5)	0.3 (7)
FR6							
7.3 (185)	6.7 (170)	6.2 (157)	21.2 (539)	21.6 (549)	0.3 (7)	0.2 (5)	0.3 (7)

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, FR7

2



Voltage	hp (kW)	H1	H2	H3	D1	D2	D3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)	Knockouts at Inches (mm) N1 (O.D.)
230V	20–30	24.8 (630)	24.2 (614)	23.2 (590)	10.1 (257)	3.0 (77)	7.3 (184)	9.3 (237)	7.5 (190)	0.7 (18)	0.4 (9)	77.2 (35)	3 at 1.5 (37)
480V	40–60												
575V	30–40												

2.5

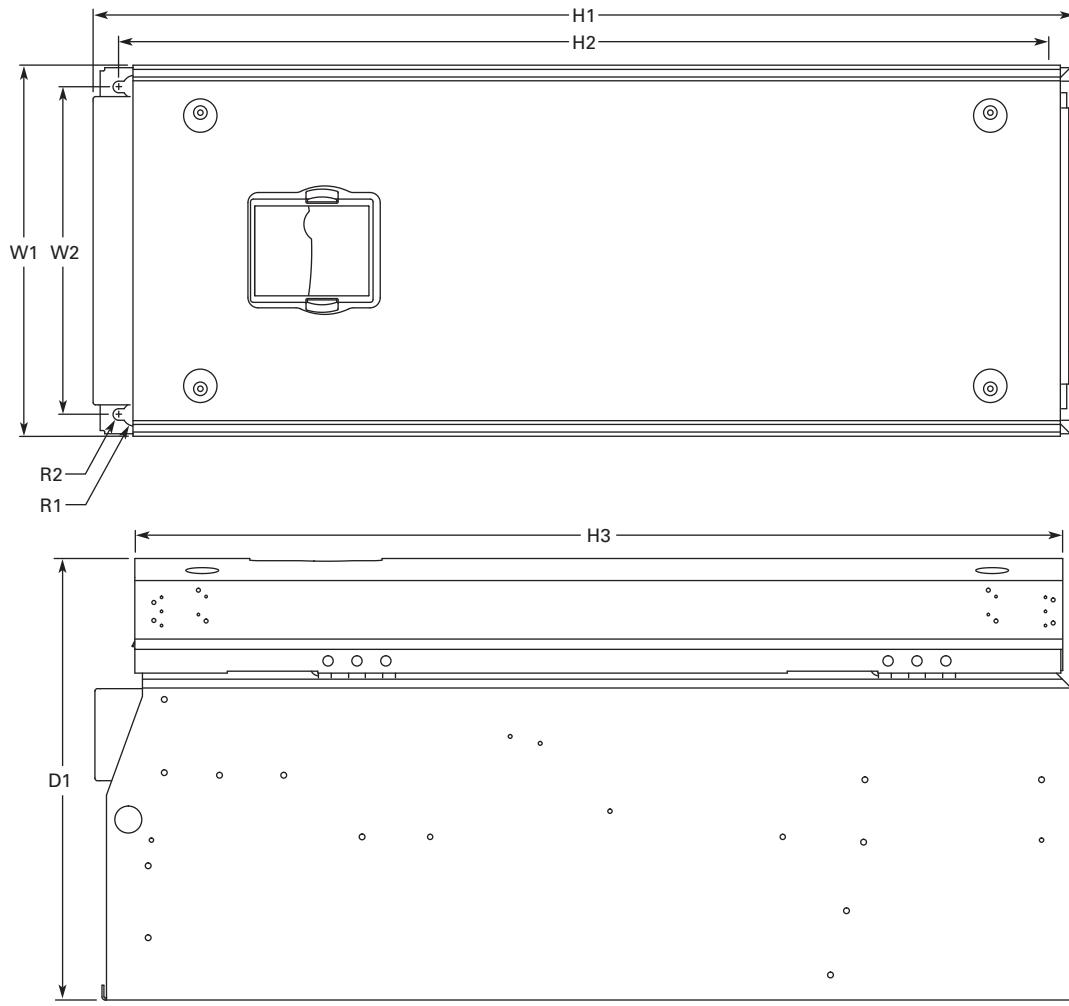
Adjustable Frequency Drives

SVX9000 Drives

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, FR8

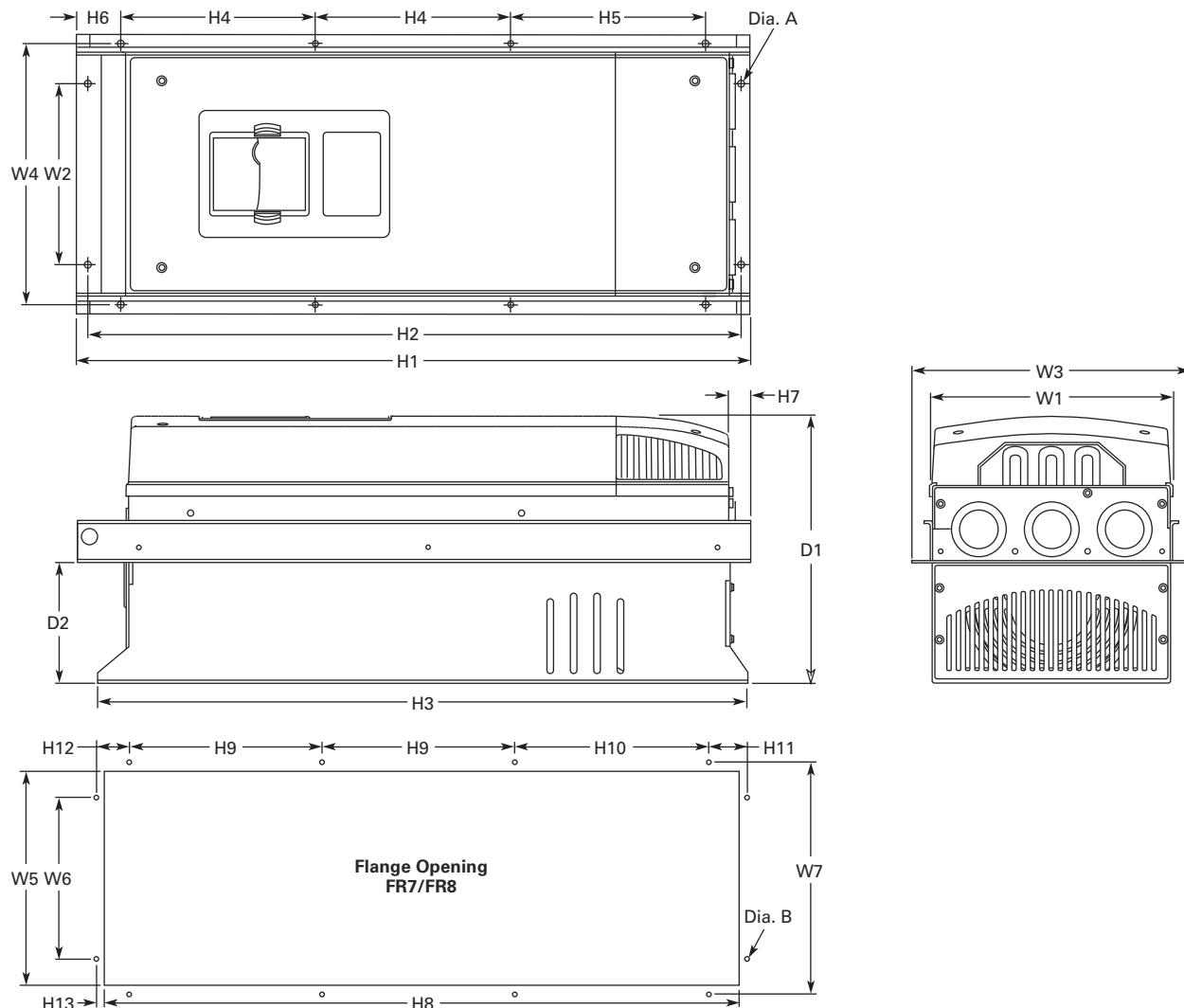
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Voltage	hp (l _H)	D1	H1	H2	H3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)
230V	40–60	13.5 (344)	30.1 (764)	28.8 (732)	28.4 (721)	11.5 (291)	10 (255)	0.7 (18)	0.4 (9)	127 (58)
480V	75–125									
575V	50–75									

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, with Flange Kit, FR7 and FR8



W1	W2	W3	W4	H1	H2	H3	H4	H5	H6	H7	D1	D2	Dia. A
FR7													
9.3 (237)	6.8 (175)	10.6 (270)	10.0 (253)	24.9 (652)	24.8 (632)	24.8 (630)	7.4 (189)	7.4 (189)	0.9 (23)	0.8 (20)	10.1 (257)	4.6 (117)	0.3 (6)
FR8													
11.2 (285)	—	14.0 (355)	13.0 (330)	32.8 (832)	—	29.3 (745)	10.2 (258)	10.4 (265)	1.7 (43)	2.2 (57)	13.5 (344)	4.3 (110)	0.4 (9)

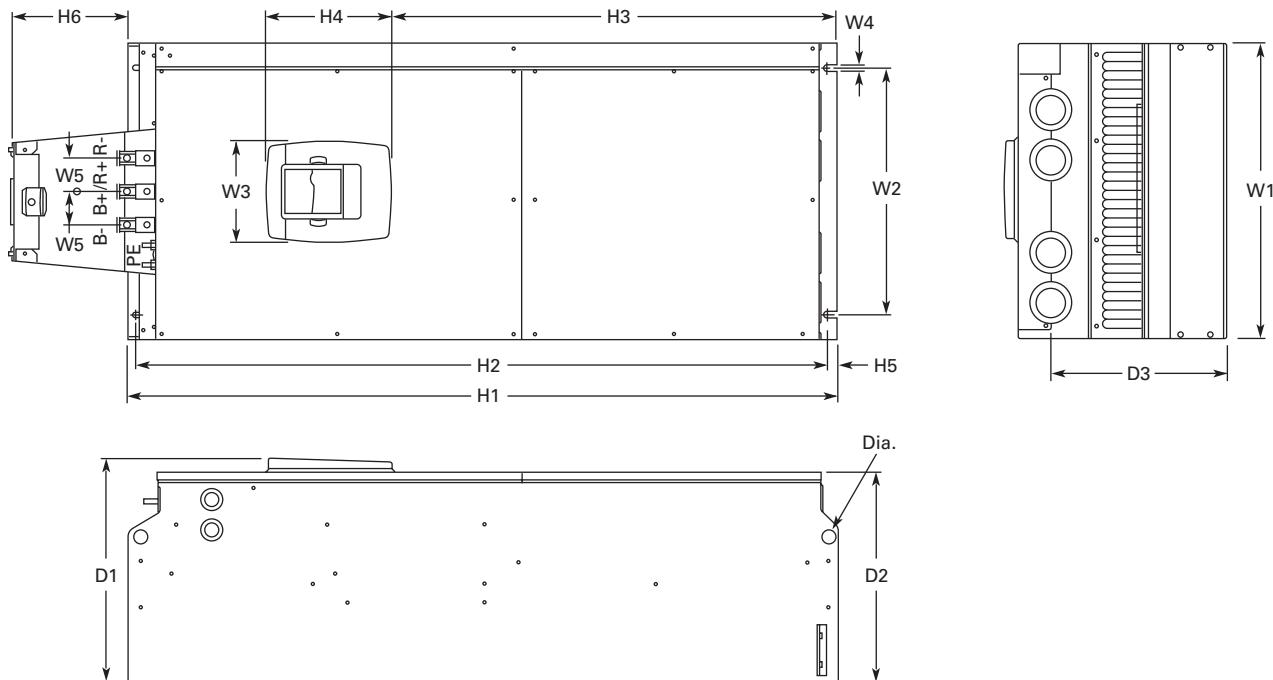
Flange Opening, FR7 and FR8

W5	W6	W7	H8	H9	H10	H11	H12	H13	Dia. B
FR7									
9.2 (233)	6.9 (175)	10.0 (253)	24.4 (619)	7.4 (189)	7.4 (189)	1.4 (35)	1.3 (32)	1.0 (25)	0.3 (6)
FR8									
11.9 (301)	—	13.0 (330)	31.9 (810)	10.2 (258)	10.4 (265)	—	—	1.3 (33)	0.4 (9)

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54 FR9

2



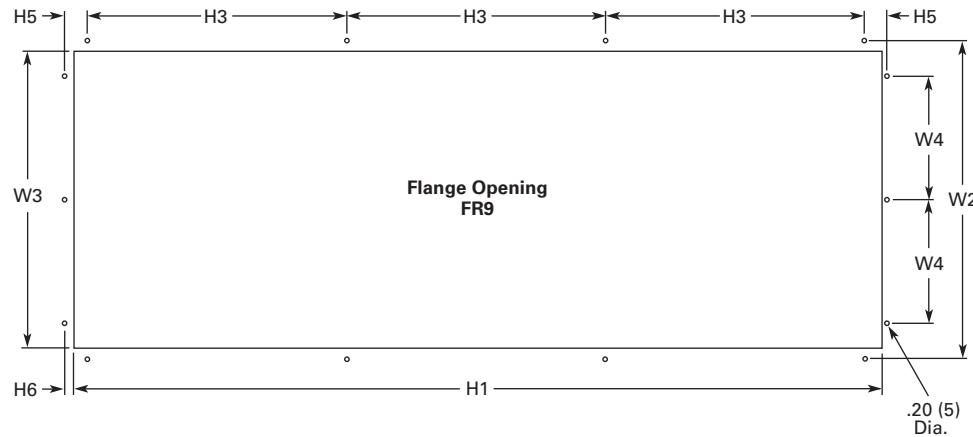
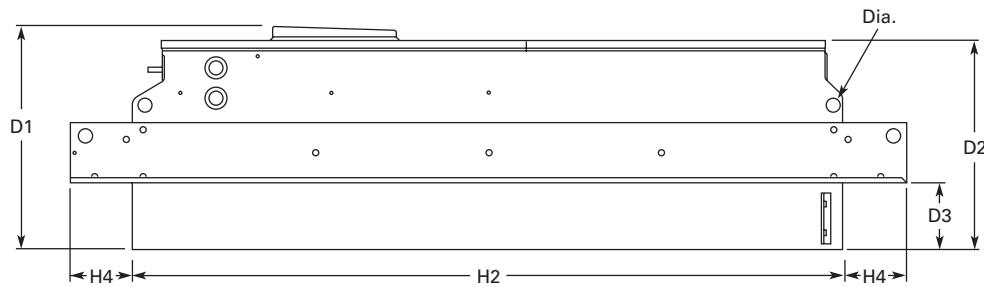
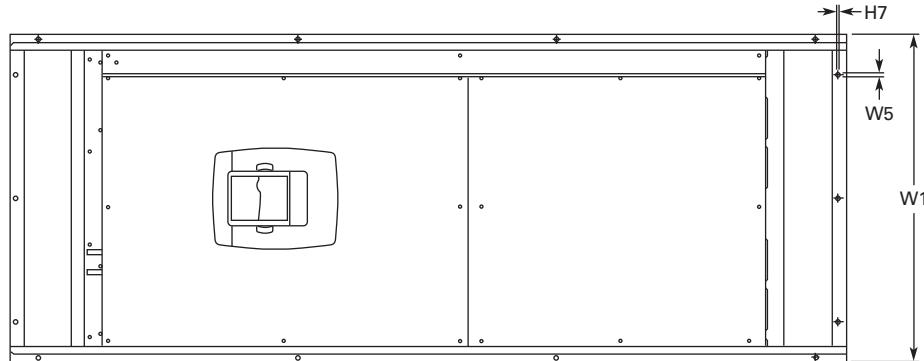
Voltage	hp (I_H)	W1	W2	W3	W4	H1	H2	H3	H4 ①	D1	D2	D3	Dia.	Weight Lbs (kg)
230V	75–100	18.9 (480)	15.7 (400)	0.4 (9)	2.1 (54)	45.3 (1150)	44.1 (1120)	0.6 (16)	7.4 (188)	14.2 (361.5)	13.4 (340)	11.2 (285)	0.8 (21)	321.9 (146)
480V	150–200													
575V	100–175													

Note

① Brake resistor terminal box (H6) included when brake chopper ordered.

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, FR9 with Flange Kit



W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	H6	H7	D1	D2	D3	Dia.
20.9 (530)	20.0 (510)	19.1 (485)	7.9 (200)	0.2 (5.5)	51.7 (1312)	45.3 (1150)	16.5 (420)	3.9 (100)	1.4 (35)	0.4 (9)	0.1 (2)	24.9 (362)	13.4 (340)	4.3 (109)	0.8 (21)

2.5

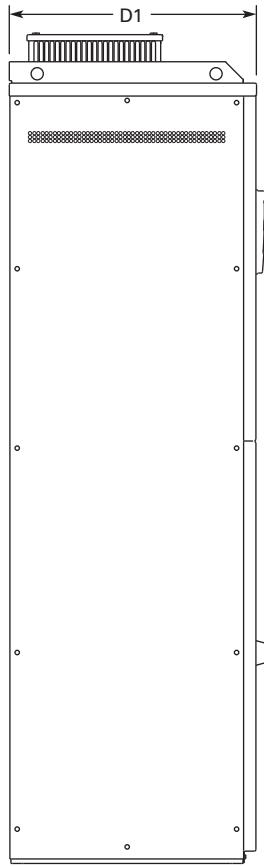
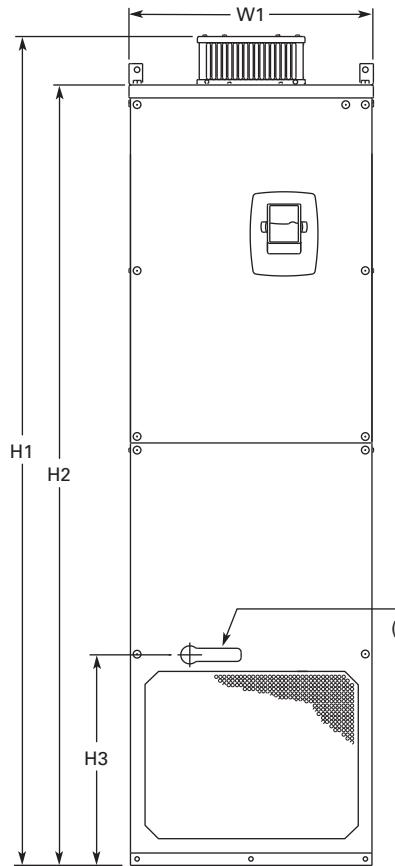
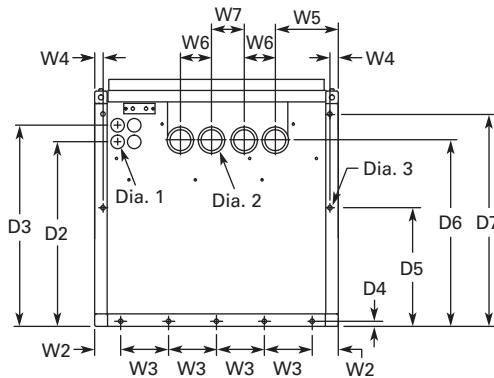
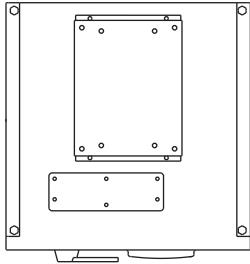
Adjustable Frequency Drives

SVX9000 Drives

Approximate Dimensions in Inches (mm)

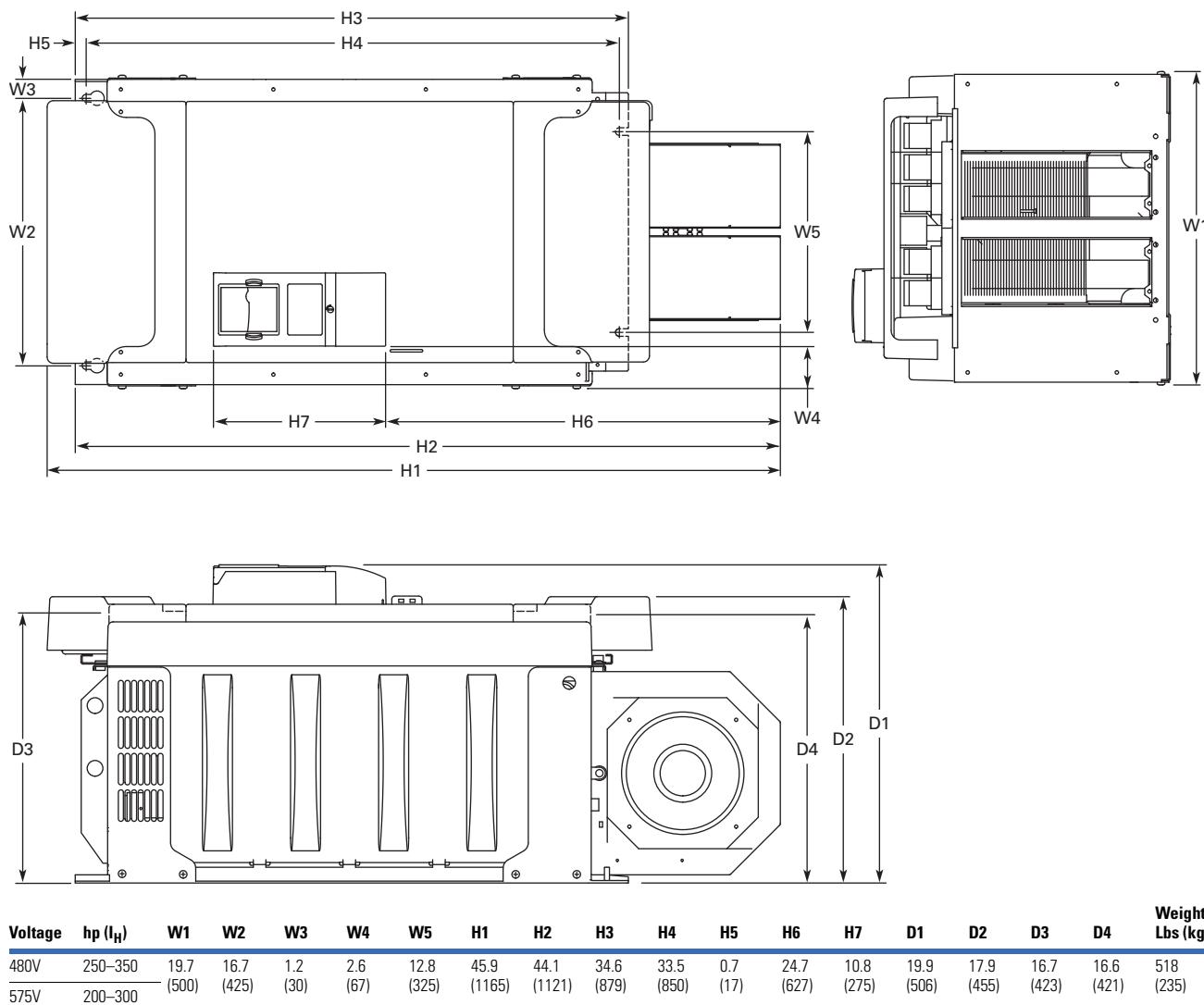
NEMA Type 1/IP21 and NEMA Type 12/IP54, FR10 Freestanding

2



W1	W2	W3	W4	W5	W6	W7	H1	H2	H3	D1	D2	D3	D4	D5	D6	D7	Weight Lbs (kg)			
23.43 (595)	2.46 (62.5)	4.53 (115)	0.79 (20)	5.95 (151)	2.95 (75)	30.11 (79)	79.45 (2018)	74.80 (1900)	20.18 (512.5)	23.70 (602)	17.44 (443)	19.02 (483)	0.47 (12)	11.22 (285)	17.60 (447)	20.08 (510)	0.83 (21)	1.89 (48)	0.43 (11)	857 (389)

Approximate Dimensions in Inches (mm)

FR10 Open Chassis ^①**Note**

① 9000X FR12 is built of two FR10 modules. Please refer to SPX9000 installation manual for mounting instructions.

2.5

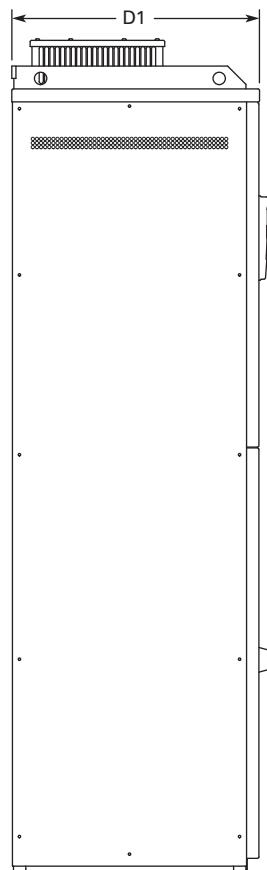
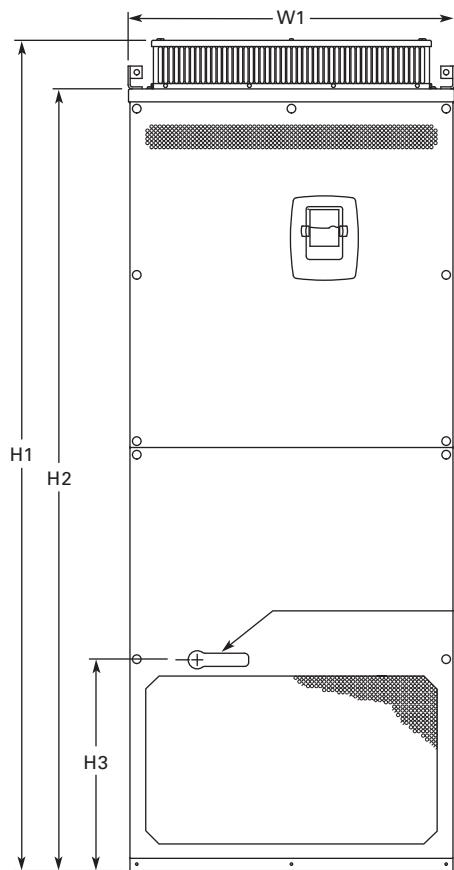
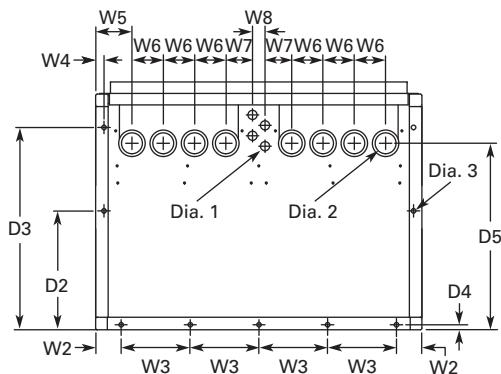
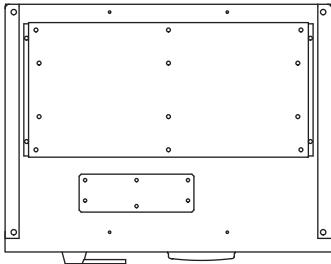
Adjustable Frequency Drives

SVX9000 Drives

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21, FR11 Freestanding Drive

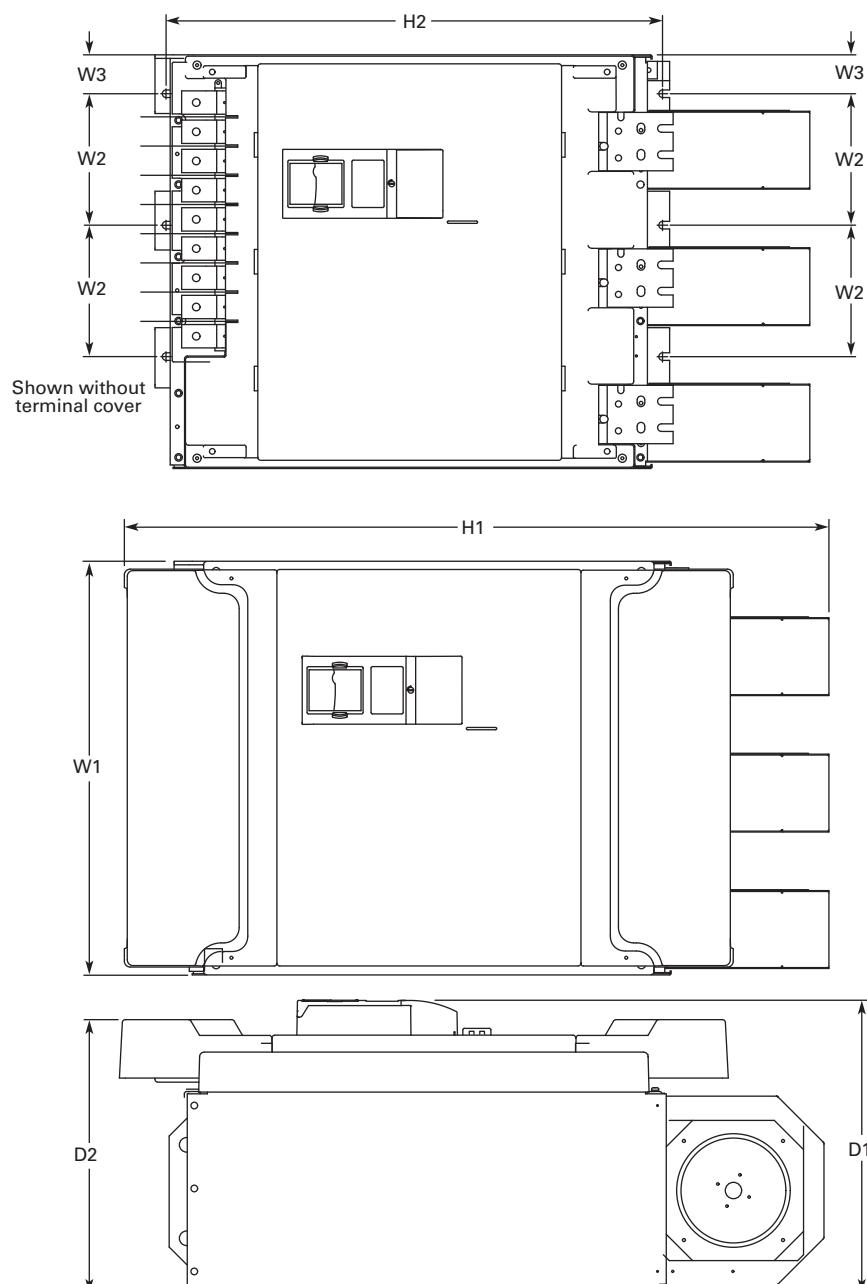
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Voltage	hp (kW)	W1	W2	W3	W4	W5	W6	W7	W8	H1	H2	H3	D1	D2	D3	D4	D5	Diag. 1	Diag. 2	Diag. 3	Weight Lbs (kg)
480	400-550 (794)	31.26 (61)	2.40 (165)	6.50 (20)	0.79 (87)	3.43 (75)	2.95 (75)	2.52 (30)	1.18 (30)	79.45 (2018)	74.80 (1900)	20.18 (512.5)	23.70 (602)	11.22 (285)	19.09 (485)	0.47 (12)	17.60 (447)	0.83 (21)	1.89 (48)	0.35 x 0.43 (9 x 11)	526 (239)

Approximate Dimensions in Inches (mm)

FR11 Open Chassis

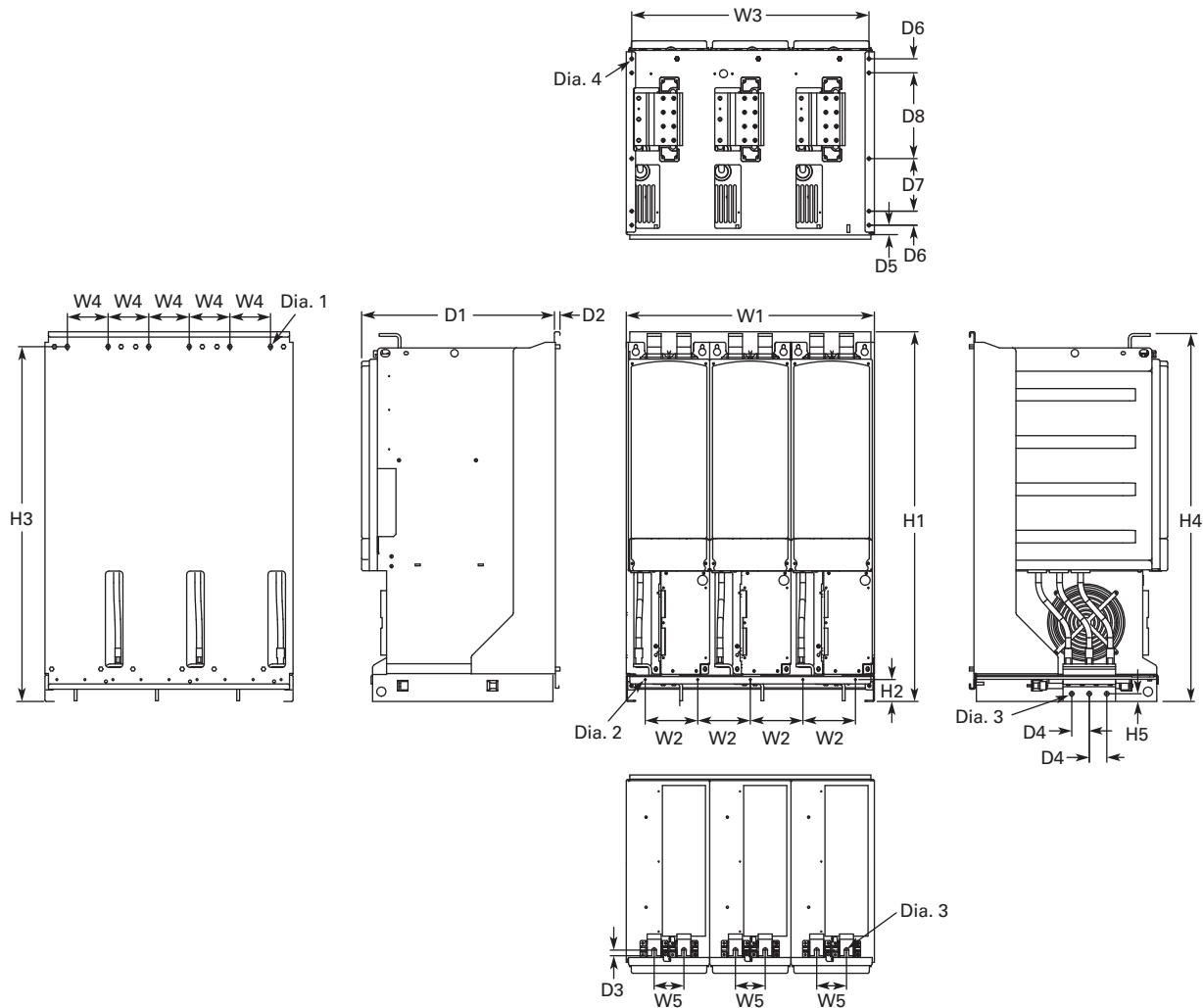


Voltage	hp (kW)	W1	W2	W3	H1	H2	D1	D2	Weight Lbs (kg)
480V	400–550	27.9 (709)	8.86 (225)	2.6 (67)	45.5 (1155)	33.5 (850)	19.8 (503)	18.4 (468)	833 (378)
575V	400–500								

Approximate Dimensions in Inches (mm)

FR13, Open Chassis Inverter

2



W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	D1	D2	D3	D4	D5	D6	D7	D8	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Weight Lbs (kg)
27.87 (708)	5.91 (150)	26.65 (677)	4.57 (116)	3.35 (85)	41.54 (1055)	2.46 (62.5)	39.86 (1012.5)	41.34 (1050)	0.79 (20)	21.77 (553)	0.51 (13)	0.63 (16)	1.97 (50)	1.06 (27)	1.57 (40)	5.91 (150)	9.64 (244.8)	0.35x0.59 (9x15)	0.18 (4.6)	0.51 (13)	0.37 (9.5)	683 (310)

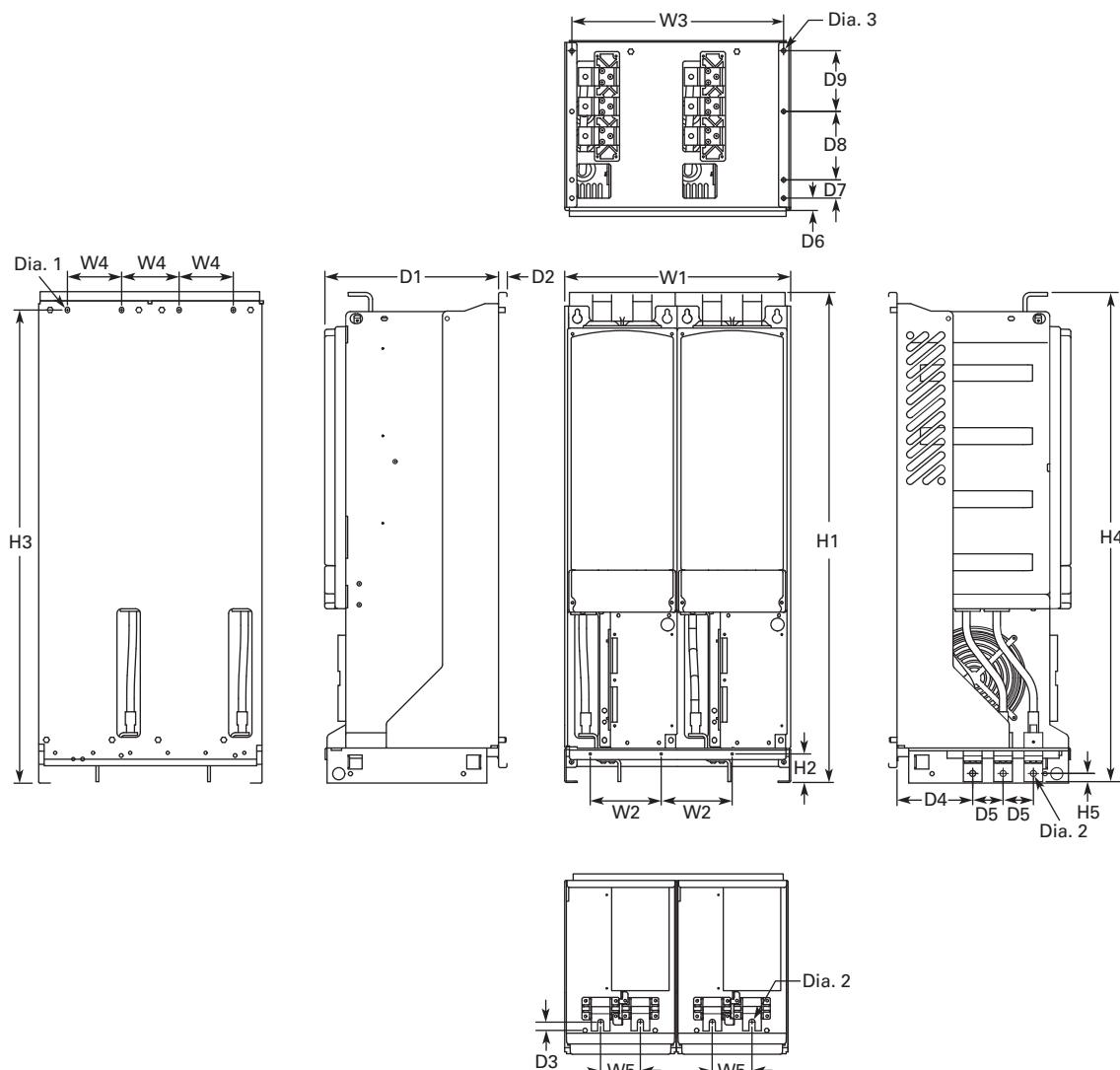
Notes

9000X FR14 is built of two FR13 modules. Please refer to SPX9000 installation manual for mounting instructions.

FR13 is built from an inverter module and a converter module. Please refer to SPX9000 installation manual for mounting instructions.

Approximate Dimensions in Inches (mm)

FR13, Open Chassis Converter



W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	D1	D2	D3	D4	D5	D6	D7	D8	D9	Dia. 1	Dia. 2	Dia. 3	Weight Lbs (kg)
18.74 (476)	5.91 (150)	17.52 (445)	4.57 (116)	3.35 (85)	41.54 (1055)	2.46 (62.5)	39.86 (1012.5)	41.34 (1050)	0.69 (17.5)	14.69 (373)	0.51 (13)	0.73 (18.5)	6.42 (163)	2.56 (65)	1.06 (27)	1.57 (40)	5.91 (150)	5.24 (133)	0.35x0.59 (9x15)	0.51 (13)	0.37 (9.5)	295 (134)

Number of Input Units

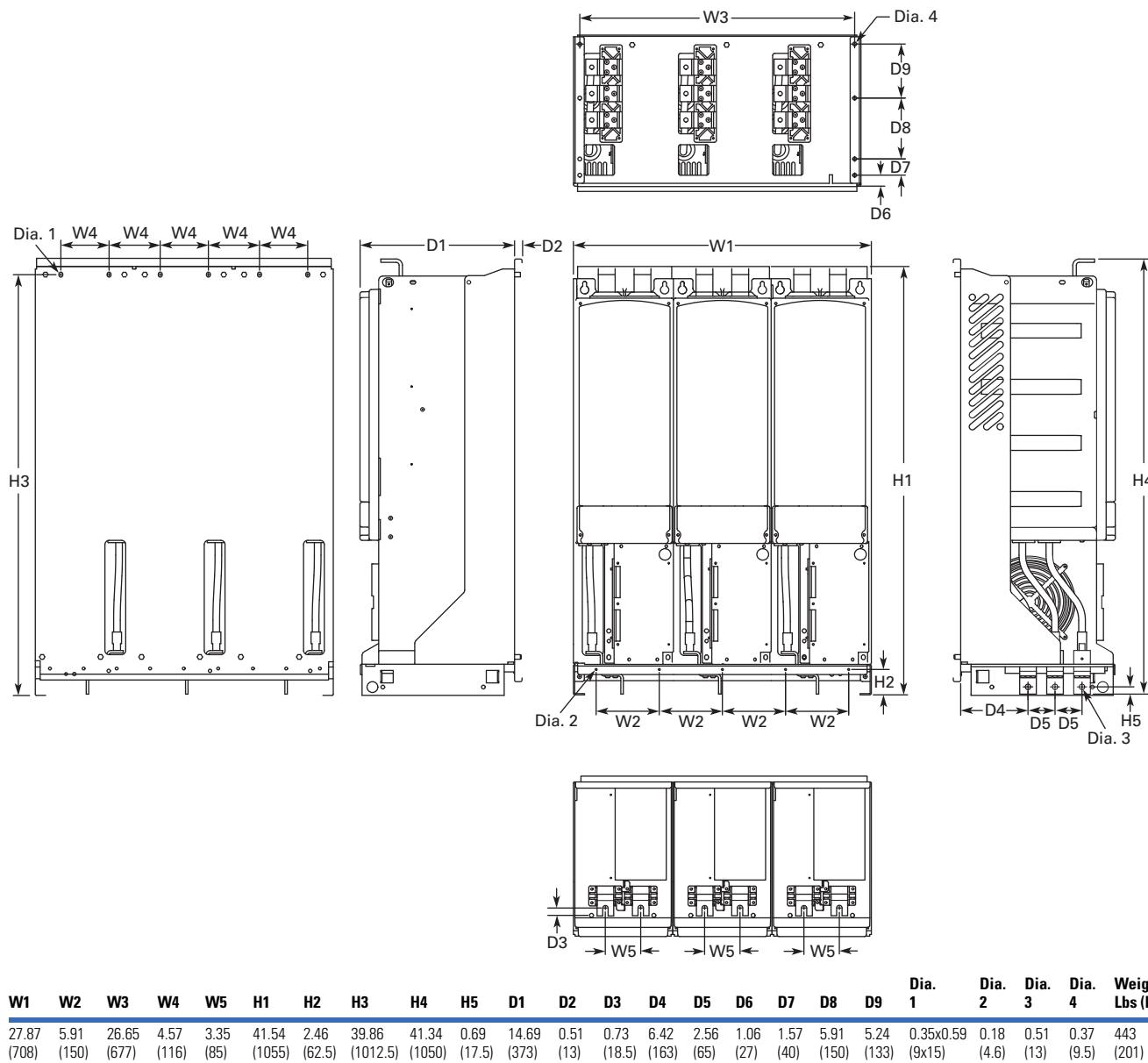
480V Catalog Number	hp	Input Modules
SPX800A0-4A2N1	800	2

690V Catalog Number	hp	Input Modules
SPX800A0-5A2N1	800	2
SPX900A0-5A2N1	900	2
SPXH10A0-5A2N1	1000	2

Approximate Dimensions in Inches (mm)

FR13, Open Chassis Converter—900/1000 hp 480V

2



Number of Input Units

480V Catalog Number	hp	Input Modules
SPX900A0-4A2N1	900	3
SPXH10A0-4A2N1	1000	3

Approximate Dimensions in Inches (mm)

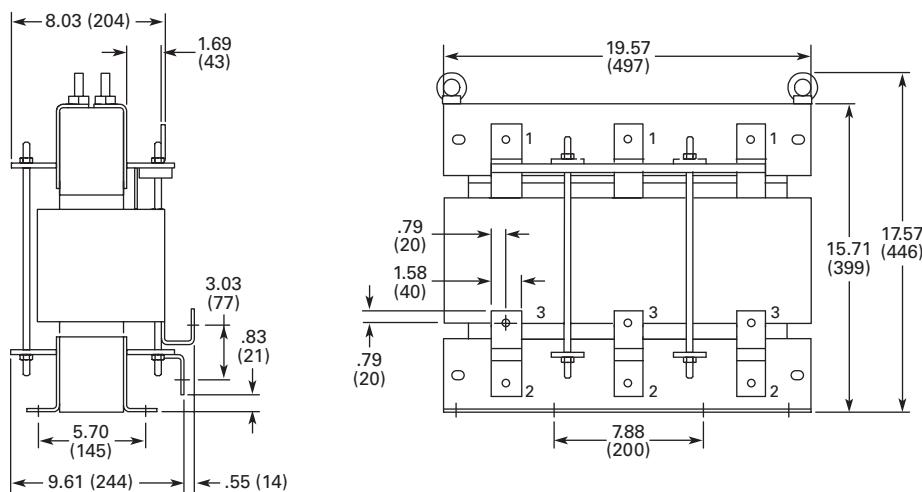
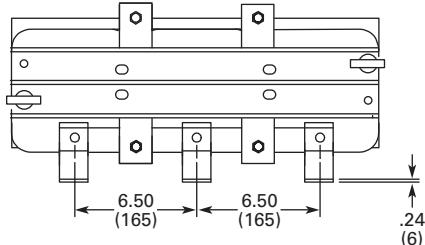
AC Choke Dimensions

2

Choke Types

Catalog Number	Frame Size	Choke Type ①
Voltage Range 380–500V		
SPX 250 4	FR10	CHK0400
SPX 300 4		CHK0520
SPX 350 4		CHK0520
SPX 400 4	FR11	2 x CHK0400
SPX 500 4		2 x CHK0400
SPX 550 4		2 x CHK0400
SPX 600 4	FR12	2 x CHK0520
SPX 650 4		2 x CHK0520
SPX 700 4		2 x CHK0520
SPX 800 4	FR13	2 x CHK0400
SPX 900 4		3 x CHK0520
SPX H10 4		3 x CHK0520
SPX H12 4	FR14	4 x CHK0520
SPX H16 4		6 x CHK0400

Catalog Number	Frame Size	Choke Type ①
Voltage Range 525–690V		
SPX 200 5	FR10	CHK0261
SPX 250 5		CHK0400
SPX 300 5		CHK0400
SPX 400 5	FR11	CHK0520
SPX 450 5		CHK0520
SPX 500 5		2 x CHK0400
SPX 550 5	FR12	2 x CHK0400
SPX 600 5		2 x CHK0400
SPX 700 5		2 x CHK0400
SPX 800 5	FR13	2 x CHK0400
SPX 900 5		2 x CHK0400
SPX H10 5		2 x CHK0400
SPX H13 5	FR14	4 x CHK0400
SPX H15 5		6 x CHK0400

CHK0520**Note**

① Chokes are provided with all FR10–FR14 drives.

2.5

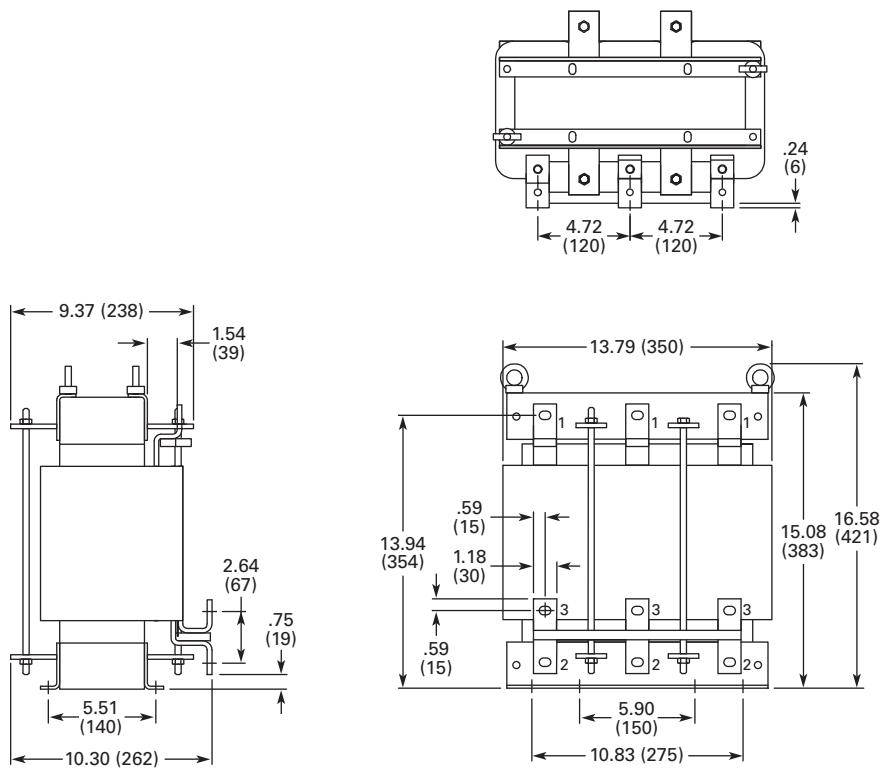
Adjustable Frequency Drives

SVX9000 Drives

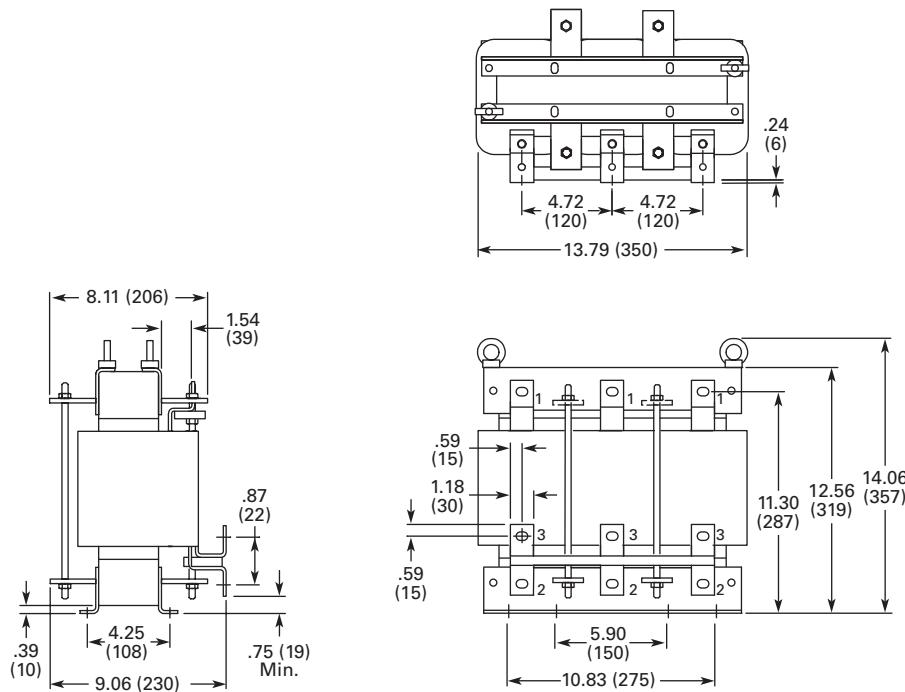
Approximate Dimensions in Inches (mm)

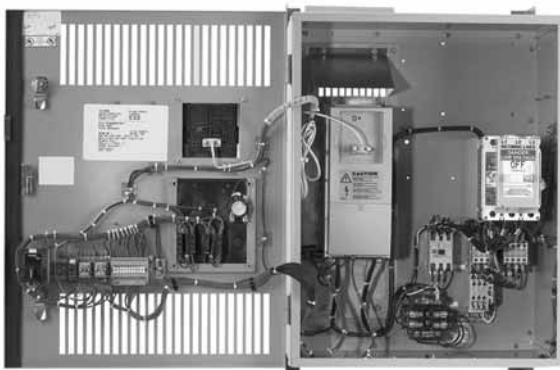
CHK0400

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CHK0261



SVX9000 Enclosed Drives**Contents****Description**

	Page
SVX9000 Drives	V6-T2-48
SVX9000 Enclosed Drives	
Product Identification	V6-T2-88
Catalog Number Selection	V6-T2-89
Product Selection	V6-T2-90
Options	V6-T2-94
Technical Data and Specifications	V6-T2-98
Dimensions	V6-T2-100
SVX9000 VFD Pump Panels	V6-T2-111

SVX9000 Enclosed Drives**Product Description**

- Standard Enclosed**— covers a wide range of the most commonly ordered options. Pre-engineering eliminates the lead time normally associated with customer specific options.
- Modified Standard Enclosed**— applies to specific customer requirements that vary from the standard enclosed offering, such as the need for an additional indicating light or minor modifications to drawings. *Consult your Eaton representative for assistance in pricing and lead time.*

- Custom Engineered**— for those applications with more unique or complex requirements, these are individually engineered to the customer's needs. *Consult your Eaton representative for assistance in pricing and lead time.*

Features

- NEMA Type 1/IP21 or NEMA Type 12/IP54 enclosures
- Input voltage: 208V, 230V, 480V and 575V (consult factory)
- Complete range of control, network and power options
- Horsepower range:
 - 208V—3/4 to 100 hp I_H ; 1 to 100 hp I_L
 - 230V—3/4 to 100 hp I_H ; 1 to 100 hp I_L
 - 480V—1 to 700 hp I_H ; 1-1/2 to 800 hp I_L
- Padlockable disconnect

Standards and Certifications

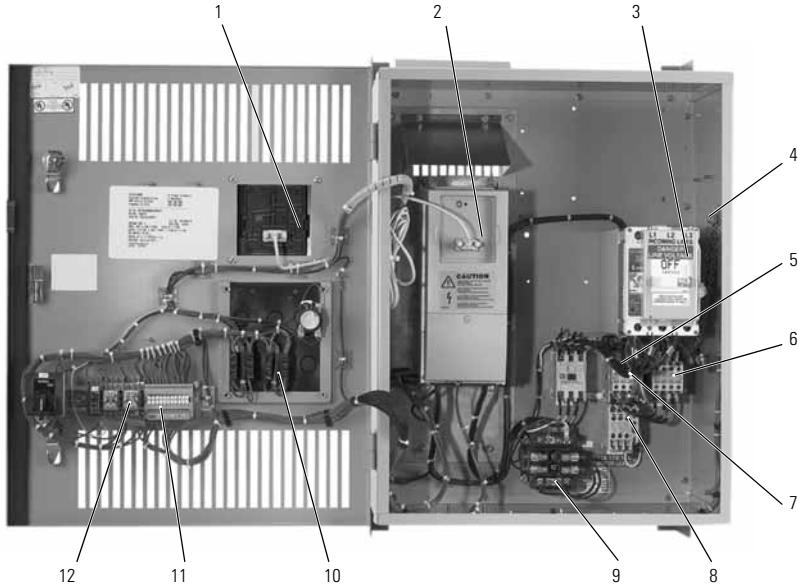
- UL Listed
- cUL Listed



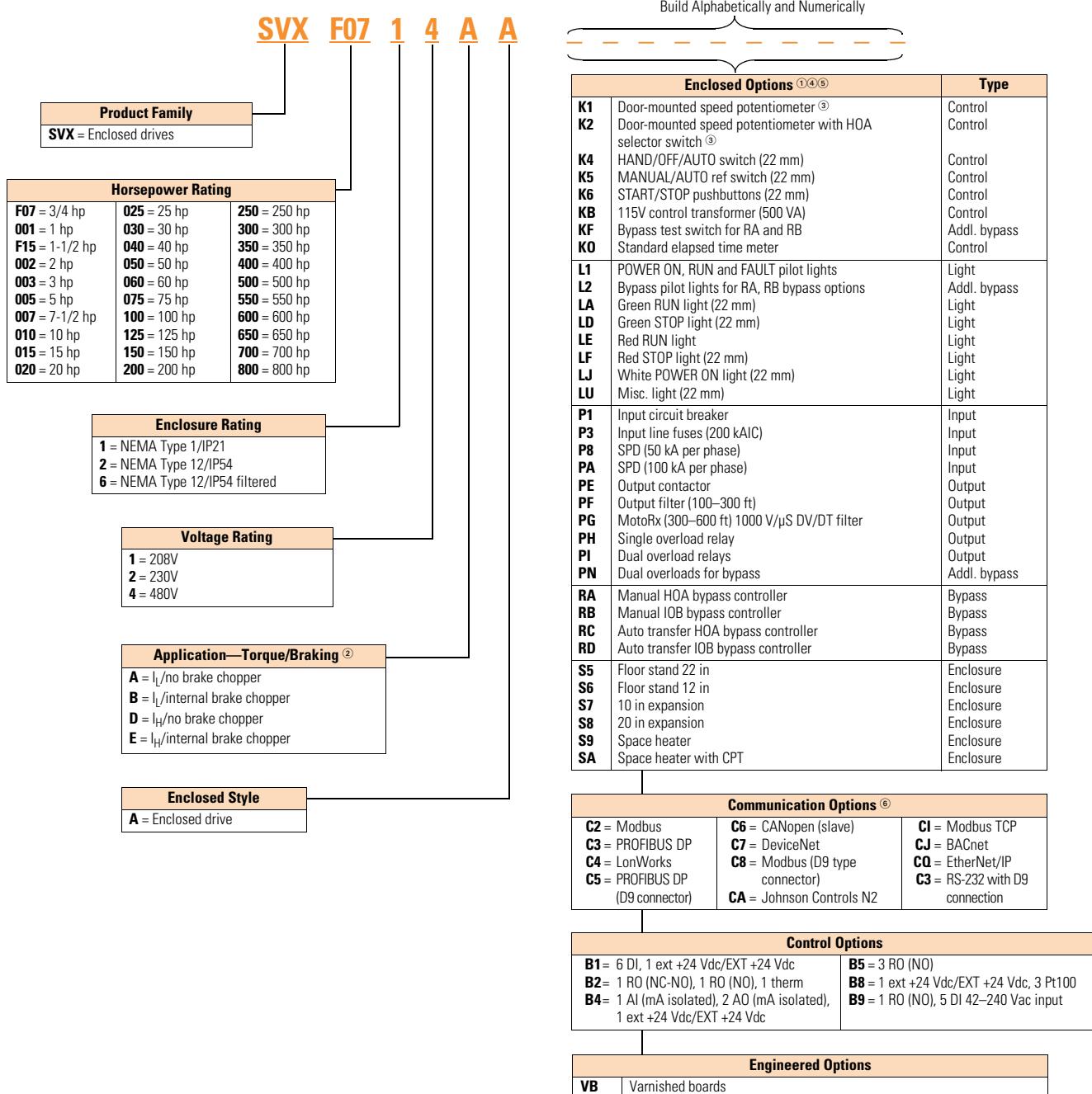
Listed

Product Identification**Enclosed 9000X Series Drive**

2



- | | | |
|---|---|--|
| 1 Door mounted keypad (included as standard with bypass option) | 6 Output contactor
• Option PE (included as standard with bypass option) | 9 115V control transformer
• Option KB |
| 2 SVX9000 variable frequency drive | 7 Bypass contactor
• Option RA
• Option RB | 10 Bypass pilot lights and selector switches
• Option RA
• Option RB
• Option L2
• Option KF |
| 3 Input disconnect
• Option P1 | 8 Overload relay
• Option PH
• Option PI | 11 Customer control and signal connection terminal block |
| 4 Input line fuses
• Option P3 | | 12 Control relay |
| 5 Input contactor (included as standard with bypass option) | | |

Catalog Number Selection**SVX9000 Enclosed NEMA Type 1/IP21 and NEMA Type 12/IP54 Drives****Notes**

- ① Local/remote keypad is included as the standard control panel.
- ② Brake chopper is a factory installed option only, see drive options on **Page V6-T2-49**. External dynamic braking resistors not included. Consult factory.
- ③ Includes local/remote speed reference switch.
- ④ Some options are voltage and/or horsepower specific. Consult your Eaton representative for details.
- ⑤ See **Pages V6-T2-96** and **V6-T2-97** for descriptions.
- ⑥ See **Pages V6-T2-94** and **V6-T2-95** for complete descriptions.

Product Selection**2****When Ordering**

- Select a base catalog number that meets the application requirements—nominal horsepower, voltage and enclosure rating (the enclosed drive's continuous output amp rating should be equal to or

greater than the motor's full load amp rating). The base enclosed package includes a standard drive, door mounted local/remote keypad and enclosure.

- If dynamic brake chopper or control/communication option is desired, change the appropriate code in the base catalog number.

- Select enclosed options. Add the codes as suffixes to the base catalog number in alphabetical and numeric order.
- Read all footnotes.**

208V Drives**SVX9000 Enclosed Drives****Input Base Drives**

Enclosure Size ①	hp	NEMA Type 1/IP21		NEMA Type 12/IP54	
		Frame Size	Base Catalog Number ②	Frame Size	Base Catalog Number ②
High Overload Drive and Enclosure					
0	3/4	3.7	4	4	SVXF0711EA
	1	4.8			SVX00111EA
	1-1/2	6.6			SVXF1511EA
	2	7.8			SVX00211EA
	3	11			SVX00311EA
	5	17.5	5		SVX00511EA
	7-1/2	25			SVX00711EA
1	10	31	6	5	SVX01011EA
	15	48			SVX01511EA
2	20	61	7	6	SVX02011DA
	25	75			SVX02511DA
	30	88			SVX03011DA
3	40	114	8	8	SVX04011DA
4	50	143	8	8	SVX05011DA
5	60	170	8	8	SVX06011DA
	75	211	9	9	SVX07511DA
	100	273			SVX10011DA
Low Overload Drive and Enclosure					
0	1	4.8	4	4	SVX00111BA
	1-1/2	6.6			SVXF1511BA
	2	7.8			SVX00211BA
	3	11			SVX00311BA
	5	17.5	5		SVX00511BA
	7-1/2	25			SVX00711BA
	10	31			SVX01011BA
1	15	48	6	5	SVX01511BA
	20	61			SVX02011BA
2	25	75	7	6	SVX02511AA
	30	88			SVX03011AA
	40	114			SVX04011AA
3	50	—	8	8	SVX05011AA
4	60	170	8	8	SVX06011AA
5	75 ③	205	8	8	SVX07511AA
	100 ③	261	9	9	SVX10011AA

Notes

For brake chopper options, see **Page V6-T2-58**.

① See enclosure dimensions starting on **Page V6-T2-100**.

② Includes drive, local/remote keypad and enclosure.

③ These units are current rated (75 l₁ hp 205 amps, 100 l₁ hp 261 amps). They do not meet NEC ampere ratings.

230V Drives

SVX9000 Enclosed Drives



Input Base Drives

Enclosure Size ①	hp	NEMA Type 1/IP21		NEMA Type 12/IP54
		Frame Size	Base Catalog Number ②	
High Overload Drive and Enclosure				
0	3/4	3.7	4	SVXF0712EA
	1	4.8		SVX00112EA
	1-1/2	6.6		SVXF1512EA
	2	7.8		SVX00212EA
	3	11		SVX00312EA
	5	17.5	5	SVX00512EA
	7-1/2	25		SVX00712EA
1	10	31	6	SVX01012EA
	15	48		SVX01512EA
2	20	61	7	SVX02012DA
	25	75		SVX02512DA
	30	88		SVX03012DA
3	40	114	8	SVX04012DA
4	50	140	8	SVX05012DA
5	60	170	8	SVX06012DA
	75	205	9	SVX07512DA
	100 ③	261		SVX10012DA
Low Overload Drive and Enclosure				
0	1	4.8	4	SVX00112BA
	1-1/2	6.6		SVXF1512BA
	2	7.8		SVX00212BA
	3	11		SVX00312BA
	5	17.5	5	SVX00512BA
	7-1/2	25		SVX00712BA
	10	31		SVX01012BA
1	15	48	6	SVX01512BA
	20	61		SVX02012BA
2	25	75	7	SVX02512AA
	30	88		SVX03012AA
	40	114		SVX04012AA
3	50	140	8	SVX05012AA
4	60	170	8	SVX06012AA
5	75	205	8	SVX07512AA
	100 ③	261	9	SVX10012AA

Notes

For brake chopper options, see **Page V6-T2-58**.

① See enclosure dimensions starting on **Page V6-T2-100**.

② Includes drive, local/remote keypad and enclosure.

③ This unit is current rated (100 I_L hp 100 amps, 261 I_L hp). It is not hp rated. They do not meet NEC ampere ratings.

480V Drives

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SVX9000 Enclosed Drives



Input Base Drives

Enclosure Size ①	hp	Current (A)	NEMA Type 1/IP21		NEMA Type 12/IP54	
			Frame Size	Base Catalog Number ②	Frame Size	Base Catalog Number ②
High Overload Drive and Enclosure						
0	1	2.2	4	SVX00114EA	4	SVX00124EA
	1-1/2	3.3		SVXF1514EA		SVXF1524EA
	2	4.3		SVX00214EA		SVX00224EA
	3	5.6		SVX00314EA		SVX00324EA
	5	7.6		SVX00514EA		SVX00524EA
	7-1/2	12	5	SVX00714EA	5	SVX00724EA
	10	16		SVX01014EA		SVX01024EA
	15	23		SVX01514EA		SVX01524EA
1	20	31	6	SVX02014EA	6	SVX02024EA
	25	38		SVX02514EA		SVX02524EA
	30	46		SVX03014EA		SVX03024EA
2	40	61	7	SVX04014DA	7	SVX04024DA
	50	72		SVX05014DA		SVX05024DA
	60	87		SVX06014DA		SVX06024DA
3	75	105	8	SVX07514DA	8	SVX07524DA
	100	140		SVX10014DA		SVX10024DA
4	125	170	8	SVX12514DA	8	SVX12524DA
5	150	205	9	SVX15014DA	9	SVX15024DA
	200	245		SVX20014DA		SVX20024DA
6, 8 ③④	250	300	10	SVX25014DA	10	SVX25064DA
	300	385		SVX30014DA		SVX30064DA
	350	460		SVX35014DA		SVX35064DA
8, 9 ④⑤	400	520	11	SVX40014DA	11	SVX40064DA
	500	590		SVX50014DA		SVX50064DA
	550	650		SVX55014DA		SVX55064DA
⑥	600	730	12	SVX60014DA	12	SVX60064DA
	650	820		SVX65014DA		SVX65064DA
	700	920		SVX70014DA		SVX70064DA

Notes

For brake chopper options, see **Page V6-T2-58**.① See enclosure dimensions starting on **Page V6-T2-100**.

② Includes drive, local/remote keypad and enclosure.

③ The smaller enclosure Size 6 accommodates only power options, input disconnect (P1) and input line fuses (P3). Bypass and other options require Size 8. Adding any standard control option will not require the larger enclosure.

④ For other options, consult factory.

⑤ The smaller enclosure Size 8 accommodates only power options, input disconnect (P1) and input line fuses (P3). Bypass and other options require Size 9. Adding any standard control option will not require the larger enclosure.

⑥ Consult factory.

SVX9000 Enclosed Drives**Input Base Drives, continued**

NEMA Type 1/IP21				NEMA Type 12/IP54
Enclosure Size ①	hp	Current (A)	Frame Size	Base Catalog Number ②
Low Overload Drive and Enclosure				
0	1-1/2	3.3	4	SVXF1514BA
	2	4.3		SVX00214BA
	3	5.6		SVX00314BA
	5	7.6		SVX00514BA
	7-1/2	12		SVX00714BA
	10	16	5	SVX01014BA
	15	23		SVX01514BA
	20	31		SVX02014BA
1	25	38	6	SVX02514BA
	30	46		SVX03014BA
	40	61		SVX04014BA
2	50	72	7	SVX05014AA
	60	87		SVX06014AA
	75	105		SVX07514AA
3	100	140	8	SVX10014AA
4	125	170	8	SVX12514AA
	150	205		SVX15014AA
5	200	261	9	SVX20014AA
	250	300		SVX25014AA
6, 8 ③④	300	385	10	SVX30014AA
	350	460		SVX35014AA
	400	520		SVX40014AA
8, 9 ③⑤	500	590	11	SVX50014AA
	550	650		SVX55014AA
	600	730		SVX60014AA
⑥	650	820	12	SVX65014AA
	700	920		SVX70014AA
	800	1030		SVX80014AA

Notes

For brake chopper options, see **Page V6-T2-58**.

① See enclosure dimensions starting on **Page V6-T2-100**.

② Includes drive, local/remote keypad and enclosure.

③ The smaller enclosure Size 6 accommodates only power options, input disconnect (P1) and input line fuses (P3). Bypass and other options require Size 8. Adding any standard control option will not require the larger enclosure.

④ For other options, consult factory.

⑤ The smaller enclosure Size 8 accommodates only power options, input disconnect (P1) and input line fuses (P3). Bypass and other options require Size 9. Adding any standard control option will not require the larger enclosure.

⑥ Consult factory.

Options

9000X Series Option Board Kits

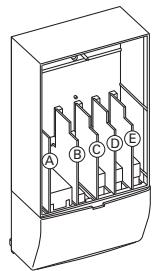
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The 9000X Series drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of five option boards.

The 9000X Series factory installed standard board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B.

Option Boards

Option Board Kits



Option Kit Description ^①	Allowed Slot Locations ^②	Field Installed Catalog Number	Factory Installed Option Designator	SVX Ready Programs				
				Basic	Remote	Standard	MSS	PID
Standard I/O Cards								
6 DI, 1 DO, 2 AI, 1AO, 1 +10 Vdc ref, 2 ext +24 Vdc/EXT +24 Vdc	A	OPTA9	—	■	■	■	■	■
2 RO (NC-NO)	B	OPTA2	—	■	■	■	■	■
Extended I/O Cards								
2 RO, therm—SPX only	B	OPTA3	A3	—	■	■	■	■
Encoder low volt +5V/15V/24V—SPX only	C	OPTA4	A4	—	■	■	■	■
Encoder high volt +15V/24V—SPX only	C	OPTA5	A5	—	■	■	■	■
Double encoder—SPX only	C	OPTA7	A7	■	■	■	■	■
6 DI, 1 DO, 2 AI, 1AO—SPX only	A	OPTA8	A8	—	■	■	■	■
3 DI (encoder 10–24V, out +15V/+24V, 2 DO (pulse+direction)—SPX only	C	OPTAE	AE	■	■	■	■	■
6 DI, 1 ext +24 Vdc/EXT +24 Vdc	B, C, D, E	OPTB1	B1	—	—	—	—	■
1 RO (NC-NO), 1 RO (NO), 1 therm	B, C, D, E	OPTB2	B2	—	—	—	—	■
1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24 Vdc/EXT +24 Vdc	B, C, D, E	OPTB4	B4	■	■	■	■	■
3 RO (NO)	B, C, D, E	OPTB5	B5	—	—	—	—	■
1 ext +24 Vdc/EXT +24 Vdc, 3 Pt100	B, C, D, E	OPTB8	B8	—	—	—	—	—
1 RO (NO), 5 DI 42–240 Vac input	B, C, D, E	OPTB9	B9	—	—	—	—	■
Communication Cards								
Modbus ^③	D, E	OPTC2	C2	■	■	■	■	■
Modbus TCP	D, E	OPTC1	CI	■	■	■	■	■
BACnet	D, E	OPTCJ	CJ	■	■	■	■	■
EtherNet/IP	D, E	OPTCQ	CQ	■	■	■	■	■
Johnson Controls N2 ^③	D, E	OPTC2	CA	—	—	—	—	—
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■
LonWorks	D, E	OPTC4	C4	■	■	■	■	■
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■
CANopen (slave)	D, E	OPTC6	C6	■	■	■	■	■
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■
Modbus (D9 type connector)	D, E	OPTC8	C8	■	■	■	■	■
Adapter—SPX only	D, E	OPTD1	D1	■	■	■	■	■
Adapter—SPX only	D, E	OPTD2	D2	■	■	■	■	■
RS-232 with D9 connection	D, E	OPTD3	D3	■	■	■	■	■

Notes

^① AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

^② Option card must be installed in one of the slots listed for that card. Slot indicated in bold is the preferred location.

^③ OPTC2 is a multi-protocol option card.

Modbus RTU Network Communications

The Modbus Network Card OPTC2 is used for connecting the 9000X Drive as a slave on a Modbus network. The interface is connected by a 9-pin DSUB connector (female) and the baud rate ranges from 300 to 19200 baud. Other communication parameters include an address range from 1 to 247; a parity of None, Odd or Even; and the stop bit is 1.

PROFIBUS Network Communications

The PROFIBUS Network Card OPTC3 is used for connecting the 9000X Drive as a slave on a PROFIBUS-DP network. The interface is connected by a 9-pin DSUB connector (female). The baud rates range from 9.6K baud to 12M baud, and the addresses range from 1 to 127.

LonWorks Network Communications

The LonWorks Network Card OPTC4 is used for connecting the 9000X Drive on a LonWorks network. This interface uses Standard Network Variable Types (SNVT) as data types. The channel connection is achieved using a FTT-10A Free Topology transceiver via a single twisted transfer cable. The communication speed with LonWorks is 78 kBits/s.

CANopen (Slave) Communications

The CANopen (Slave) Network Card OPTC6 is used for connecting the 9000X Drive to a host system. According to ISO11898 standard cables to be chosen for CAN bus should have a nominal impedance of 120 ohms, and specific line delay of nominal 5 nS/m. 120 ohms line termination resistors required for installation.

DeviceNet Network Communications

The DeviceNet Network Card OPTC7 is used for connecting the 9000X Drive on a DeviceNet Network. It includes a 5.08 mm pluggable connector. Transfer method is via CAN using a two-wire twisted shielded cable with two-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud.

Johnson Controls Metasys N2 Network Communications

The OPTC2 fieldbus board provides communication between the 9000X Drive and a Johnson Controls Metasys™ N2 network. With this connection, the drive can be controlled, monitored and programmed from the Metasys system. The N2 fieldbus is available as a factory installed option and as a field installable kit.

Modbus/TCP Network Communications

The Modbus/TCP Network Card OPTC1 is used for connecting the 9000X Drive to Ethernet networks utilizing Modbus protocol. It includes an RJ-45 pluggable connector. This interface provides a selection of standard and custom register values to communicate drive parameters. The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable over Ethernet using a supplied software tool.

BACnet Network Communications

The BACnet Network Card OPTCJ is used for connecting the 9000X Drive to BACnet networks. It includes a 5.08 mm pluggable connector. Data transfer is Master-Slave/Token Passing (MS/TP) RS-485. This interface uses a collection of 30 Binary Value Objects (BVOs) and 35 Analog Value Objects (AVOs) to communicate drive parameters. The card supports 9.6, 19.2 and 38.4 Kbaud communication speeds and supports network addresses 1–127.

EtherNet/IP Network Communications

The EtherNet/IP Network Card OPTCK is used for connecting the 9000X Drive to Ethernet/Industrial Protocol networks. It includes an RJ-45 pluggable connector. The interface uses CIP objects to communicate drive parameters (CIP is "Common Industrial Protocol", the same protocol used by DeviceNet). The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable by Static, BOOTP and DHCP methods.

Control/Communication Option Descriptions

For availability, see Product Selection for base drive voltage required.

Available Control/Communications Options

Option	Description	Option Type
K1	Door-Mounted Speed Potentiometer —Provides the SVX9000 with the ability to adjust the frequency reference using a door-mounted potentiometer. This option uses the 10 Vdc reference to generate a 0–10V signal at the analog voltage input signal terminal. When the HOA bypass option is added, the speed is controlled when the HOA switch is in the HAND position. Without the HOA bypass option, a two-position switch (labeled local/remote) is provided on the keypad to select speed reference from the speed potentiometer or a remote speed signal.	Control
K2	Door-Mounted Speed Potentiometer with HOA Selector Switch —Provides the SVX9000 with the ability to start/stop and adjust the speed reference from door-mounted control devices or remotely from customer supplied inputs. In HAND position, the drive will start and the speed is controlled by the door-mounted speed potentiometer. The drive will be disabled in the OFF position. When AUTO is selected, the drive run and speed control commands are via user-supplied dry contact and 4–20 mA signal.	Control
K4	HAND/OFF/AUTO Switch for Non-Bypass Configurations —Provides a three-position selector switch that allows the user to select either a HAND or AUTO mode of operation. HAND mode is defaulted to keypad operation, and AUTO mode is defaulted to control from an external terminal source. These modes of operation can be configured via programming to allow for alternate combinations of start and speed sources. Start and speed sources include keypad, I/O and fieldbus.	Control
K5	MANUAL/AUTO Speed Reference Switch —Provides a door-mounted selector switch for MANUAL/AUTO speed reference.	Control
K6	START/STOP Pushbuttons —Provide door-mounted START and STOP pushbuttons for either bypass or non-bypass configurations.	Control
KB	115V Control Transformer, 500 VA —Provides a fused control power transformer with additional 500 VA at 115V for customer use.	Control
KF	Bypass Test Switch for RB and RA —Allows the user to energize the AF drive for testing while operating the motor on the bypass controller. The test switch is mounted on the inside of the enclosure door.	Addl. bypass
K0	Standard Elapsed Time Meter —Provides a door-mounted elapsed run time meter.	Control
L1	POWER ON, RUN and FAULT Pilot Lights —Provide a white POWER ON light that indicates power to the enclosed cabinet, a green RUN light that indicates the drive is running and a red FAULT light that indicates a drive fault has occurred.	Light
L2	Bypass Pilot Lights for RA and RB Bypass Options —A green MOTOR ON INVERTER light indicates when the motor is running in inverter mode and an amber MOTOR ON BYPASS light indicates when the motor is running in bypass mode. The lights are mounted on the enclosure door, above the switches.	Addl. bypass
LA	Green RUN Light (22 mm) —Provides a green RUN light that indicates the drive is running.	Light
LD	Green STOP Light (22 mm) —Provides a green STOP light that indicates the drive is stopped.	Light
LE	Red RUN Pilot Light (22 mm) —Provides a red RUN pilot light that indicates the drive is running.	Light
LF	Red STOP Light (22 mm) —Provides a red STOP light that indicates the drive is stopped.	Light
LJ	White POWER ON Light (22 mm) —Provides a white POWER ON light that indicates power to the enclosed cabinet.	Light
LU	Misc. Light (22 mm) —Provides a misc. "user defined" pilot light. User to define light function and color.	Light
P1	Input Circuit Breaker —Provides a means of short-circuit protection for the power cables between it and the SVX9000, and protection from high-level ground faults on the power cable. Allows a convenient means of disconnecting the SVX9000 from the line and the operating mechanism can be padlocked in the OFF position. This is factory mounted in the enclosure.	Input
P3	Input Line Fuses Rated to 200 kAIC —Provides high-level fault protection of the SVX9000 input power circuit from the load side of the fuses to the input side of the power transistors. This option consists of three 200 kA fuses, which are factory mounted in the enclosure.	Input
P8	SPD (50 kA per Phase) —Provides a surge protection device (SPD) connected to the line side terminals and is designed to clip line side transients. Rated for 50,000A.	Input
PA	SPD (100 kA per Phase) —Provides a surge protection device (SPD) connected to the line side terminals and is designed to clip line side transients. Rated for 100,000A.	Input
PE	Output Contactor —Provides a means for positive disconnection of the drive output from the motor terminals. The contactor coil is controlled by the drive's run or permissive logic. NC and NO auxiliary contacts rated at 10A, 600 Vac are provided for customer use. Bypass options RB and RA include an output contactor as standard. This option includes a low VA 115 Vac fused control power transformer and is factory mounted in the enclosure.	Output
PF	Output Filter (100–300 ft) —Used to reduce the transient voltage (DV/DT) at the motor terminals. The output filter is recommended for cable lengths exceeding 100 ft (30m) with a drive of 3 hp and above, for cable lengths of 33 ft (10m) with a drive of 2 hp and below, or for a drive rated at 525–690V. This option is mounted in the enclosure, and may be used in conjunction with a brake chopper circuit.	Output
PG	MotoRx (300–600 ft) 1000 V/μs DV/DT Filter —Used to reduce transient voltage (DV/DT) and peak voltages at the motor terminals. This option is comprised of a 0.5% line reactor, followed by capacitive filtering and an energy recovery/clamping circuit. Unlike the output filter (See option PF), the MotoRx recovers most of the energy from the voltage peaks, resulting in a lower voltage drop to the motor, and therefore conserving power. This option is used when the distance between a single motor and the drive is 300–600 ft (91–183m). <i>This option can not be used with the brake chopper circuit. The output filter (option PF) should be investigated as an alternative.</i>	Output
PH	Single Overload Relay —Uses a bimetallic overload relay to provide additional overload current protection to the motor on configurations without bypass options. It is included with the bypass configurations for overload current protection in the bypass mode. The overload relay is mounted within the enclosure, and is manually resettable. Heater pack included.	Output
PI	Dual Overload Relays —This option is recommended when a single drive is operating two motors and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable. Heater packs not included.	Output
PN	Dual Overloads for Bypass —This option is recommended when a single drive is operating two motors in the bypass mode and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable.	Addl. bypass

For availability, see Product Selection for base drive voltage required.

Available Control/Communications Options, continued

Option	Description	Option Type
RA	Manual HOA Bypass Controller —The manual HAND/OFF/AUTO (HOA)—3-contactor—bypass option provides a means of bypassing the SVX9000, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in the inverter mode. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked.	Bypass
RB	Manual IOB Bypass Controller —The manual INVERTER/OFF/BYPASS (IOB)—3-contactor—bypass option provides a means of bypassing the SVX9000, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted IOB selector switch. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked.	Bypass
RC	Auto Transfer HOA Bypass Controller —The manual HAND/OFF/AUTO (HOA)—3-contactor—bypass option provides a means of bypassing the SVX9000, allowing the AC motor to be operated at full speed directly from the AC supply line. The circuitry provides an automatic transfer of the load to “across the line” operation after a drive trip. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in either mode. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked. Door-mounted pilot lights are provided which indicate bypass or inverter operation. A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode. WARNING: The motor may restart when the overcurrent relay is reset when operating in bypass, unless the IOB selector switch is turned to the OFF position.	Bypass
RD	Auto Transfer IOB Bypass Controller —The auto INVERTER/OFF/BYPASS (IOB)—3-contactor—bypass option provides a means of bypassing the SVX9000, allowing the AC motor to be operated at full speed directly from the AC supply line. The circuitry provides an automatic transfer of the load to “across the line” operation after a drive trip. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted IOB selector switch. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked. Door-mounted pilot lights are provided which indicate bypass or inverter operation. A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode. WARNING: The motor may restart when the overcurrent relay is reset when operating in bypass, unless the IOB selector switch is turned to the OFF position.	Bypass
S5	Floor Stand 22 in —Converts a Size 1 or 2, normally wall mounted enclosure to a floor standing enclosure with a height of 22 in (558.8 mm).	Enclosure
S6	Floor Stand 12 in —Converts a Size 2, normally wall mounted enclosure to a floor standing enclosure with a height of 12 in (304.8 mm).	Enclosure
S7	10 in Expansion —In a Size 5 enclosure, the extension allows for bottom cable entry and additional space for customer mounted components. NOTE: Enclosure expansion rated NEMA Type 1/IP21 only.	Enclosure
S8	20 in Expansion —In a Size 5 enclosure, the extension allows for bottom cable entry and additional space for customer mounted components. When the output filter (option PF) is selected for a drive using a Size 5 enclosure, this expansion box is required and included in the option pricing. Enclosure expansion rated NEMA Type 1/IP21 only.	Enclosure
S9	Space Heater —Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. A 200W heater is installed in enclosures 0 and 1, and a 400W heater is installed in enclosures 2–5.	Enclosure
SA	Space Heater with CPT —Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. A 200W heater is installed in enclosures 0 and 1, and a 400W heater is installed in enclosures 2–5. Includes a 115V supply to power heater.	Enclosure

Enclosed Drive Options

Brake Chopper Options

The brake chopper circuit option is used for applications that require dynamic braking. Dynamic braking resistors are not included with drive purchase. Consult **Page V6-T2-58** for dynamic braking resistors which are supplied separately. Resistors are not UL Listed.

For brake chopper circuit selection and adder—NEMA Type 1/IP21, NEMA Type 12/IP54, consult the factory

SVX Conversion Kit

Frame 4–7 ^①

Frame Size	Enclosure Size	Delivery Code	Catalog Number
FR4	0	FB10	OPTCON-SVXFR4-SZ00
	1		OPTCON-SVXFR4-SZ01
FR5	0	FB10	OPTCON-SVXFR5-SZ00
	1		OPTCON-SVXFR5-SZ01
FR6	1	FB10	OPTCON-SVXFR6-SZ01
	2		OPTCON-SVXFR6-SZ02
FR7	2	FB10	OPTCON-SVXFR7-SZ02

Note

^① The kit consists of a flange kit, adapter plate(s), hardware, remote keypad kit and SVX9000 decal.

Technical Data and Specifications

2

9000X Enclosed Drives

Description	NEMA Type 1/IP21 or NEMA Type 12/IP54 Specification
Primary Design Features	
45–66 Hz input frequency	Standard
Output: AC volts maximum	Input voltage base
Output frequency range	0–320 Hz
Initial output current (I_H)	250% for 2 seconds
Overload (1 minute [I_H/I_L])	150%/110%
Enclosure space heater	Optional
Oversize enclosure	Standard
Output contactor	Optional
Bypass motor starter	Optional
Listings	UL, cUL
Protection Features	
Incoming line fuses	Optional
AC input circuit disconnect	Optional
Line reactors (3%)	Standard
Phase rotation insensitive	Standard
EMI filter	Standard
Input phase loss protection	Standard
Input overvoltage protection	Standard
Line surge protection	Optional
Output short-circuit protection	Standard
Output ground fault protection	Standard
Output phase protection	Standard
Overtemperature protection	Standard
DC overvoltage protection	Standard
Drive overload protection	Standard
Motor overload protection	Standard
Programmer software	Optional
Local/remote keypad	Standard
Keypad lockout	Standard
Fault alarm output	Standard
Built-in diagnostics	Standard

Description	NEMA Type 1/IP21 or NEMA Type 12/IP54 Specification
Input/Output Interface Features	
Setup adjustment provisions	
Remote keypad/display	Standard
Personal computer	Standard
Operator control provisions	
Drive mounted keypad/display	Standard
Remote keypad/display	Standard
Conventional control elements	Standard
Serial communications	Optional
115 Vac control circuit	Optional
Speed setting inputs	
Keypad	Standard
0–10 Vdc potentiometer/voltage signal	Standard
4–20 mA Isolated	Configurable
4–20 mA Differential	Configurable
Analog outputs	
Speed/frequency	Standard
Torque/load/current	Programmable
Motor voltage	Programmable
Kilowatts	Programmable
0–10 Vdc signals	Configurable w/jumpers
4–20 mA DC signals	Standard
Isolated signals	Optional
Discrete outputs	
Fault alarm	Standard
Drive running	Standard
Drive at set speed	Programmable
Optional parameters	14
Dry contacts	1 (2 relays Form C)
Open collector outputs	1
Additional discrete outputs	Optional
Communications	
RS-232	Standard
RS-422/485	Optional
DeviceNet™	Optional
Modbus RTU	Optional
CANopen (slave)	Optional
PROFIBUS-DP	Optional
Lonworks®	Optional
Johnson Controls Metasys™ N2	Optional
EtherNet/IP	Optional
Modbus TCP	Optional
BACnet	Optional

9000X Enclosed Drives, continued

Description	NEMA Type 1/IP21 or NEMA Type 12/IP54 Specification
Performance Features	
Sensorless vector control	Standard
Volts/hertz control	Standard
IR and slip compensation	Standard
Electronic reversing	Standard
Dynamic braking	Optional ①
DC braking	Standard
PID setpoint controller	Programmable
Critical speed lockout	Standard
Current (torque) limit	Standard
Adjustable acceleration/deceleration	Standard
Linear or S curve accel/decel	Standard
Jog at preset speed	Standard
Thread/preset speeds	7 Standard, 15 Optional
Automatic restart	Selectable
Coasting motor start	Standard
Coast or ramp stop selection	Standard
Elapsed time meter	Optional
Carrier frequency adjustment	1–16 kHz
Standard Conditions for Application and Service	
Operating ambient temperature	0 to 40°C
Storage temperature	–40 to 60°C
Humidity (maximum), non-condensing	95%
Altitude (maximum without derate)	3300 ft (1000m)
Line voltage variation	+10/-15%
Line frequency variation	45–66 Hz
Efficiency	>96%
Power factor (displacement)	>0.94

Standard I/O Specifications

Description	Specification
Six-digital input programmable	24V: "0" ≤10V, "1" ≥18V, $R_i > 5$ kohms
Two-analog input configurable w/jumpers	Voltage: 0–±10V, $R_i > 200$ kohms Current: 0 (4)–20 mA, $R_i = 250$ ohms
Two-digital output programmable	Form C relays 250 Vac 30 Vdc 2 amp resistive
One-analog output programmable configurable w/jumper	0–20 mA, R_L max. 500 ohms 10 bits ±2%
One digital output programmable	Open collector 48 Vdc 50 mA

2

I/O Specifications for Control/Communication Options

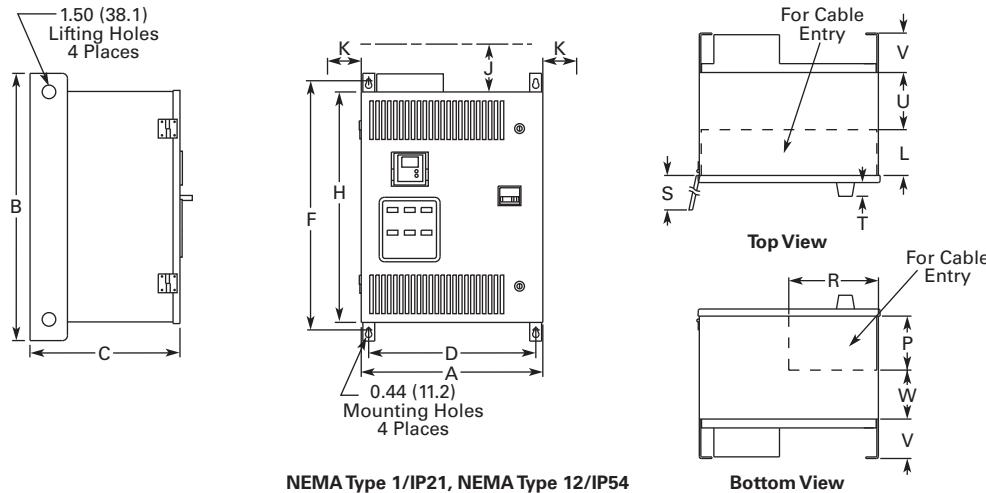
Description	Specification
Analog voltage, input	0–±10V, $R_i \geq 200$ kohms
Analog current, input	0 (4)–20 mA, $R_i = 250$ ohms
Digital input	24V: "0" ≤10V, "1" ≥18V, $R_i > 5$ kohms
Auxiliary voltage	24V (±20%), max. 50 mA
Reference voltage	10V ±3%, max. 10 mA
Analog current, output	0 (4)–20 mA, $R_L = 500$ kohms resolution 10 bit, accuracy ≤±2%
Analog voltage, output	0 (2)–10V, $R_L \geq 1$ kohms, resolution 10 bit, accuracy ≤±2%
Relay output	
Maximum switching voltage	300 Vdc, 250 Vac
Maximum switching load	8A/24 Vdc, 0.4A/300 Vdc, 2 kVA/250 Vac
Maximum continuous load	2A rms
Thermistor input	$R_{trip} = 4.7$ kohms
Encoder input	24V: "0" ≤10V, "1" ≥18V, $R_i = 2.2$ kohms 5V: "0" ≤2V, "1" ≥3V, $R_i = 330$ ohms

Note

- ① Some horsepower units include dynamic braking chopper as standard—refer to individual drive sections.

Dimensions

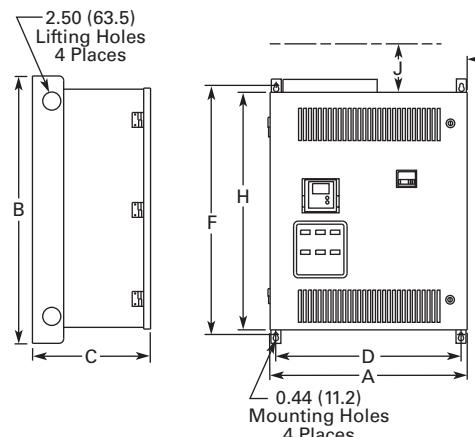
Approximate Dimensions in Inches (mm)

2**9000X Enclosed Drives****Size 0**

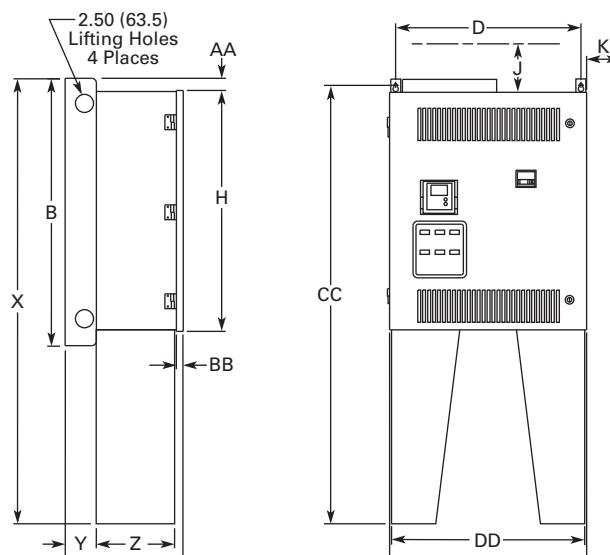
For reference only, dimensions are subject to change.

Wide A	High B	Deep C	Mounting D	D1	E	E1	F	G	G1	Door Height H	Min. Air Space J	K
19.9 (504)	29.0 (737)	16.4 (416)	18.3 (465)	—	—	—	27.4 (695)	—	—	25.4 (644)	4.0 (102)	3.0 (76)
Cable Entry												
L	M	N	P	R	S	Door Clearance	CB Handle	T	U	V	W	Max. Approx. Shipping Weight Lbs (kg)
5.0 (127)	—	—	6.0 (152)	9.6 (245)	26.4 (669)		1.5 (38)	6.3 (160)	4.3 (108)	5.3 (134)	200 (91)	

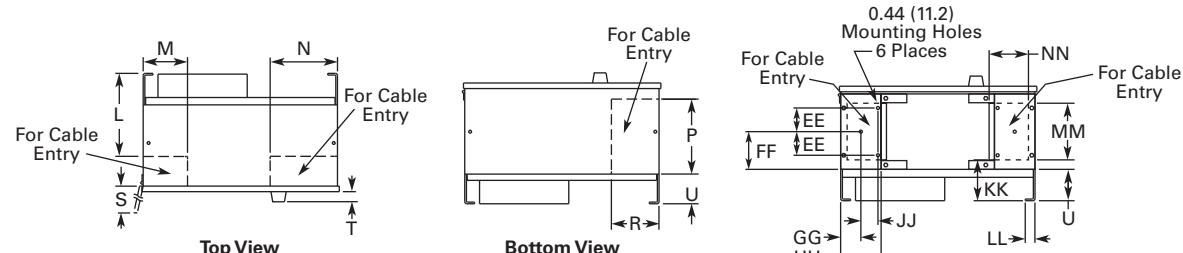
Approximate Dimensions in Inches (mm)

Size 1

NEMA Type 1/IP21, NEMA Type 12/IP54
NEMA Type 12/IP54 Includes Cover Plates Over Louvers



NEMA Type 1/IP21, NEMA Type 12/IP54
with Floor Stand



NEMA Type 1/IP21, NEMA Type 12/IP54
with Floor Stand

For reference only, dimensions are subject to change.

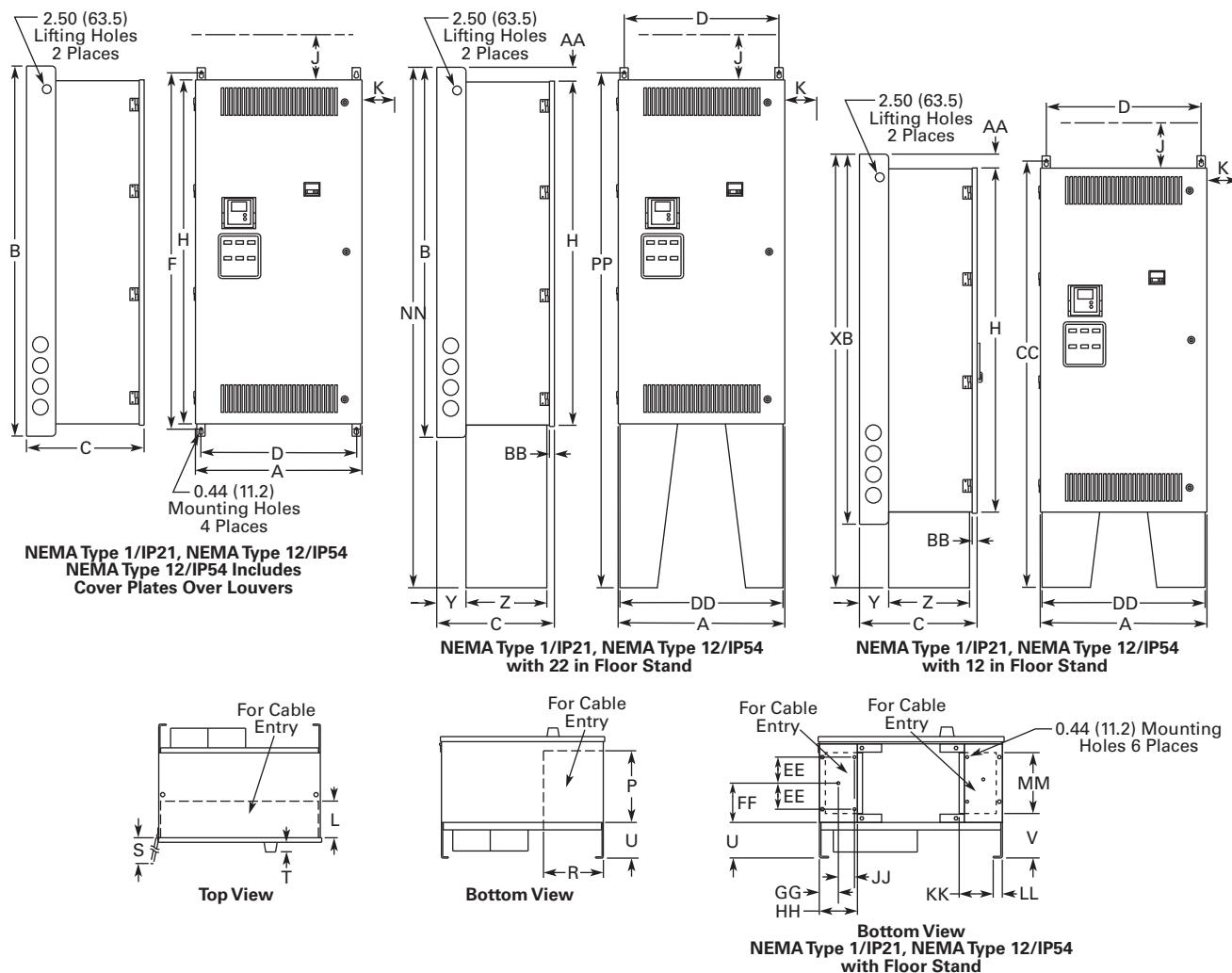
Wide A	High B	Deep C	Mounting D	D1	E	E1	F	G	G1	Door Height H	Min. Air Space J	K
26.4 (669)	36 (914)	16.3 (414)	24.8 (630)	—	—	—	34.0 (864)	—	—	32.4 (822)	4.0 (102)	3.0 (76)

Cable Entry L	M	N	P	R	S	Door Clearance T	CB Handle U	V	W	Max. Approx. Shipping Weight Lbs (kg)
11.0 (279)	6.0 (152)	9.0 (229)	10.0 (254)	6.5 (165)	26.4 (669)	1.5 (38)	4.3 (108)	—	—	230 (104)

Floor Stand																					
X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL	MM	NN	PP	RR	SS	TT	UU	VV
56.0 (1422)	4.3 (108)	11.1 (281)	1.8 (46)	0.8 (19)	55.2 (1402)	26.0 (660)	3.5 (90)	5.5 (141)	3.0 (76)	6.0 (152)	2.0 (51)	5.4 (136)	1.1 (28)	8.8 (224)	5.4 (137)	—	—	—	—	—	—

Approximate Dimensions in Inches (mm)

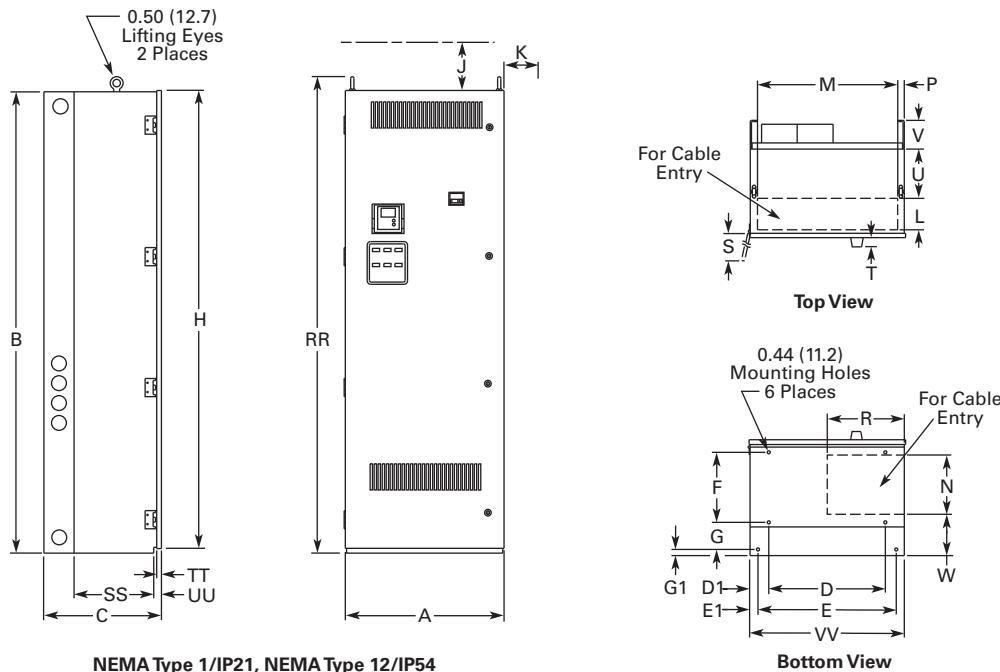
Size 2



For reference only, dimensions are subject to change.

Wide A	High B	Deep C	Mounting D	D1	E	E1	F	G	G1	Door Height H	Min. Air Space J	K									
26.4 (669)	59.0 (1499)	19.4 (492)	24.8 (630)	—	—	—	57.0 (1448)	—	—	55.4 (1406)	4.0 (102)	3.0 (76)									
Cable Entry												Max. Approx. Shipping Weight Lbs (kg)									
5.9 (149)	—	—	12.4 (315)	9.5 (241)	26.4 (669)		1.5 (38)	4.8 (121)	5.9 (151)	—	—	380 (173)									
Floor Stand																					
X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL	MM	NN	PP	RR	SS	TT	UU	VV
69.0 (1753)	4.8 (121)	13.6 (344)	1.8 (46)	0.8 (19)	68.2 (1732)	26.0 (660)	4.8 (121)	6.8 (172)	3.0 (76)	6.0 (152)	2.0 (51)	5.0 (127)	1.1 (28)	11.3 (288)	79.0 (2007)	78.2 (1986)	—	—	—	—	—

Approximate Dimensions in Inches (mm)

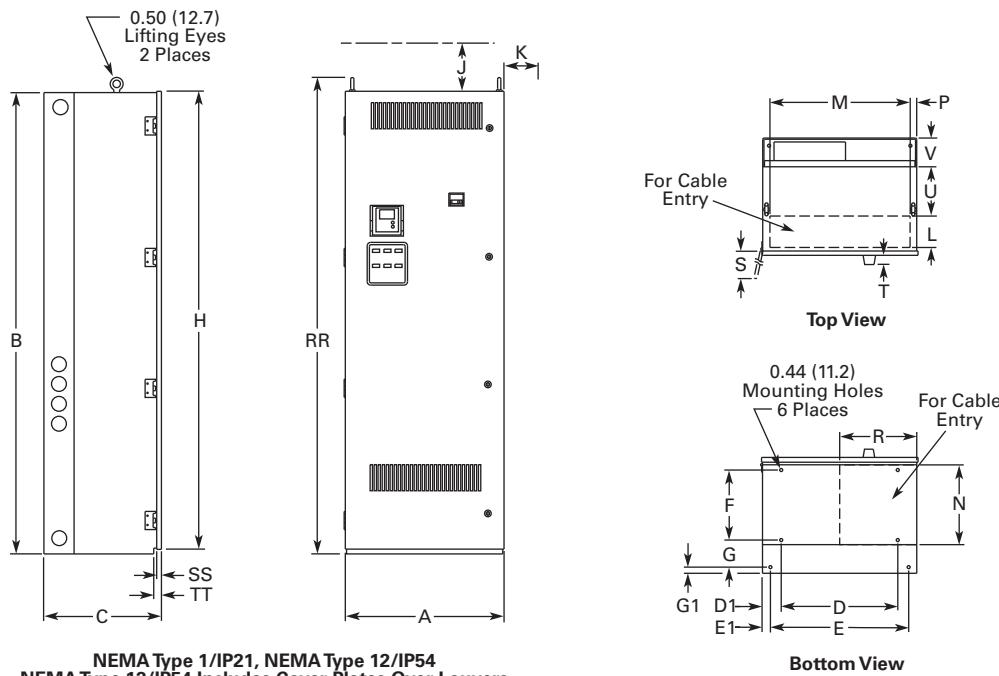
Size 3

For reference only, dimensions are subject to change.

Wide A	High B	Deep C	Mounting					Door Height H	Min. Air Space J	K	
26.4 (671)	77.0 (1956)	19.4 (493)	D	D1	E	E1	F	G	G1	H	
			19.5 (495)	3.3 (83)	23.0 (584)	1.5 (38)	11.7 (298)	5.5 (140)	0.9 (24)	76.4 (1939)	4.0 (102)
											3.0 (76)

Cable Entry												Max. Approx. Shipping Weight			
L	M	N	P	R	S	T	U	V	W	RR	SS	TT	UU	VV	Lbs (kg)
5.3 (133)	23.4 (594)	10.0 (254)	1.3 (32)	12.9 (328)	26.4 (669)	1.5 (38)	8.0 (203)	4.8 (121)	6.8 (173)	79.5 (2018)	13.40 (340)	0.8 (19)	1.3 (32)	26.0 (660)	690 (313)

Approximate Dimensions in Inches (mm)

Size 4**2**

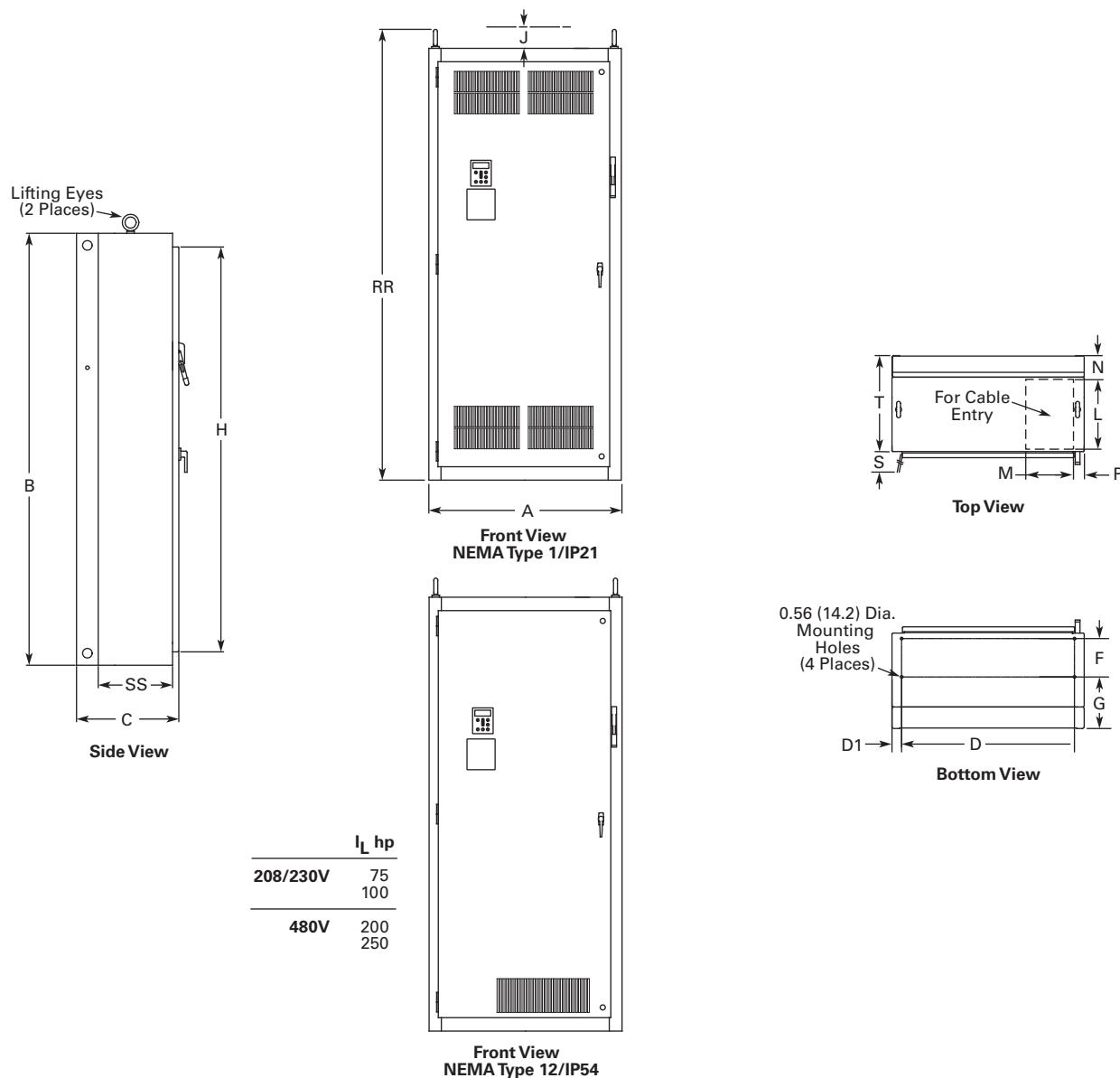
For reference only, dimensions are subject to change.

Wide A	High B	Deep C	Mounting D	D1	E	E1	F	G	G1	Door Height H	Min. Air Space J	K
26.4 (671)	90.0 (2286)	19.4 (493)	19.5 (495)	3.3 (83)	23.0 (584)	1.5 (38)	11.7 (298)	5.5 (140)	0.9 (24)	89.4 (2270)	4.0 (102)	3.0 (76)

Cable Entry										Door Clearance	CB Handle	Max. Approx. Shipping Weight Lbs (kg)				
L	M	N	P	R	S	T	U	V	W	RR	SS	TT	UU	VV		
5.3 (133)	23.4 (594)	13.8 (351)	1.0 (25)	11.2 (286)	26.4 (669)	1.5 (38)	8.0 (204)	4.8 (121)	—	92.5 (2349)	0.8 (19)	1.3 (32)	—	—	825 (375)	

Approximate Dimensions in Inches (mm)

Size 5



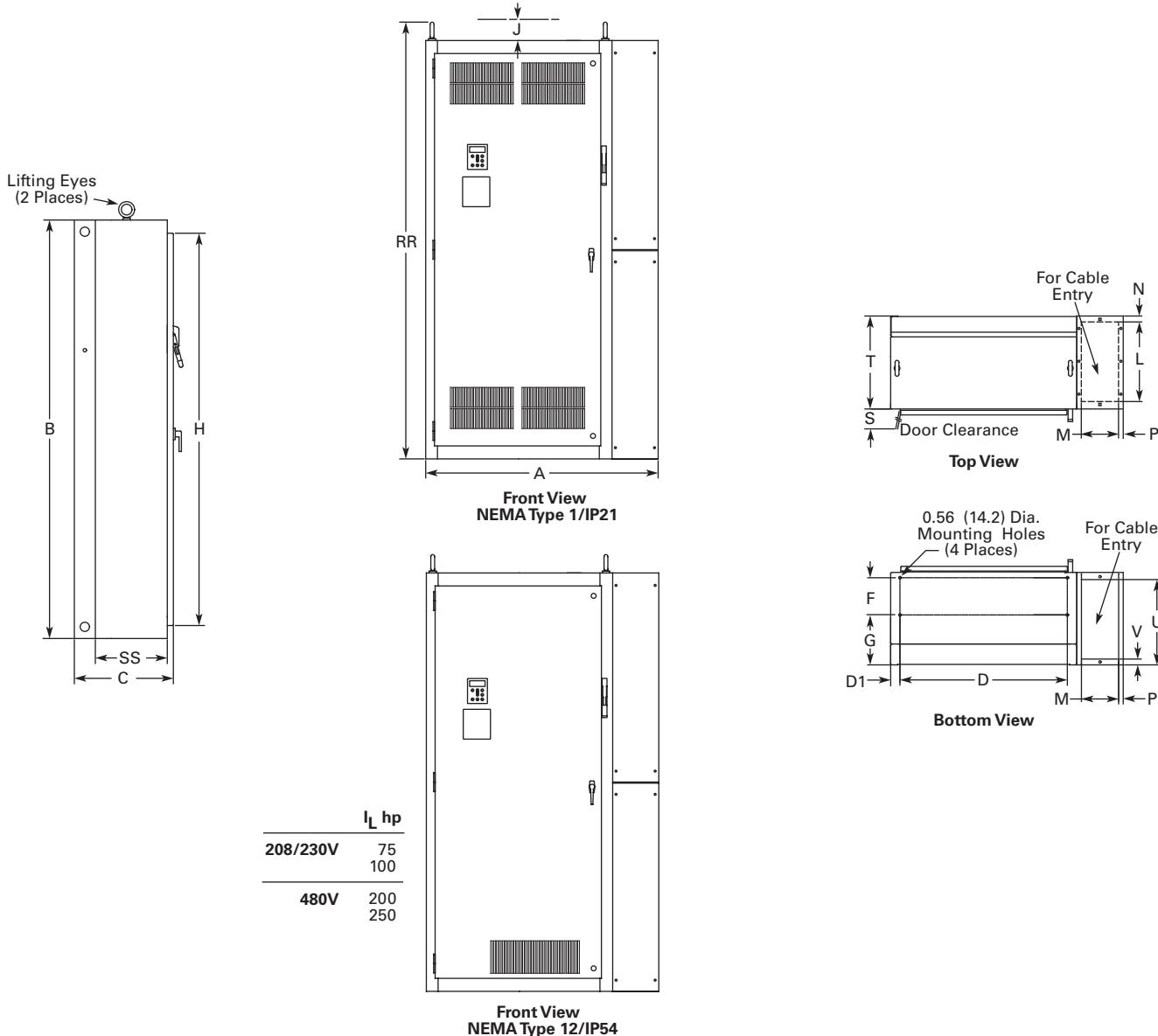
For reference only, dimensions are subject to change.

Wide A	High B	Deep C	Mounting				F	G	G1	Door Height H	Min. Air Space J	K
				D1	E	E1						
40.0 (1016)	90.0 (2286)	21.3 (541)	36.0 (914)	2.0 (51)	—	—	8.0 (203)	10.8 (273)	—	84.4 (2143)	4.0 (102)	—
Cable Entry												
L	M	N	P	R	S	T	U	V	W	RR	SS	TT
15.0 (381)	10.0 (254)	4.8 (122)	2.0 (51)	—	36.3 (921)	20.0 (508)	—	—	—	94.0 (2387)	15.5 (394)	—
UU	VV											Max. Approx. Shipping Weight Lbs (kg)
—	—											1275 (579)

Approximate Dimensions in Inches (mm)

Size 5-1P

2



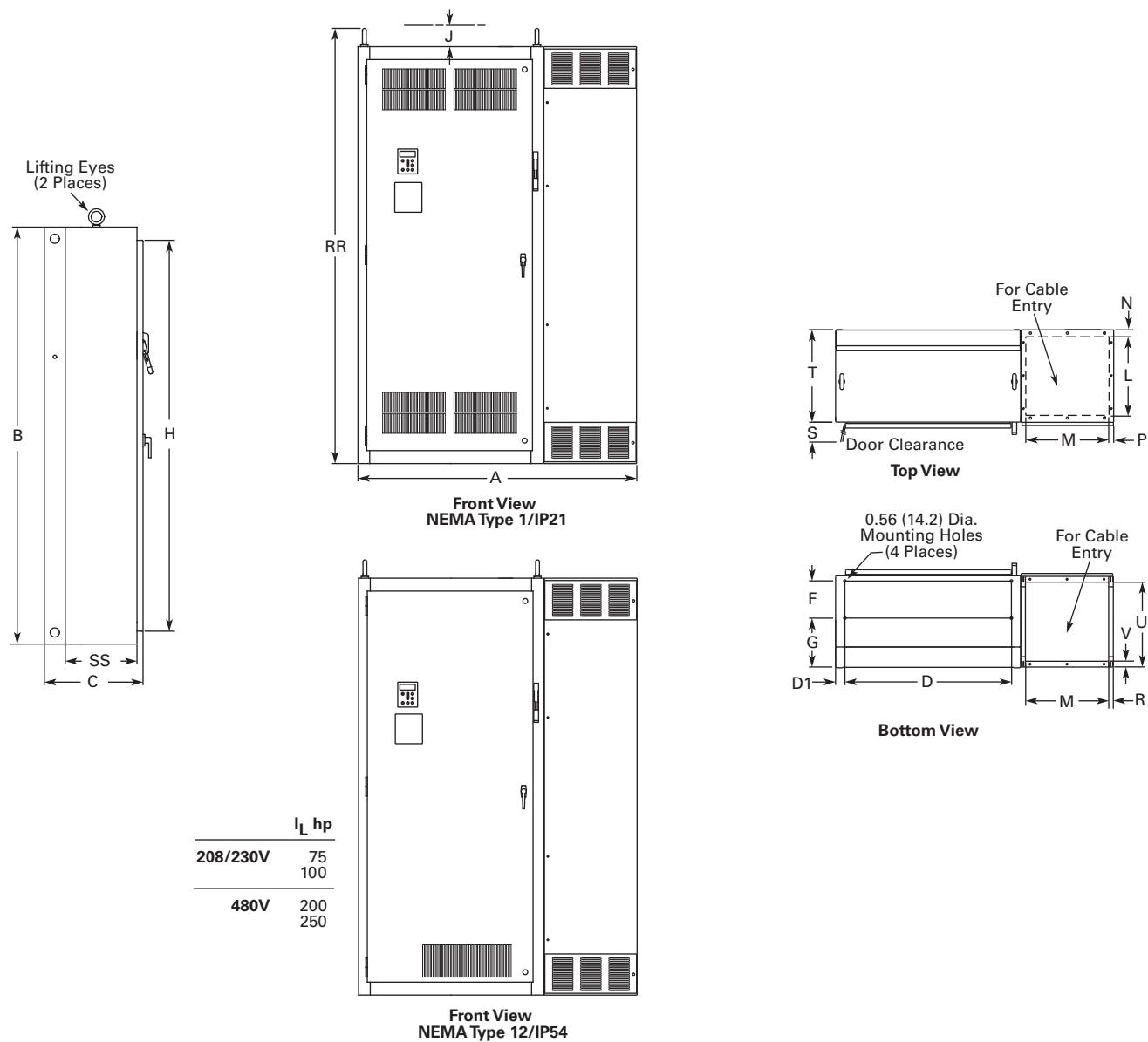
For reference only, dimensions are subject to change.

Wide A	High B	Deep C	Mounting				Door Height H			Min. Air Space K		
50.0 (1270)	90.0 (2286)	21.3 (541)	D	D1	E	E1	F	G	G1	J	—	—
50.0 (1270)	90.0 (2286)	21.3 (541)	36.0 (914)	2.0 (51)	—	—	8.0 (203)	10.8 (273)	—	84.4 (2143)	4.0 (102)	—

Door Clearance													Max. Approx. Shipping Weight Lbs (kg)	
L	M	N	P	R	S	T	U	V	W	RR	SS	TT	UU	VV
17.1 (435)	8.0 (203)	1.3 (33)	1.0 (25)	—	36.3 (921)	20.0 (508)	18.4 (466)	1.3 (32)	—	94.0 (2387)	15.5 (394)	—	—	1375 (624)

Approximate Dimensions in Inches (mm)

Size 5-2P



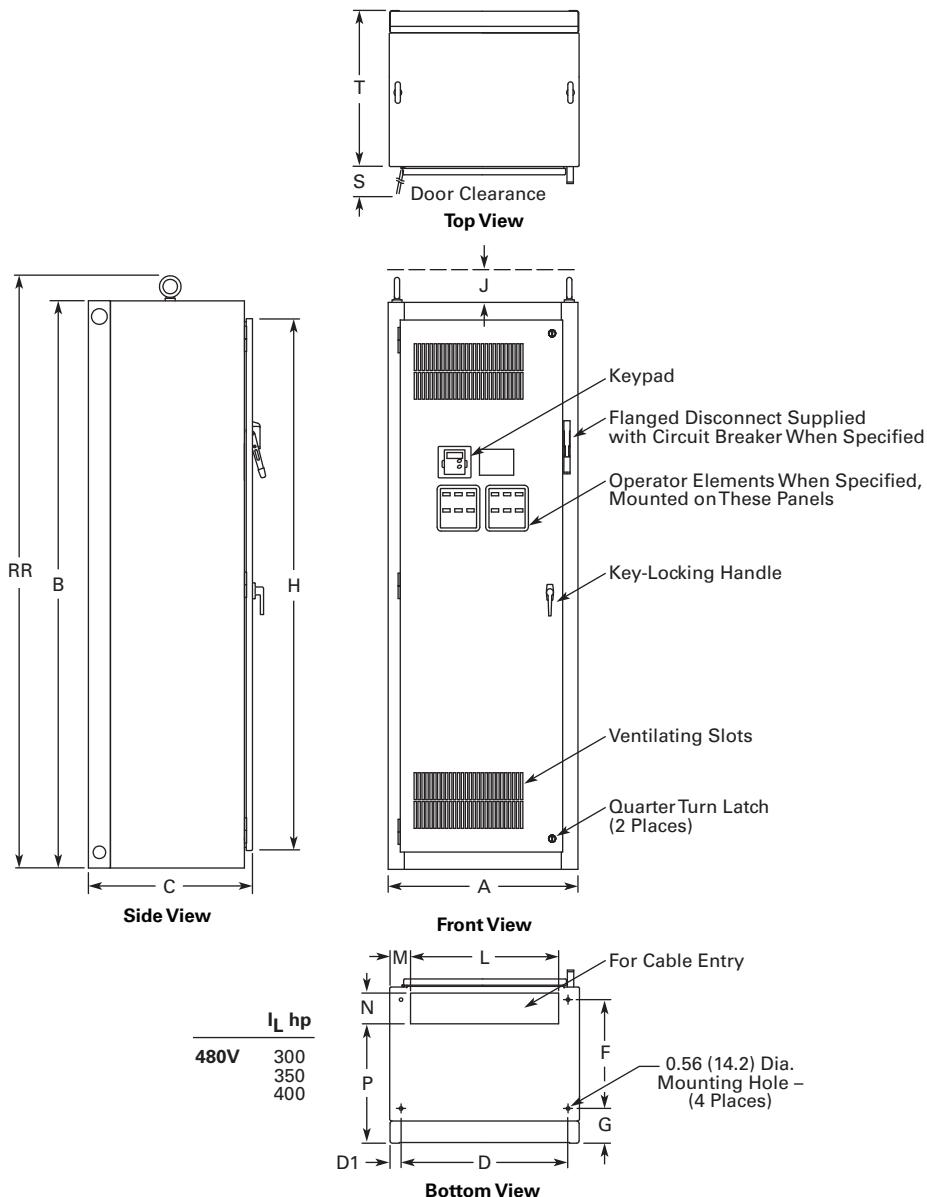
For reference only, dimensions are subject to change.

Wide A	High B	Deep C	Mounting D	D1	E	E1	F	G	G1	Door Height H	Min. Air Space J	K
Enclosure Size 5-2P												
60.0 (1524)	90.0 (2286)	21.3 (541)	36.0 (914)	2.0 (51)	—	—	8.0 (203)	10.8 (273)	—	84.4 (2143)	4.0 (102)	—
Cable Entry L	M	N	P	R	S	Door Clearance T	U	V	W	RR	SS	TT
17.0 (432)	18.0 (457)	1.5 (38)	1.0 (25)	0.9 (23)	36.3 (921)	20.0 (508)	18.4 (466)	1.3 (32)	—	94.0 (2387)	15.5 (394)	—
											Max. Approx. Shipping Weight Lbs (kg)	
											1585 (720)	

Approximate Dimensions in Inches (mm)

Size 6

2



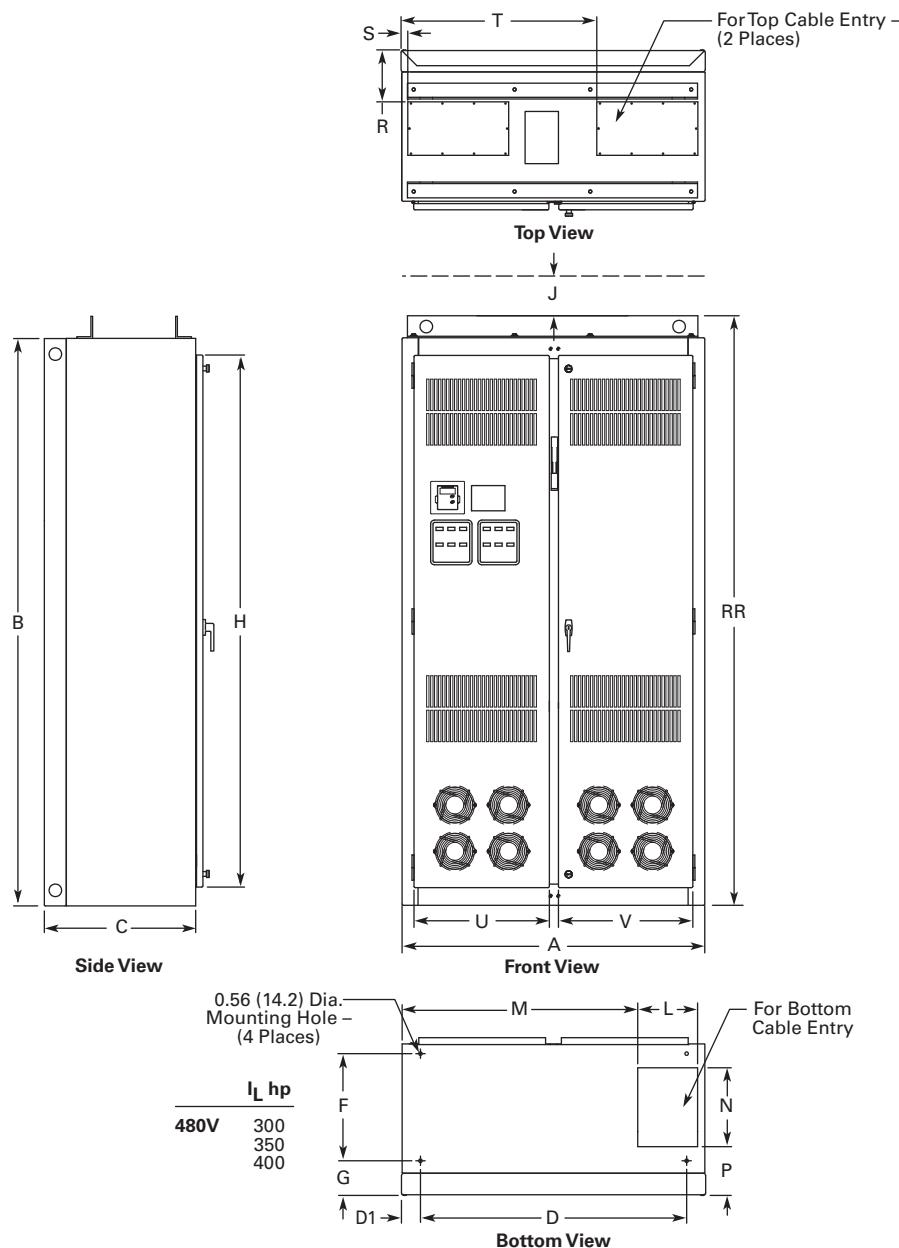
For reference only, dimensions are subject to change. See **Page V6-T2-92**, notes 3 and 5 for enclosure and option selection.

Wide A	High B	Deep C	Mounting					Door Height H	Min. Air Space J	K
30.0 (762)	90.0 (2286)	26.0 (660)	D	D1	E	E1	F	G	G1	H

Cable Entry										Door Clearance					Max. Approx. Shipping Weight
L	M	N	P	R	S	T	U	V	W	RR	SS	TT	UU	VV	Lbs (kg)
23.5 (597)	3.3 (84)	4.5 (114)	19.3 (490)	—	26.2 (667)	24.8 (629)	—	—	—	93.9 (2386)	—	—	—	—	1500 (681)

Approximate Dimensions in Inches (mm)

Size 8

For reference only, dimensions are subject to change. See **Page V6-T2-92**, notes 3 and 5 for enclosure and option selection.

Wide A	High B	Deep C	Mounting D	D1	E	E1	F	G	G1	Door Height H	Min. Air Space J									
										K										
48.0 (1219)	90.0 (2286)	24.0 (610)	42.2 (1072)	3.0 (77)	—	—	—	5.5 (139)	—	84.4 (2143)	4.0 (102)									
Cable Entry																				
L	M	N	P	R	S	T	U	V	W	RR	SS									
9.5 (241)	37.5 (952)	12.5 (318)	7.7 (196)	8.3 (210)	1.3 (32)	31.0 (787)	21.5 (545)	21.3 (541)	—	93.5 (2375)	—									
TT	UU	VV																		
—	—	—																		
Max. Approx. Shipping Weight Lbs (kg)																				
2000 (908)																				

2.5

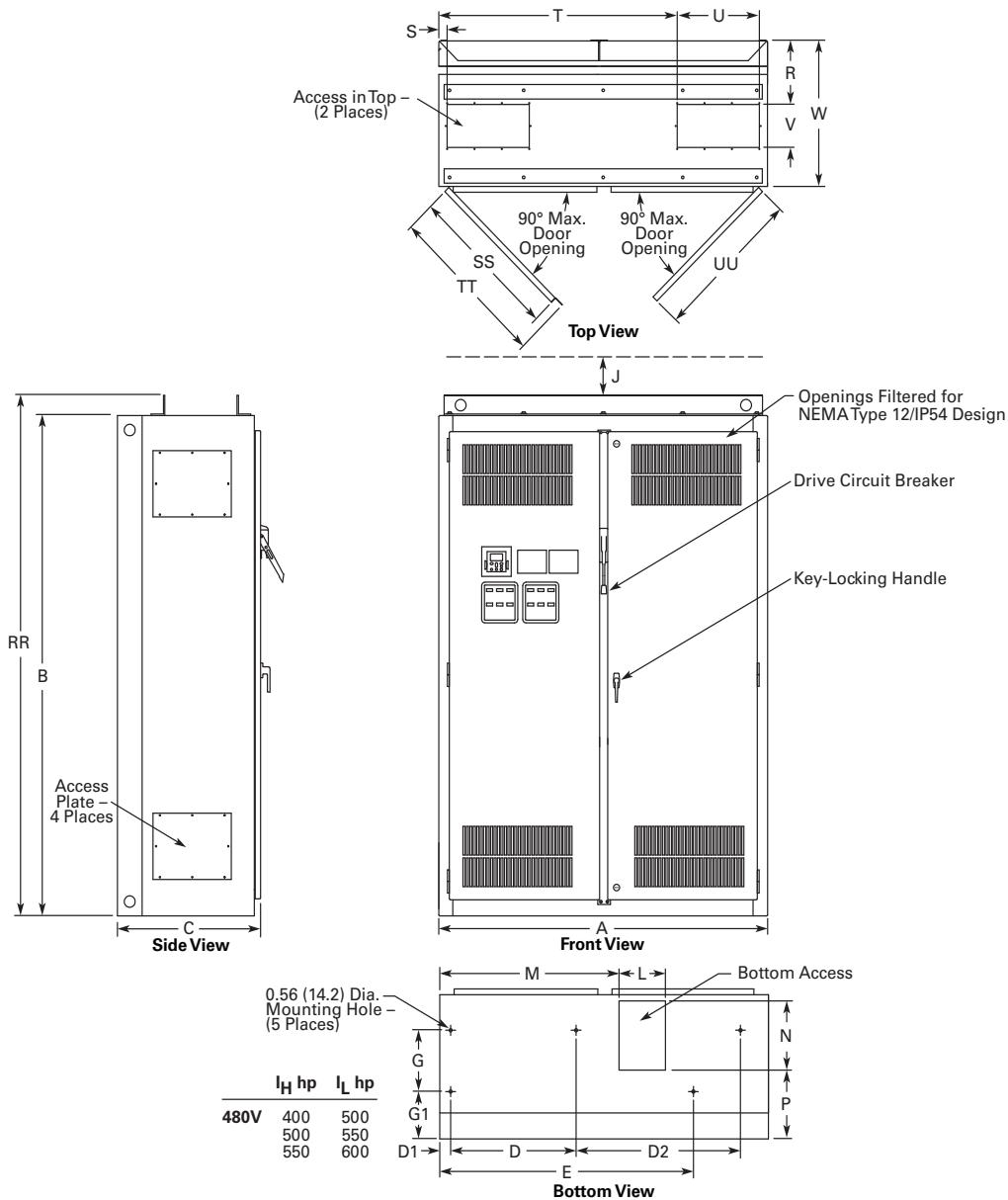
Adjustable Frequency Drives

SVX9000 Drives

Approximate Dimensions in Inches (mm)

Size 9

2



For reference only, dimensions are subject to change. See **Page V6-T2-92**, notes 3 and 5 for enclosure and option selection.

Wide A	High B	Deep C	Mounting D	D1	E	E1	F	G	G1	Door Height H	Min. Air Space K
60.0 (1524)	90.0 (2286)	260.1 (664)	22.9 (582)	2.0 (51)	30.0 (762)	44.3 (1125)	10.6 (270)	10.6 (270)	8.2 (208)	—	4.0 (102)

Cable Entry															Max. Approx. Shipping Weight Lbs (kg)
L	M	N	P	R	S	T	U	V	W	RR	SS	TT	UU	VV	
8.5 (216)	32.7 (831)	12.0 (305)	11.9 (303)	9.8 (249)	1.5 (38)	43.5 (1105)	15.0 (381)	7.5 (191)	25.0 (635)	93.5 (2375)	27.4 (696)	290.1 (738)	270.1 (687)	—	2500 (1135)

SVX9000 VFD Pump Panels**Contents****Description**

	Page
SVX9000 Drives	V6-T2-48
SVX9000 Enclosed Drives	V6-T2-87
SVX9000 VFD Pump Panels	
Catalog Number Selection	V6-T2-112
Product Selection	V6-T2-113
Options	V6-T2-118
Technical Data and Specifications	V6-T2-121
Wiring Diagrams	V6-T2-123
Dimensions	V6-T2-124

2

SVX9000 VFD Pump Panels**Product Description**

- Standard Enclosed**— covers a wide range of the most commonly ordered options. Pre-engineering eliminates the lead time normally associated with customer specific options.

- Modified Standard Enclosed**—applies to specific customer requirements that vary from the Standard Enclosed offering, such as the need for an additional indicating light or minor modifications to drawings. *Consult your Eaton representative for assistance in pricing and lead time.*

- Custom Engineered**—for those applications with more unique or complex requirements, these are individually engineered to the customer's needs.

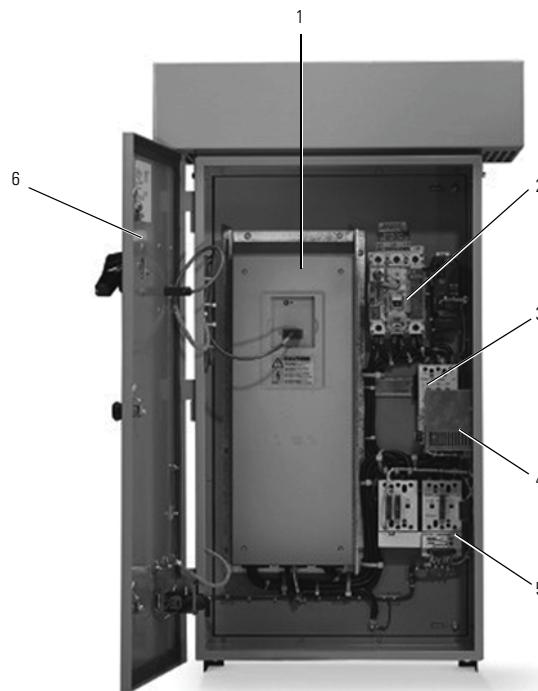
Consult your Eaton representative for assistance in pricing and lead time.

Features

- NEMA Type 12/IP54 or NEMA Type 3R enclosures
- Input voltage: 208V, 230V, 480V and 575V (consult factory)
- Complete range of control, network and power options
- Horsepower range:
 - 208V—3/4 to 100 hp I_H ; 1 to 100 hp I_L
 - 230V—3/4 to 100 hp I_H ; 1 to 100 hp I_L
 - 480V—1 to 350 hp I_H ; 1-1/2 to 400 hp I_L
- Padlockable disconnect
- Single-phase input available

Standards and Certifications

- UL Listed
- cUL Listed

**Product Identification****SVX9000 Pump Application**

1 SVX9000 variable frequency drive

2 Input disconnect Option P1

3 Input contactor (included as standard with bypass option)

4 Space heater Option S9

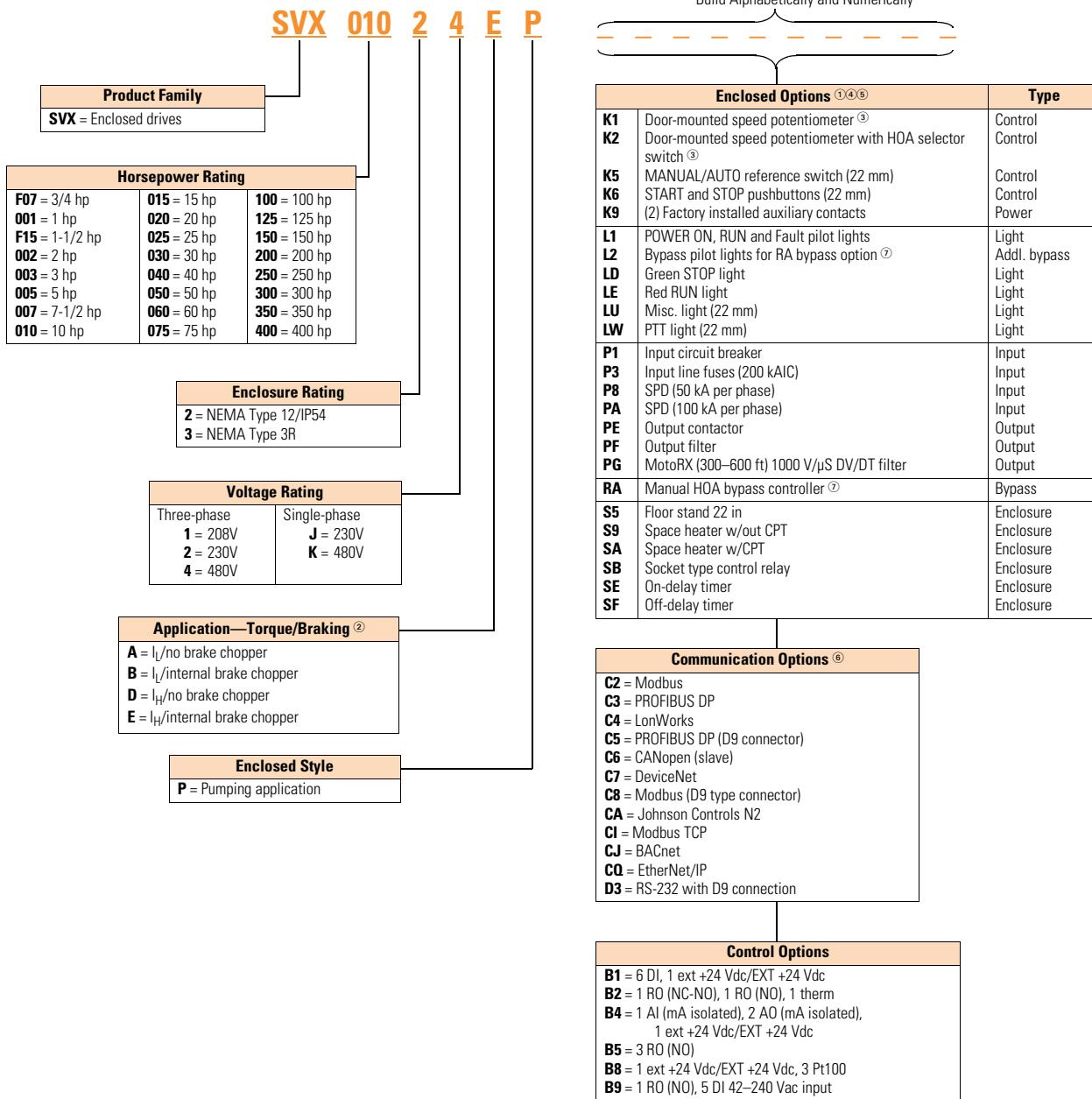
5 Bypass contactor Option RA/RB

6 Door-mounted keypad (included as standard)

Catalog Number Selection

SVX9000 Enclosed NEMA Type 12/IP54/3R Drive

2



Notes

- ① Local/remote keypad is included as the standard control panel.
- ② Brake chopper is a factory installed option only, see drive options on **Page V6-T2-49**. External dynamic braking resistors not included. See Page **V6-T2-58**.
- ③ Includes local/remote speed reference switch.
- ④ Some options are voltage and/or horsepower specific. Consult your Eaton representative for details.
- ⑤ See **Page V6-T2-120** for descriptions.
- ⑥ See **Pages V6-T2-118** and **V6-T2-119** for complete descriptions.
- ⑦ Bypass options applicable only in the pump panel three-phase design.

Product Selection**When Ordering**

- Select a base catalog number that meets the application requirements—nominal horsepower, voltage and enclosure rating (the enclosed drive's continuous output amp rating should be equal to or

greater than the motor's full load amp rating). The base enclosed package includes a standard drive, door mounted local/remote keypad and enclosure.

- If dynamic brake chopper or control/communication option is desired, change the appropriate code in the base catalog number.

- Select enclosed options. Add the codes as suffixes to the base catalog number in alphabetical and numeric order.
- Read all footnotes.**

208V Drives**SVX9000 Enclosed Drives****Pump Panel Style (Three-Phase)**

NEMA Type 12/IP54			NEMA Type 3R		
Enclosure Size ^①	hp	Frame Size	Base Catalog Number ^②	Frame Size	Base Catalog Number ^②
High Overload Drive and Enclosure					
A	3/4	4	SVXF0721EP	4	SVXF0731EP
	1		SVX00121EP		SVX00131EP
	1-1/2		SVXF1521EP		SVXF1531EP
	2		SVX00221EP		SVX00231EP
	3	5	SVX00321EP	5	SVX00331EP
	5		SVX00521EP		SVX00531EP
	7-1/2		SVX00721EP		SVX00731EP
	10	6	SVX01021EP	6	SVX01031EP
	15		SVX01521EP		SVX01531EP
B	20	7	SVX02021DP	7	SVX02031DP
	25		SVX02521DP		SVX02531DP
	30		SVX03021DP		SVX03031DP
C	40	8	SVX04021DP	8	SVX04031DP
	50		SVX05021DP		SVX05031DP
	60		SVX06021DP		SVX06031DP
F	75	9	—	9	SVX07531DP
	100		—		SVX10031DP
Low Overload Drive and Enclosure					
A	1	4	SVX00121BP	4	SVX00131BP
	1-1/2		SVXF1521BP		SVXF1531BP
	2		SVX00221BP		SVX00231BP
	3		SVX00321BP		SVX00331BP
	5	5	SVX00521BP	5	SVX00531BP
	7-1/2		SVX00721BP		SVX00731BP
	10		SVX01021BP		SVX01031BP
	15	6	SVX01521BP	6	SVX01531BP
	20		SVX02021BP		SVX02031BP
B	25	7	SVX02521AP	7	SVX02531AP
	30		SVX03021AP		SVX03031AP
	40		SVX04021AP		SVX04031AP
C	50	8	SVX05021AP	8	SVX05031AP
	60		SVX06021AP		SVX06031AP
	75		SVX07521AP		SVX07531AP
F	100	9	—	9	SVX10031AP
	125		—		SVX12531AP

Notes

^① Enclosure dimensions starting on **Page V6-T2-124**.

^② Includes drive, local/remote keypad and enclosure.

230V Drives

2

SVX9000 Enclosed Drives



Pump Panel Style (Three-Phase)

Enclosure Size ①	hp	NEMA Type 12/IP54		NEMA Type 3R	
		Frame Size	Base Catalog Number ②	Frame Size	Base Catalog Number ②
High Overload Drive and Enclosure					
A	3/4	4	SVXF0722EP	4	SVXF0732EP
	1		SVX00122EP		SVX00132EP
	1-1/2		SVXF1522EP		SVXF1532EP
	2		SVX00222EP		SVX00232EP
	3	5	SVX00322EP	5	SVX00332EP
	5		SVX00522EP		SVX00532EP
	7-1/2		SVX00722EP		SVX00732EP
	10	6	SVX01022EP	6	SVX01032EP
	15		SVX01522EP		SVX01532EP
B	20	7	SVX02022DP	7	SVX02032DP
	25		SVX02522DP		SVX02532DP
	30		SVX03022DP		SVX03032DP
C	40	8	SVX04022DP	8	SVX04032DP
	50		SVX05022DP		SVX05032DP
	60		SVX06022DP		SVX06032DP
F	75	9	—	9	SVX07532DP
	100		—		SVX10032DP
Low Overload Drive and Enclosure					
A	1	4	SVX00122BP	4	SVX00132BP
	1-1/2		SVXF1522BP		SVXF1532BP
	2		SVX00222BP		SVX00232BP
	3		SVX00322BP		SVX00332BP
	5	5	SVX00522BP	5	SVX00532BP
	7-1/2		SVX00722BP		SVX00732BP
	10		SVX01022BP		SVX01032BP
	15	6	SVX01522BP	6	SVX01532BP
	20		SVX02022BP		SVX02032BP
B	25	7	SVX02522AP	7	SVX02532AP
	30		SVX03022AP		SVX03032AP
	40		SVX04022AP		SVX04032AP
C	50	8	SVX05022AP	8	SVX05032AP
	60		SVX06022AP		SVX06032AP
	75		SVX07522AP		SVX07532AP
F	100	9	—	9	SVX10032AP
	125		—		SVX12532AP

Notes

① Enclosure dimensions starting on **Page V6-T2-124**.

② Includes drive, local/remote keypad and enclosure.

230V Drives, continued**SVX9000 Enclosed Drives****Pump Panel Style (Single-Phase)**

Enclosure Size ①	NEMA Type 12/IP54		
	hp	Frame Size	Base Catalog Number ②
Low Overload Drive and Enclosure			
A	3/4	4	SVXF072JBP
	1		SVX0012JBP
	2	5	SVX0022JBP
	3		SVX0032JBP
	5		SVX0052JBP
	7-1/2	6	SVX0072JBP
	10		SVX0102JBP
B	15	7	SVX0152JBP
	20		SVX0202JAP
C	25	8	SVX0252JAP
	30		SVX0302JAP
	40		SVX0402JAP

Frame Size	NEMA Type 3R	
	Base Catalog	Number ②
Low Overload Drive and Enclosure		
4	SVXF073JBP	
	SVX0013JBP	
5	SVX0023JBP	
	SVX0033JBP	
	SVX0053JBP	
6	SVX0073JBP	
	SVX0103JBP	
7	SVX0153JBP	
	SVX0203JAP	
8	SVX0253JAP	
	SVX0303JAP	
	SVX0403JAP	

Notes

- ① Enclosure dimensions starting on **Page V6-T2-124**.
 ② Includes drive, local/remote keypad and enclosure.

480V Drives

2

SVX9000 Enclosed Drives



Pump Panel Style (Three-Phase)

Enclosure Size ①	hp	NEMA Type 12/IP54		NEMA Type 3R	
		Frame	Base Catalog Number ②	Frame	Base Catalog Number ②
High Overload Drive and Enclosure					
A	1	4	SVX00124EP	4	SVX00134EP
	1-1/2		SVXF1524EP		SVXF1534EP
	2		SVX00224EP		SVX00234EP
	3		SVX00324EP		SVX00334EP
	5		SVX00524EP		SVX00534EP
	7-1/2	5	SVX00724EP	5	SVX00734EP
	10		SVX01024EP		SVX01034EP
	15		SVX01524EP		SVX01534EP
	20	6	SVX02024EP	6	SVX02034EP
	25		SVX02524EP		SVX02534EP
B	30	7	SVX03024EP	7	SVX03034EP
	40		SVX04024DP		SVX04034DP
	50		SVX05024DP		SVX05034DP
	60		SVX06024DP		SVX06034DP
C	75	8	SVX07524DP	8	SVX07534DP
	100		SVX10024DP		SVX10034DP
	125		SVX12524DP		SVX12534DP
F	150	9	—	9	SVX15034DP
	200		—		SVX20034DP
	250	10	—	10	SVX25034DP
	300		—		SVX30034DP
	350		—		SVX35034DP
	400	11 ③	—	11	SVX40034DP
	500		—		SVX50034DP
Low Overload Drive and Enclosure					
A	1-1/2	4	SVXF1524BP	4	SVXF1534BP
	2		SVX00224BP		SVX00234BP
	3		SVX00324BP		SVX00334BP
	5		SVX00524BP		SVX00534BP
	7-1/2		SVX00724BP		SVX00734BP
	10	5	SVX01024BP	5	SVX01034BP
	15		SVX01524BP		SVX01534BP
	20		SVX02024BP		SVX02034BP
	25	6	SVX02524BP	6	SVX02534BP
	30		SVX03024BP		SVX03034BP
B	40	7	SVX04024BP	7	SVX04034BP
	50		SVX05024AP		SVX05034AP
	60		SVX06024AP		SVX06034AP
	75		SVX07524AP		SVX07534AP
C	100	8	SVX10024AP	8	SVX10034AP
	125		SVX12524AP		SVX12534AP
	150		SVX15024AP		SVX15034AP
F	200	9	—	9	SVX20034AP
	250		—		SVX25034AP
	300	10	—	10	SVX30034AP
	350		—		SVX35034AP
	400		—		SVX40034AP
	500	11 ③	—	11	SVX50034AP
	600		—		SVX60034AP

Notes

- ① Enclosure dimensions starting on **Page V6-T2-124**.
- ② Includes drive, local/remote keypad and enclosure.
- ③ FR11 has limited power options available.

480V Drives, continued**SVX9000 Enclosed Drives****Pump Panel Style (Single-Phase)**

Enclosure Size ^①	hp	Frame Size	NEMA Type 12/IP54
			Base Catalog Number ^②
Low Overload Drive and Enclosure			
A	3/4	4	SVXF072KBP
	1		SVX0012KBP
	2		SVX0022KBP
	3		SVX0032KBP
	5	5	SVX0052KBP
	7-1/2		SVX0072KBP
	10		SVX0102KBP
	15	6	SVX0152KBP
	20		SVX0202KBP
B	25	7	SVX0252KAP
	30		SVX0302KAP
C	40	8	SVX0402KAP
	50		SVX0502KAP
	60		SVX0602KAP

NEMA Type 3R Frame Size	Base Catalog Number ^②
4	SVXF073KBP
	SVX0013KBP
	SVX0023KBP
	SVX0033KBP
5	SVX0053KBP
	SVX0073KBP
	SVX0103KBP
6	SVX0153KBP
	SVX0203KBP
7	SVX0253KAP
	SVX0303KAP
8	SVX0403KAP
	SVX0503KAP
	SVX0603KAP

Notes

- ① Enclosure dimensions starting on **Page V6-T2-124**.
 ② Includes drive, local/remote keypad and enclosure.

Options

9000X Series Option Board Kits

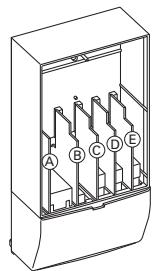
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The 9000X Series drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of five option boards.

The 9000X Series factory installed standard board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B.

Option Boards

Option Board Kits



Option Kit Description ^①	Allowed Slot Locations ^②	Field Installed Catalog Number	Factory Installed Option Designator	SVX Ready Programs						
				Basic	Local/Remote	Standard	MSS	PID	Multi-P.	PFC
Standard I/O Cards										
6 DI, 1 DO, 2 AI, 1AO, 1 +10 Vdc ref, 2 ext +24 Vdc/EXT +24 Vdc	A	OPTA9	—	■	■	■	■	■	■	■
2 RO (NC-NO)	B	OPTA2	—	■	■	■	■	■	■	■
Extended I/O Cards										
6 DI, 1 ext +24 Vdc/EXT +24 Vdc	B, C, D , E	OPTB1	B1	—	—	—	—	■	■	
1 RO (NC-NO), 1 RO (NO), 1 therm	B, C, D , E	OPTB2	B2	—	—	—	—	■	■	
1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24 Vdc/EXT +24 Vdc	B, C, D , E	OPTB4	B4	■	■	■	■	■	■	
3 RO (NO)	B, C, D , E	OPTB5	B5	—	—	—	—	■	■	
1 ext +24 Vdc/EXT +24 Vdc, 3 Pt100	B, C, D , E	OPTB8	B8	—	—	—	—	—	—	
1 RO (NO), 5 DI 42–240 Vac input	B, C, D , E	OPTB9	B9	—	—	—	—	■	■	
Communication Cards										
Modbus ^③	D, E	OPTC2	C2	■	■	■	■	■	■	
Modbus TCP	D, E	OPTC1	C1	■	■	■	■	■	■	
BACnet	D, E	OPTCJ	CJ	■	■	■	■	■	■	
EtherNet/IP	D, E	OPTCQ	CQ	■	■	■	■	■	■	
Johnson Controls N2 ^③	D, E	OPTC2	CA	—	—	—	—	—	—	
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■	■	
LonWorks	D, E	OPTC4	C4	■	■	■	■	■	■	
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■	■	
CANopen (slave)	D, E	OPTC6	C6	■	■	■	■	■	■	
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■	■	
Modbus (D9 type connector)	D, E	OPTC8	C8	■	■	■	■	■	■	
RS-232 with D9 connection	D, E	OPTD3	D3	■	■	■	■	■	■	

Notes

① AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

② Option card must be installed in one of the slots listed for that card. Slot indicated in bold is the preferred location.

③ OPTC2 is a multi-protocol option card.

Modbus RTU Network Communications

The Modbus Network Card OPTC2 is used for connecting the 9000X Drive as a slave on a Modbus network. The interface is connected by a 9-pin DSUB connector (female) and the baud rate ranges from 300 to 19200 baud. Other communication parameters include an address range from 1 to 247; a parity of None, Odd or Even; and the stop bit is 1.

PROFIBUS Network Communications

The PROFIBUS Network Card OPTC3 is used for connecting the 9000X Drive as a slave on a PROFIBUS-DP network. The interface is connected by a 9-pin DSUB connector (female). The baud rates range from 9.6K baud to 12M baud, and the addresses range from 1 to 127.

LonWorks Network Communications

The LonWorks Network Card OPTC4 is used for connecting the 9000X Drive on a LonWorks network. This interface uses Standard Network Variable Types (SNVT) as data types. The channel connection is achieved using a FTT-10A Free Topology transceiver via a single twisted transfer cable. The communication speed with LonWorks is 78 kBits/s.

CANopen (Slave) Communications

The CANopen (Slave) Network Card OPTC6 is used for connecting the 9000X Drive to a host system. According to ISO11898 standard cables to be chosen for CAN bus should have a nominal impedance of 120 ohms, and specific line delay of nominal 5 nS/m. 120 ohms line termination resistors required for installation.

DeviceNet Network Communications

The DeviceNet Network Card OPTC7 is used for connecting the 9000X Drive on a DeviceNet Network. It includes a 5.08 mm pluggable connector. Transfer method is via CAN using a two-wire twisted shielded cable with two-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud.

Johnson Controls Metasys N2 Network Communications

The OPTC2 fieldbus board provides communication between the 9000X Drive and a Johnson Controls Metasys™ N2 network. With this connection, the drive can be controlled, monitored and programmed from the Metasys system. The N2 fieldbus is available as a factory installed option and as a field installable kit.

Modbus/TCP Network Communications

The Modbus/TCP Network Card OPTCI is used for connecting the 9000X Drive to Ethernet networks utilizing Modbus protocol. It includes an RJ-45 pluggable connector. This interface provides a selection of standard and custom register values to communicate drive parameters. The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable over Ethernet using a supplied software tool.

BACnet Network Communications

The BACnet Network Card OPTCJ is used for connecting the 9000X Drive to BACnet networks. It includes a 5.08 mm pluggable connector. Data transfer is Master-Slave/Token Passing (MS/TP) RS-485. This interface uses a collection of 30 Binary Value Objects (BVOs) and 35 Analog Value Objects (AVOs) to communicate drive parameters. The card supports 9.6, 19.2 and 38.4 Kbaud communication speeds and supports network addresses 1–127.

EtherNet/IP Network Communications

The EtherNet/IP Network Card OPTCK is used for connecting the 9000X Drive to Ethernet/Industrial Protocol networks. It includes an RJ-45 pluggable connector. The interface uses CIP objects to communicate drive parameters (CIP is "Common Industrial Protocol", the same protocol used by DeviceNet). The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable by Static, BOOTP and DHCP methods.

Control/Communication Option Descriptions

For availability, see Product Selection for base drive voltage required.

Available Control/Communications Options

Option	Description	Option Type
K1	Door-Mounted Speed Potentiometer —Provides the SVX9000 with the ability to adjust the frequency reference using a door-mounted potentiometer. This option uses the 10 Vdc reference to generate a 0–10V signal at the analog voltage input signal terminal. When the HOA bypass option is added, the speed is controlled when the HOA switch is in the HAND position. Without the HOA bypass option, a two-position switch (labeled local/remote) is provided on the keypad to select speed reference from the Speed Potentiometer or a remote speed signal.	Control
K2	Door-Mounted Speed Potentiometer with HOA Selector Switch —Provides the SVX9000 with the ability to start/stop and adjust the speed reference from door-mounted control devices or remotely from customer supplied inputs. In HAND position, the drive will start and the speed is controlled by the door-mounted speed potentiometer. The drive will be disabled in the OFF position. When AUTO is selected, the drive run and speed control commands are via user-supplied dry contact and 4–20 mA signal.	Control
K5	MANUAL/AUTO Speed Reference Switch —Provides a door-mounted selector switch for MANUAL/AUTO speed reference.	Control
K6	START and STOP Pushbuttons (22 mm) —START (green) STOP (red). Provide door-mounted START and STOP pushbuttons for either bypass or non-bypass configurations.	Control
K9	(2) Factory Installed Auxiliary Contacts —Provide two NO/NC auxiliary contacts.	Power
L2	Bypass Pilot Lights for RA and RB Bypass Options —A green MOTOR ON INVERTER light indicates when the motor is running in inverter mode and an amber MOTOR ON BYPASS light indicates when the motor is running in bypass mode. The lights are mounted on the enclosure door, above the switches.	Addl. bypass
LD	Green STOP Light (22 mm) —Provides a green STOP light that indicates the drive is stopped.	Light
LE	Red RUN Pilot Light (22 mm) —Provides a red RUN pilot light that indicates the drive is running.	Light
LU	Misc. Light (22 mm) —Provides a misc. "user defined" pilot light. User to define light function and color.	Light
LW	PTT (Push-To-Test) Light (22 mm) —Provides misc. "user defined" PTT pilot light. User to define light function and color.	Light
P1	Input Circuit Breaker —Provides a means of short-circuit protection for the power cables between it and the SVX9000, and protection from high-level ground faults on the power cable. Allows a convenient means of disconnecting the SVX9000 from the line and the operating mechanism can be padlocked in the OFF position. This is factory mounted in the enclosure.	Input
P3	Input Line Fuses Rated to 200 kAIC —Provide high-level fault protection of the SVX9000 input power circuit from the load side of the fuses to the input side of the power transistors. This option consists of three 200 kA fuses, which are factory mounted in the enclosure.	Input
P8	SPD (50 kA per Phase) —Provides a surge protection device (SPD) connected to the line side terminals and is designed to clip line side transients. Rated for 50,000A.	Input
PA	SPD (100 kA per Phase) —Provides a surge protection device (SPD) connected to the line side terminals and is designed to clip line side transients. Rated for 100,000A.	Input
PE	Output Contactor —Provides a means for positive disconnection of the drive output from the motor terminals. The contactor coil is controlled by the drive's run or permissive logic. NC and NO auxiliary contacts rated at 10A, 600 Vac are provided for customer use. Bypass option RA includes an output contactor as standard. This option includes a low VA 115 Vac fused control power transformer and is factory mounted in the enclosure.	Output
RA	Manual HOA Bypass Controller —The Manual HAND/OFF/AUTO (HOA)—3-contactor—bypass option provides a means of bypassing the SVX9000, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in the inverter mode. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked.	Bypass
RB	Manual IOB Bypass Controller —The manual INVERTER/OFF/BYPASS (IOB)—3-contactor—bypass option provides a means of bypassing the SVX9000, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted IOB selector switch. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked.	Bypass
S5	Floor Stand 22 in —Converts a Size A or B, normally wall mounted enclosure to a floor standing enclosure with a height of 22 in (558.8 mm).	Enclosure
S9	Space Heater without CPT —Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. A 200W heater is installed in enclosures A and B, and 400W heater is installed in enclosures C and D. Requires a customer supplied 115V remote supply source.	Enclosure
SA	Space Heater with CPT —Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. A 200W heater is installed in enclosures A and B, and 400W heater is installed in enclosures C and D. Provided with CPT connected to load side of input disconnect.	Enclosure
SB	Ice Cube Style Control Relay —Provides misc. "user defined" 4PDT control relay. Requires user to define functionality.	Enclosure
SE	On-Delay Timer (Delay on Make) —Provides misc. "user defined" time delay relay. Requires user to define functionality and time setting requirement.	Enclosure
SF	Off-Delay Timer (Delay on Break) —Provides misc. "user defined" time delay relay. Requires user to define functionality and time setting requirement.	Enclosure

Technical Data and Specifications

9000X VFD Pump Panels

Description		NEMA Type 12/IP54 or NEMA Type 3R Specification
Primary Design Features		
45–66 Hz input frequency	Standard	
Output (AC volts maximum)	Input voltage base	
Output frequency range	0–320 Hz	
Initial output current (I_H)	250% for 2 seconds	
Overload (1 minute $[I_H/I_L]$)	150%/110%	
Enclosure space heater	Optional	
Oversize enclosure	Standard	
Output contactor	Optional	
Bypass motor starter	Optional	
Listings	UL, cUL	
Protection Features		
Incoming line fuses	Optional	
AC input circuit disconnect	Optional	
Line reactors (3%)	Standard	
Phase rotation insensitive	Standard	
EMI filter	Standard—Thru Frame 9	
Input phase loss protection	Standard	
Input overvoltage protection	Standard	
Line surge protection	Optional	
Output short-circuit protection	Standard	
Output ground fault protection	Standard	
Output phase protection	Standard	
Overtemperature protection	Standard	
DC overvoltage protection	Standard	
Drive overload protection	Standard	
Motor overload protection	Standard	
Programmer software	Optional	
Local/remote keypad	Standard	
Keypad lockout	Standard	
Fault alarm output	Standard	
Built-in diagnostics	Standard	

Description		NEMA Type 12/IP54 or NEMA Type 3R Specification
Input/Output Interface Features		
Setup adjustment provisions		
Remote keypad/display	Standard	
Personal computer	Standard	
Operator control provisions		
Drive mounted keypad/display	Standard	
Remote keypad/display	Standard	
Conventional control elements	Standard	
Serial communications	Optional	
115 Vac control circuit	Optional	
Speed setting inputs		
Keypad	Standard	
0–10 Vdc potentiometer/voltage signal	Standard	
4–20 mA isolated	Configurable	
4–20 mA differential	Configurable	
Analog outputs		
Speed/frequency	Standard	
Torque/load/current	Programmable	
Motor voltage	Programmable	
Kilowatts	Programmable	
0–10 Vdc signals	Configurable w/jumpers	
4–20 mA DC signals	Standard	
Isolated signals	Optional	
Discrete outputs		
Fault alarm	Standard	
Drive running	Standard	
Drive at set speed	Programmable	
Optional parameters	14	
Dry contacts	1 (2 relays Form C)	
Open collector outputs	1	
Additional discrete outputs	Optional	
Communications		
RS-232	Standard	
RS-422/485	Optional	
DeviceNet™	Optional	
Modbus RTU	Optional	
CANopen (slave)	Optional	
PROFIBUS-DP	Optional	
Lonworks®	Optional	
Johnson Controls Metasys™ N2	Optional	
EtherNet/IP	Optional	
Modbus TCP	Optional	
BACnet	Optional	

9000X VFD Pump Panels, continued

Description	NEMA Type 12/IP54 or NEMA Type 3R Specification
Performance Features	
Sensorless vector control	Standard
Volts/hertz control	Standard
IR and slip compensation	Standard
Electronic reversing	Standard
Dynamic braking	Optional ①
DC braking	Standard
PID setpoint controller	Programmable
Critical speed lockout	Standard
Current (torque) limit	Standard
Adjustable acceleration/deceleration	Standard
Linear or S curve accel/decel	Standard
Jog at preset speed	Standard
Thread/preset speeds	7 Standard, 15 Optional
Automatic restart	Selectable
Coasting motor start	Standard
Coast or ramp stop selection	Standard
Elapsed time meter	Optional
Carrier frequency adjustment	1–16 kHz
Standard Conditions for Application and Service	
Operating ambient temperature	0 to 40°C
Storage temperature	-40 to 60°C
Humidity (maximum), non-condensing	95%
Altitude (maximum without derate)	3300 ft (1000m)
Line voltage variation	+10/-15%
Line frequency variation	45–66 Hz
Efficiency	>96%
Power factor (displacement)	0.96

2

Standard I/O Specifications

Description	Specification
Six-digital input programmable	24V: "0" ≤10V, "1" ≥18V, $R_i > 5$ kohms
Two-analog input configurable w/jumpers	Voltage: 0–±10V, $R_i > 200$ kohms Current: 0 (4)–20 mA, $R_i = 250$ ohms
Two-digital output programmable	Form C relays 250 Vac 30 Vdc 2 amp resistive
One-analog output programmable configurable w/jumper	0–20 mA, R_L max. 500 ohms 10 bits ±2%
One digital output programmable	Open collector 48 Vdc 50 mA

I/O Specifications for Control/Communication Options

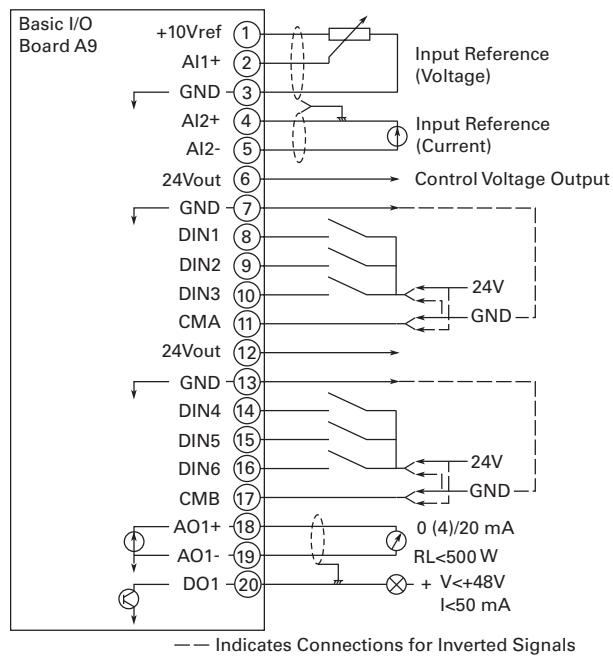
Description	Specification
Analog voltage, input	0–±10V, $R_i \geq 200$ kohms
Analog current, input	0 (4)–20 mA, $R_i = 250$ ohms
Digital input	24V: "0" ≤10V, "1" ≥18V, $R_i > 5$ kohms
Auxiliary voltage	24V (±20%), max. 50 mA
Reference voltage	10V ±3%, max. 10 mA
Analog current, output	0 (4)–20 mA, $R_L = 500$ kohms, resolution 10 bit, accuracy ≤±2%
Analog voltage, output	0 (2)–10V, $R_i \geq 1$ kohms, resolution 10 bit, accuracy ≤±2%
Relay output	
Maximum switching voltage	300 Vdc, 250 Vac
Maximum switching load	8A/24 Vdc, 0.4A/300 Vdc, 2 kVA/250 Vac
Maximum continuous load	2A rms
Thermistor input	$R_{trip} = 4.7$ kohms

Note

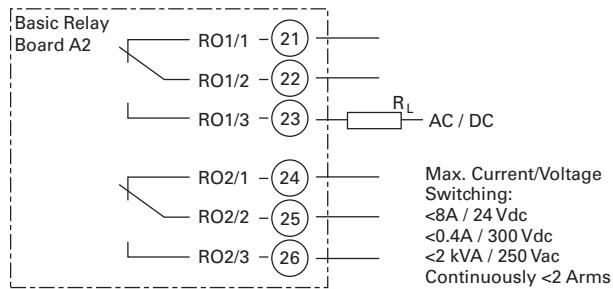
① Some horsepower units include dynamic braking chopper as standard—refer to individual drive sections.

Wiring Diagrams

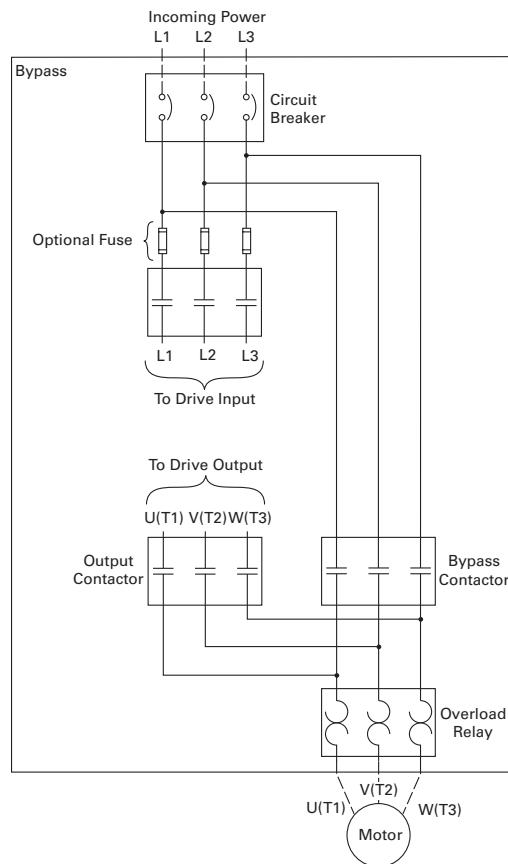
A9 Board Control Wiring



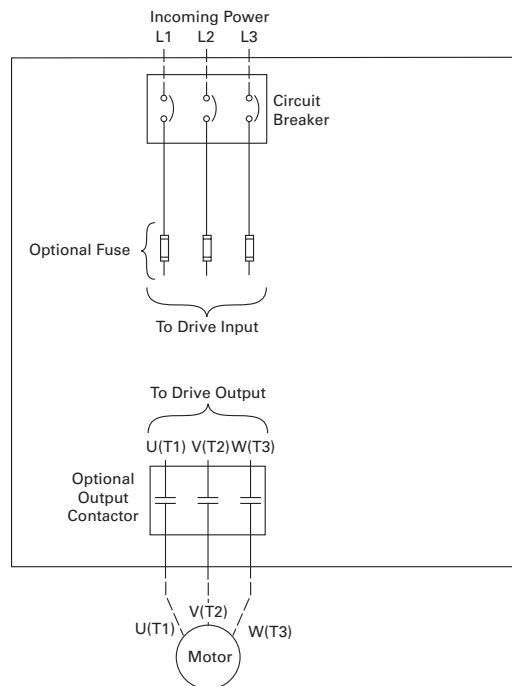
A2 Board Control Wiring



SVX9000 Pump Panel Bypass Power Wiring

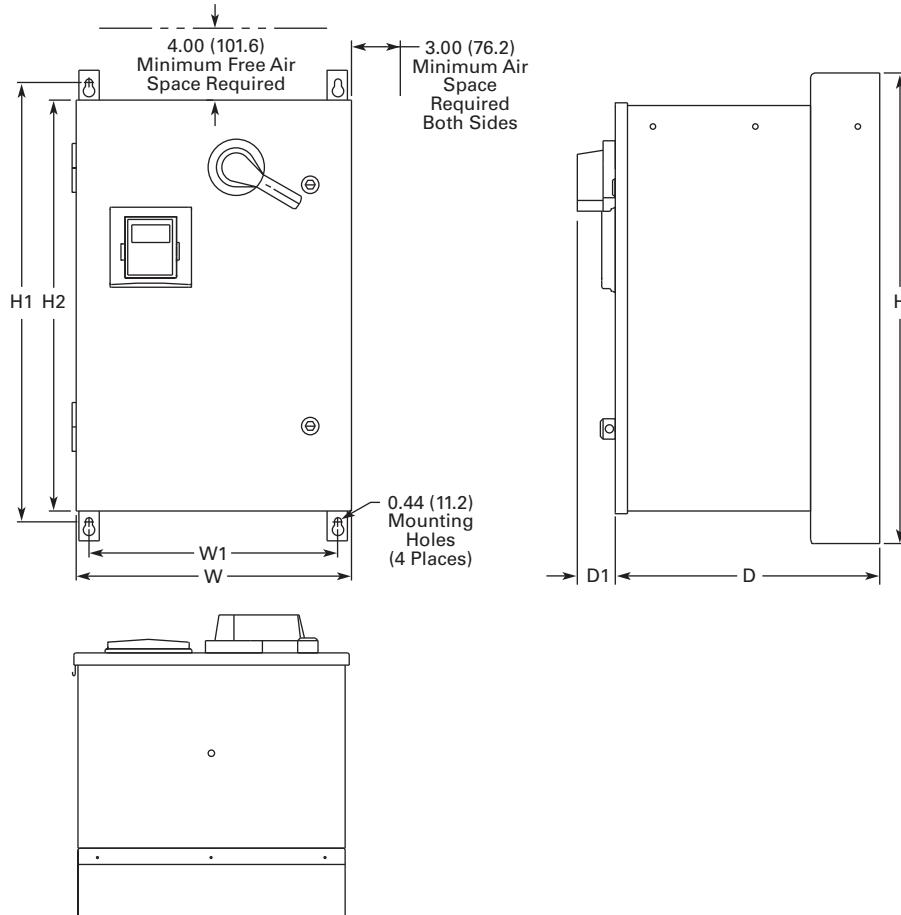


SVX9000 Pump Panel Disconnect Power Wiring



Dimensions

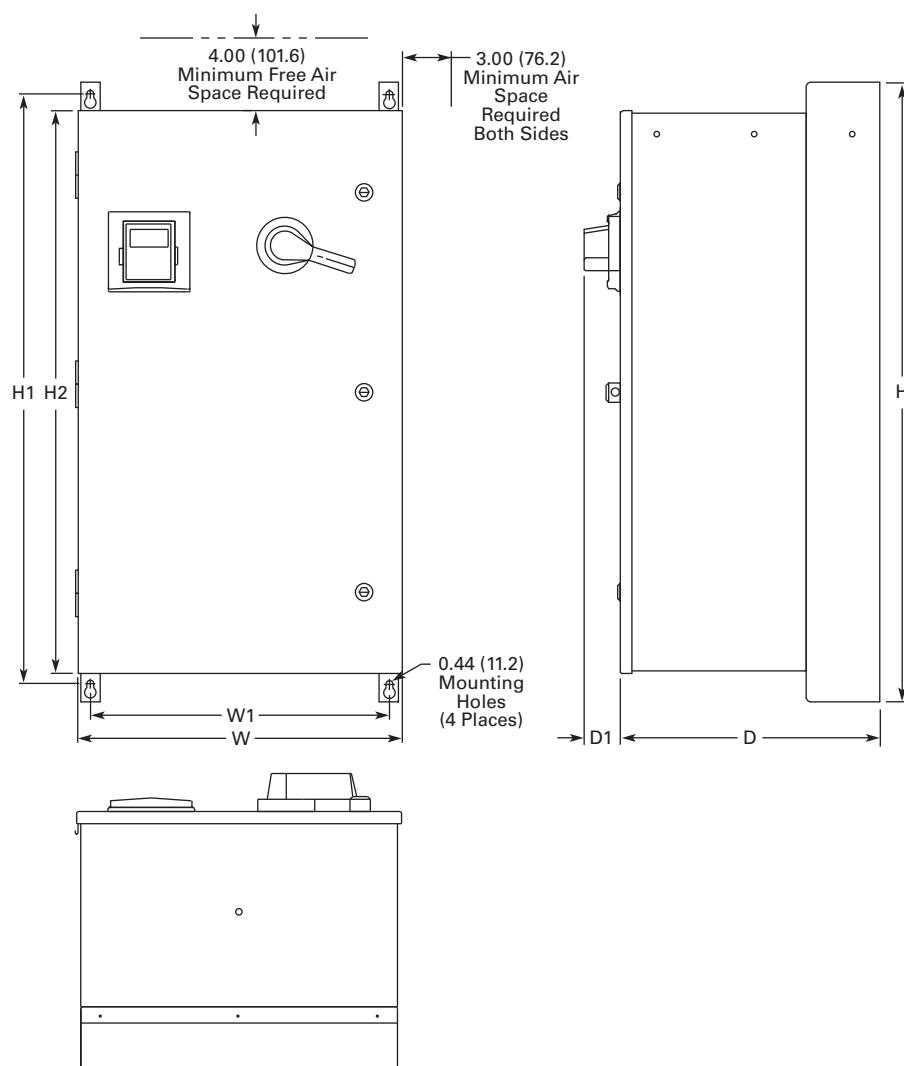
Approximate Dimensions in Inches (mm)

2**SVX9000 Pump Application Drives****Enclosure Box A NEMA Type 12/IP54**

Voltage AC	hp (I _H)	hp (I _L)	H	H1	H2	W	W1	D	D1	Approx. Weight Lbs (kg)	Approx. Shipping Weight Lbs (kg)
Three-Phase											
208V	3/4-10	1-15	29.00 (736.6)	27.00 (685.8)	25.35 (643.9)	16.92 (429.8)	15.30 (388.6)	16.26 (413.0)	2.34 (59.4)	120 (54)	160 (73)
230V	3/4-10	1-15									
480V	1-25	1-30									
Single-Phase											
230V	—	3/4-10	29.00 (736.6)	27.00 (685.8)	25.35 (643.9)	16.92 (429.8)	15.30 (388.6)	16.26 (413.0)	2.34 (59.4)	120 (54)	160 (73)
480V	—	3/4-20									

Approximate Dimensions in Inches (mm)

Enclosure Box B NEMA Type 12/IP54

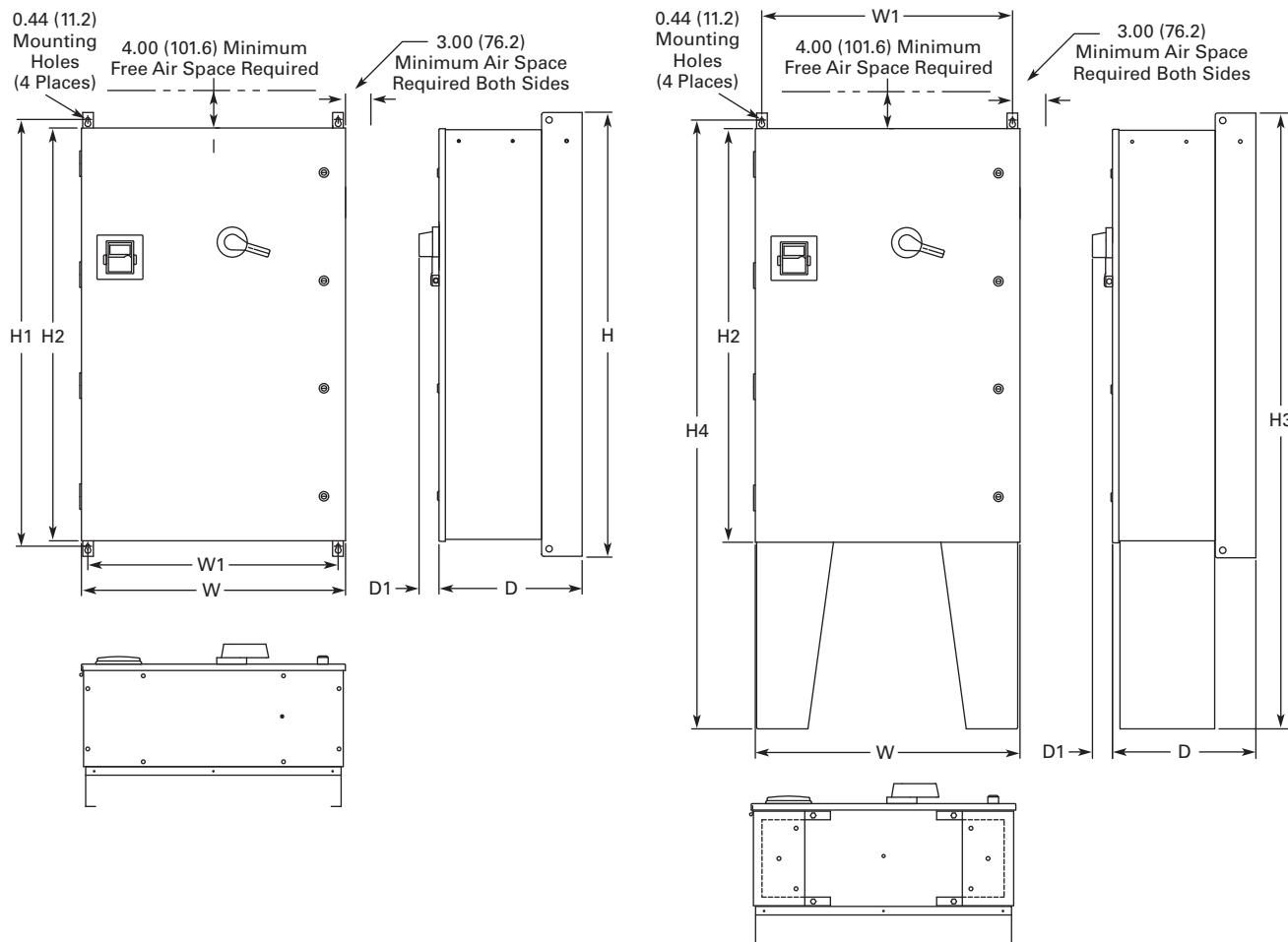


Voltage AC	hp (I _H)	hp (I _L)	H	H1	H2	W	W1	D	D1	Approx. Weight Lbs (kg)	Approx. Shipping Weight Lbs (kg)
Three-Phase											
208V	15–25	20–30	40.00 (1016.0)	38.00 (965.2)	36.35 (923.3)	20.92 (531.4)	19.30 (490.2)	16.76 (425.7)	2.34 (59.4)	185 (84)	229 (104)
230V	15–25	20–30									
480V	30–60	40–75									
Single-Phase											
230V	—	15–20	40.00 (1016.0)	38.00 (965.2)	36.35 (923.3)	20.92 (531.4)	19.30 (490.2)	16.76 (425.7)	2.34 (59.4)	185 (84)	229 (104)
480V	—	25–30									

Approximate Dimensions in Inches (mm)

Enclosure Box C NEMA Type 12/IP54

2

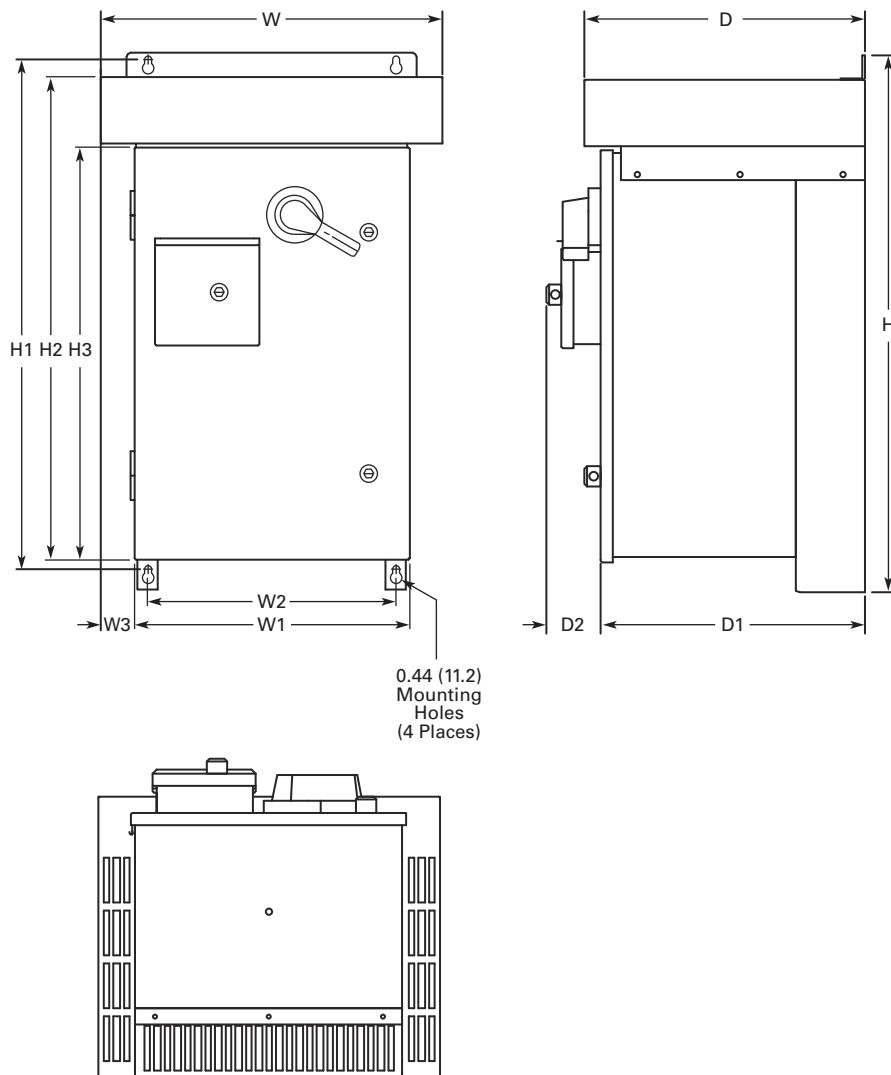


Voltage AC	hp (l _H)	hp (l _L)	H	H1	H2	H3	H4	W	W1	D	D1	Approx. Shipping Weight Lbs (kg)
Three-Phase												
208V	30-50	40-60	52.00 (1320.8)	50.00 (1270.0)	48.35 (1228.1)	72.00 (1828.8)	71.19 (1808.2)	30.92 (785.4)	29.30 (744.2)	16.78 (426.2)	2.34 (59.4)	①
230V	30-50	40-60										
480V	75-125	100-150										
Single-Phase												
230V	—	25-40	52.00 (1320.8)	50.00 (1270.0)	48.35 (1228.1)	72.00 (1828.8)	71.19 (1808.2)	30.92 (785.4)	29.30 (744.2)	16.78 (426.2)	2.34 (59.4)	①
480V	—	40-60										

Note

① Consult factory.

Approximate Dimensions in Inches (mm)

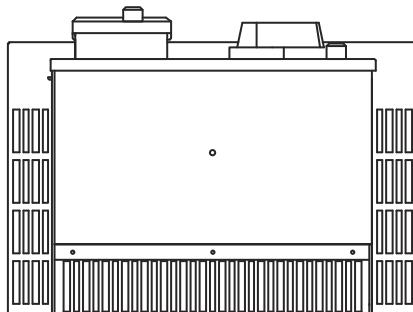
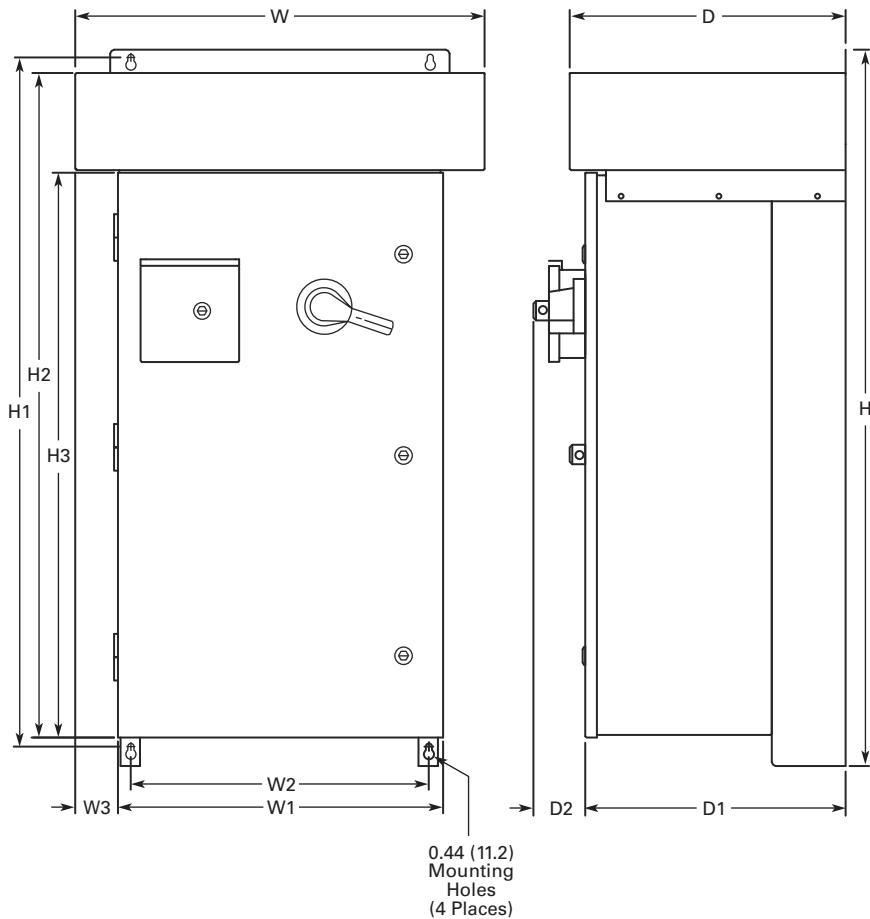
Enclosure Box A NEMA Type 3R

Voltage AC	hp (l _H)	hp (l _L)	H	H1	H2	H3	W	W1	W2	W3	D	D1	D2	Approx. Weight Lbs (kg)	Approx. Shipping Weight Lbs (kg)
Three-Phase															
208V	3/4-10	1-15	33.00	31.36 (838.2)	29.67 (753.6)	25.35 (643.9)	21.05 (534.7)	16.92 (429.8)	15.30 (388.6)	2.07 (52.6)	17.24 (437.9)	16.26 (413.0)	3.31 (84.1)	170 (77)	215 (98)
230V	3/4-10	1-15													
480V	1-25	1-30													
Single-Phase															
230V	—	3/4-10	33.00	31.36 (838.2)	29.67 (753.6)	25.35 (643.9)	21.05 (534.7)	16.92 (429.8)	15.30 (388.6)	2.07 (52.6)	17.24 (437.9)	16.26 (413.0)	3.31 (84.1)	170 (77)	215 (98)
480V	—	3/4-20													

Approximate Dimensions in Inches (mm)

Enclosure Box B NEMA Type 3R

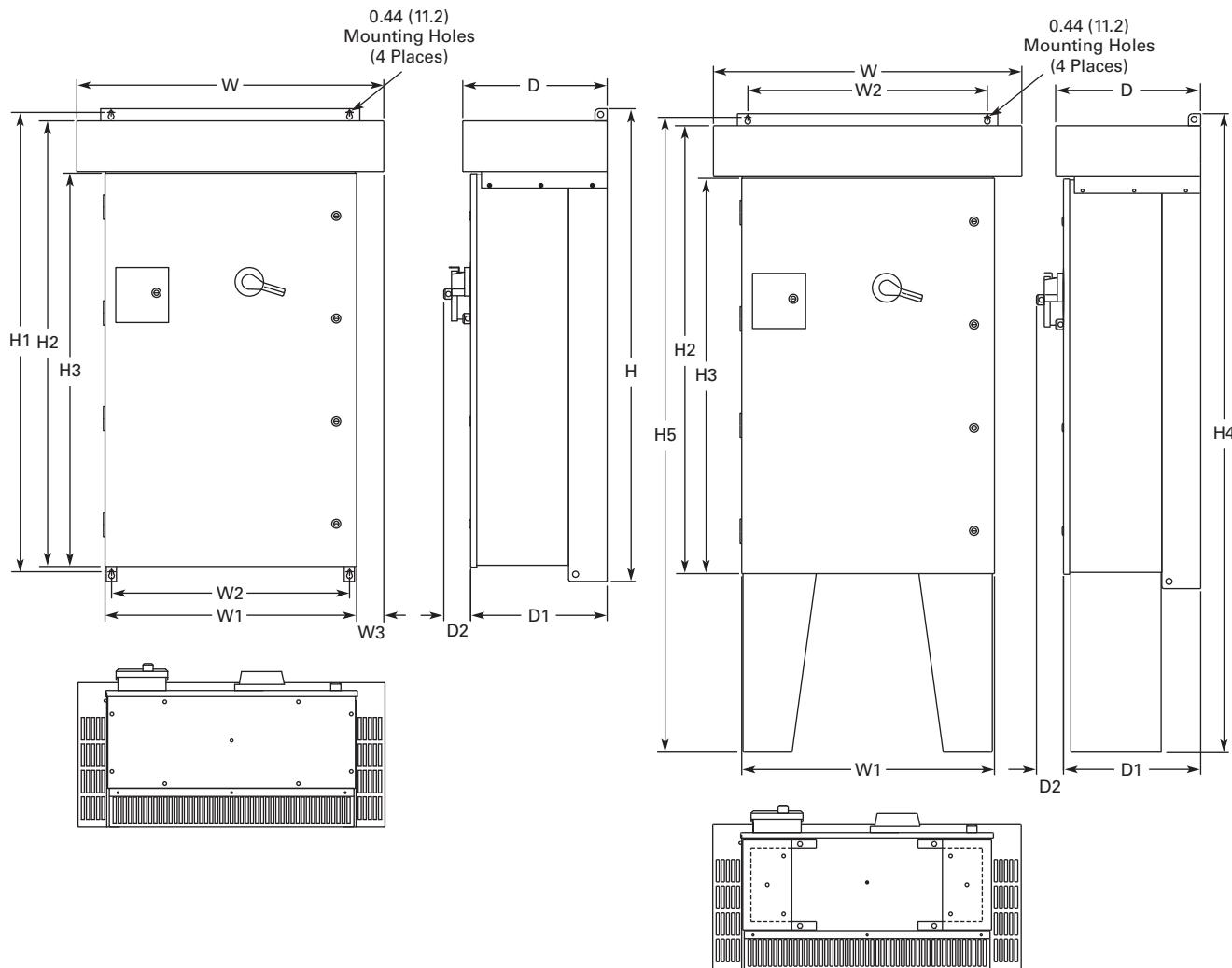
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Voltage AC	hp (I _H)	hp (I _L)	H	H1	H2	H3	W	W1	W2	W3	D	D1	D2	Approx. Weight Lbs (kg)	Approx. Shipping Weight Lbs (kg)
Three-Phase															
208V	15-25	20-30	46.09	44.45	42.77	36.35	26.31	20.92	19.30	2.69	17.74	16.76	3.31	235	290
			(1170.7)	(1129.0)	(1086.4)	(923.3)	(668.3)	(531.4)	(490.2)	(68.3)	(450.6)	(425.7)	(84.1)	(107)	(132)
230V	15-25	20-30													
480V	30-60	40-75													
Single-Phase															
230V	—	15-20	46.09	44.45	42.77	36.35	26.31	20.92	19.30	2.69	17.74	16.76	3.31	235	290
			(1170.7)	(1129.0)	(1086.4)	(923.3)	(668.3)	(531.4)	(490.2)	(68.3)	(450.6)	(425.7)	(84.1)	(107)	(132)
480V	—	25-30													

Approximate Dimensions in Inches (mm)

Enclosure Box C NEMA Type 3R



Voltage AC	hp (I _H)	hp (I _L)	H	H1	H2	H3	H4	H5	W	W1	W2	W3	D	D1	D2	Approx. Weight Lbs (kg)
Three-Phase																
208	30-50	40-60	58.09	56.45	54.77	48.35	78.09	77.64	37.73	30.92	29.30	3.34	17.74	16.77	3.31	①
			(1475.5)	(1433.8)	(1391.2)	(1228.1)	(1983.5)	(1972.1)	(958.3)	(785.4)	(744.2)	(84.8)	(450.6)	(426.0)	(84.1)	
230	30-50	40-60														
480	75-125	100-150														
Single-Phase																
230V	—	25-40	58.09	56.45	54.77	48.35	78.09	77.64	37.73	30.92	29.30	3.34	17.74	16.77	3.31	①
			(1475.5)	(1433.8)	(1391.2)	(1228.1)	(1983.5)	(1972.1)	(958.3)	(785.4)	(744.2)	(84.8)	(450.6)	(426.0)	(84.1)	
480V	—	40-60														

Note

① Consult factory.

2.5

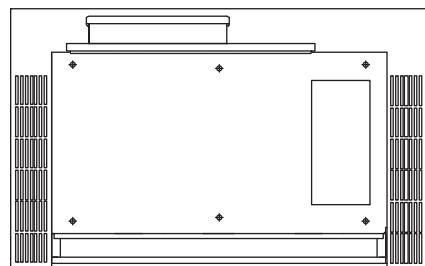
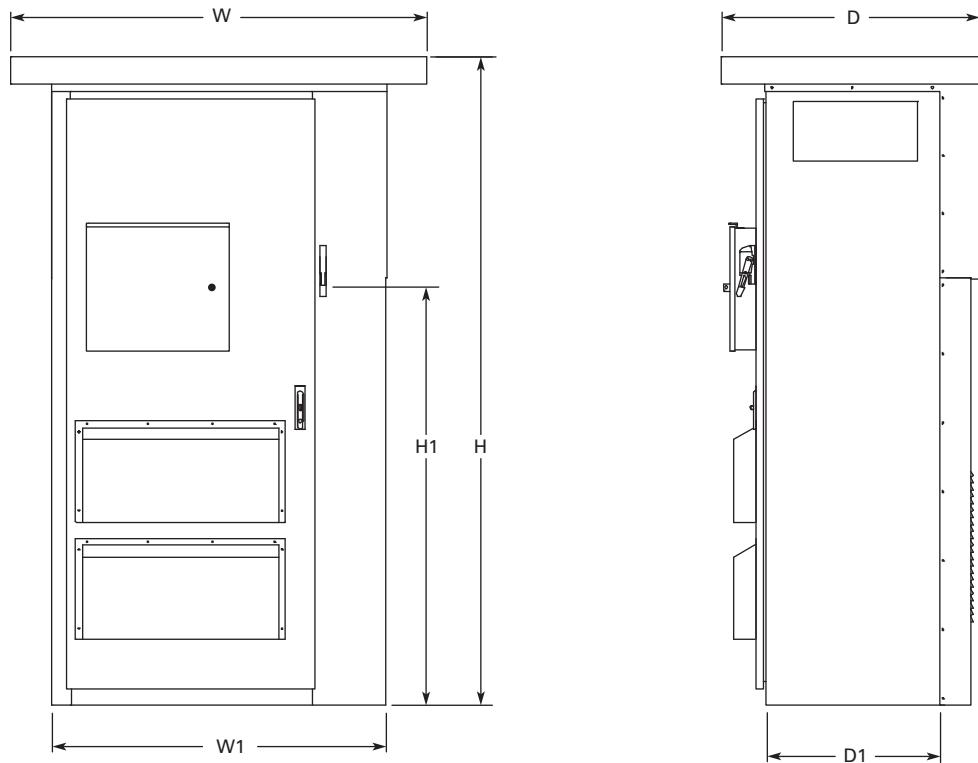
Adjustable Frequency Drives

SVX9000 Drives

Approximate Dimensions in Inches (mm)

Enclosure Size F

2



H	H1	W	W1	D	D1	Approximate Weight Lbs (kg)	Approximate Shipping Weight Lbs (kg)
93.58 (2376.9)	69.51 (1765.60)	60.00 (1524.0)	48.00 (1219.2)	37.50 (952.5)	26.00 (660.4)	1700 (771)	1850 (839)

H-Max Series Drives**Contents****Description**

<i>Page</i>
V6-T2-132
V6-T2-141

Product Overview**H-Max Family Introduction**

Eaton's H-Max™ Series VFD is the next generation of drives specifically engineered for HVAC pump and fluid control applications. The H-Max family of products boasts industry leading energy efficiency algorithms for your applications. Not only are the drives ultra-efficient—they contain software that minimizes motor winding energy losses in your applications. Designed for easy installation, simple startup, and long life; the H-Max Series drive family provides exceptional value to our customers,

Product Range**Open Style Drives:**

- 0.75–125 hp at 230 Vac
- 1.5–250 hp at 480 Vac

IntelliPass/IntelliDisconnect Drives:

- 1–30 hp at 208 Vac
- 1–30 hp at 230 Vac
- 1–75 hp at 480 Vac

Note: Available in NEMA 1, NEMA 12, or NEMA 3R enclosures.

Application Description

The H-Max Series drive was designed specifically for HVAC pump and fluid control applications. It is intended to be used on variable torque loads with the intent of moving air or liquids. With this in mind, the H-Max drive has onboard I/O pre-programmed to meet the common needs for these applications. The H-Max drive supports items such as standard speed control, PID functionality, as well as multi-motor applications. The drive easily supports interlock, second motor parameter set, as well as fire mode functionality.

Key Feature**Active Energy Control Algorithm**

Eaton's H-Max Series drives have been designed to provide industry leading energy saving solutions. Not only is the drive ultra-efficient, the drive seeks the most efficient operating point of the motor, minimizing energy loss in the windings per the given load requirements. This is an Eaton protected control algorithm exclusive to H-Max drives.

H-Max Drives**2****H-Max Drives****Product Description**

Eaton's H-Max Series VFD has software and hardware designed specifically for the HVAC, pump industry. The ultra-efficient DC capacitor and power structure allows the drive to consume less energy, lowering greenhouse gases.

The I/O configuration is designed with wiring ergonomics in mind by including removable terminal blocks. The main, easily removable, control board used for all drive frames with six digital IN, two analog IN, one analog OUT, three relay OUT accepts two additional I/O or communication board. In addition, the control board has built-in RS-485 and Ethernet communication.

These drives continue the tradition of robust performance, and raise the bar on features and functionality, ensuring the best solution at the right price.

In addition to the Active Energy Control Algorithm to maximize motor efficiency, the drive boasts an ultra-efficient DC capacitor and power structure to allow less energy consumption, lowering greenhouse gases.

Features and Benefits**Hardware**

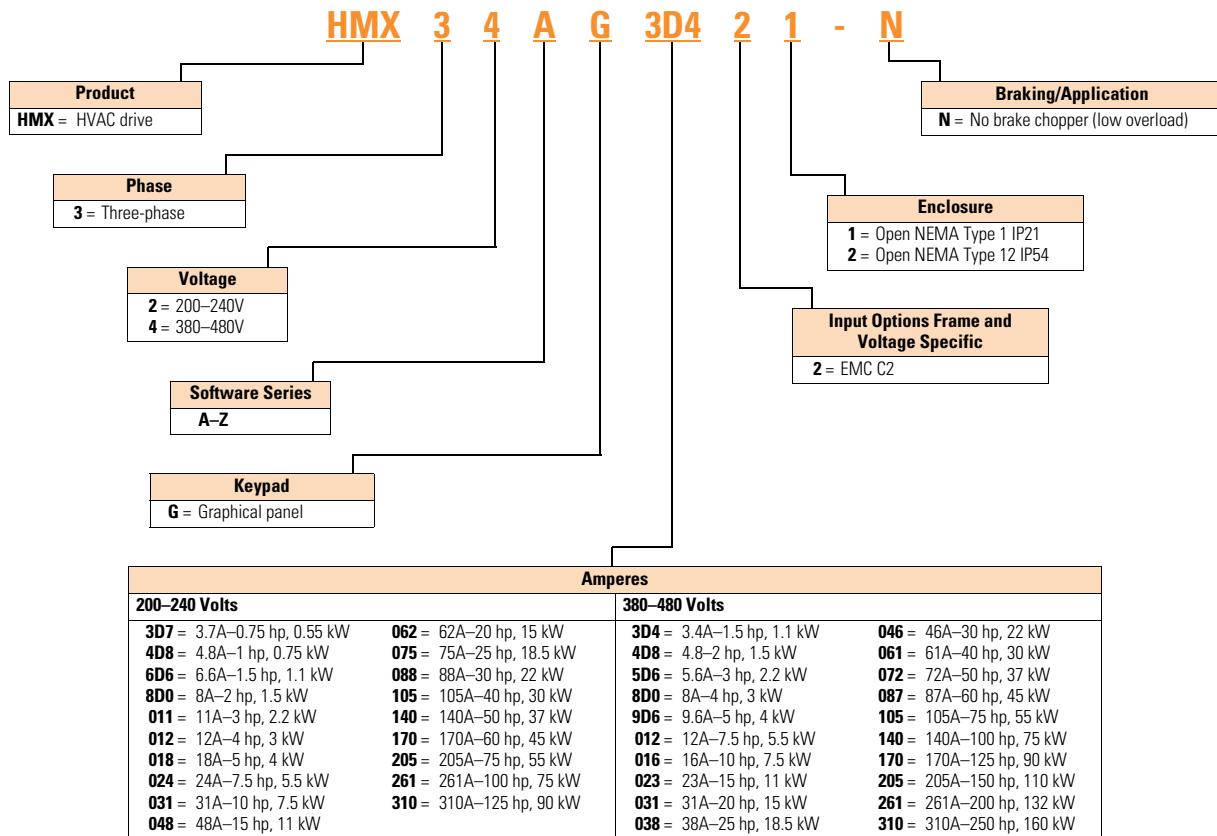
- Thin metal capacitor design—ultra-efficient drive operation and extended self life (up to five years without reforming)
- Integrated 5% DC link choke with Input surge protection—protects against voltage spikes and provides a clean wave form to the motor
- EMI/RFI filters standard on all drives—meets EMC Category 2 for commercial applications
- Real-time clock—supports calendaring and PLC functionality
- Graphic LCD display and keypad—supports simple menu navigation as well as on-screen diagnostics and troubleshooting
- HAND-OFF-AUTO and drive-bypass selector on keypad—simplifies control
- Standard I/O: 6DI, 2AI, 1AO, 2 Form C RO (NO/NC), 1 Form A RO (NO)—supports requirements for most installations

Standards and Certifications**Product**

- IEC 61800-5-1
- CE
- UL508C
- cUL
- C-Tick Mark
- OSHPD Seismic Certified
- Plenum Rated

**Contents****Description****Page**

H-Max Drives	V6-T2-133
Catalog Number Selection	V6-T2-134
Product Selection	V6-T2-137
Accessories	V6-T2-137
Replacement Parts	V6-T2-138
Technical Data and Specifications	V6-T2-139
Wiring Diagram	V6-T2-140
Dimensions	V6-T2-141
H-Max IntelliPass and IntelliDisconnect Drives ...	V6-T2-141

Catalog Number Selection**H-Max Series Drives****Notes**

All boards are varnished (conformed coated). Corrosion resistant.

Battery included in all drives for real-time clock.

Keypad kit includes HOA bypass.

Keypad kit includes HOA, back reset for Europe application.

EMI/RFI filters included.

DC link choke included.

Product Selection**H-Max Series Drives—230 Vac**

2

NEMA Type 1**NEMA Type 1/IP21**

FS Frame Size	Drive Output Current		Assigned Motor Ratings			Catalog Number
	Low Overload Full Load Amps at 40°C	Horsepower	Drive kW 230 Vac/50 Hz	230 Vac NEC Amps ①	Low Overload Full Load Amps at 50°C	
4	3.7	0.75	0.55	3.2	2.6	HMX32AG3D721-N
	4.8	1	0.75	4.2	3.7	HMX32AG4D821-N
	6.6	1.5	1.1	6.6	4.8	HMX32AG6D621-N
	8	2	1.5	6.8	6.6	HMX32AG8D021-N
	11	3	2.2	9.6	8	HMX32AG01121-N
	12.5	4	3	N/A	11	HMX32AG01221-N
5	18	5	4	15.2	12.5	HMX32AG01821-N
	24	7.5	5.5	22	18	HMX32AG02421-N
	31	10	7.5	28	24	HMX32AG03121-N
6	48	15	11	42	31	HMX32AG04821-N
	62	20	15	54	48	HMX32AG06221-N
7	75	25	18.5	68	62	HMX32AG07521-N
	88	30	22	80	75	HMX32AG08821-N
	105	40	30	104	88	HMX32AG10521-N
8	140	50	37	130	105	HMX32AG14021-N
	170	60	45	154	140	HMX32AG17021-N
	205	75	55	192	170	HMX32AG20521-N
9	261	100	75	248	205	HMX32AG26121-N
	310	125	90	N/A	261	HMX32AG31021-N

NEMA Type 12**NEMA Type 12/IP54**

FS Frame Size	Drive Output Current		Assigned Motor Ratings			Catalog Number
	Low Overload Full Load Amps at 40°C	Horsepower	Drive kW 230 Vac/50 Hz	230 Vac NEC Amps ①	Low Overload Full Load Amps at 50°C	
4	3.7	0.75	0.55	3.2	2.6	HMX32AG3D722-N
	4.8	1	0.75	4.2	3.7	HMX32AG4D822-N
	6.6	1.5	1.1	6.6	4.8	HMX32AG6D622-N
	8	2	1.5	6.8	6.6	HMX32AG8D022-N
	11	3	2.2	9.6	8	HMX32AG01122-N
	12.5	4	3	N/A	11	HMX32AG01222-N
5	18	5	4	15.2	12	HMX32AG01822-N
	24	7.5	5.5	22	18	HMX32AG02422-N
	31	10	7.5	28	24	HMX32AG03122-N
6	48	15	11	42	31	HMX32AG04822-N
	62	20	15	54	48	HMX32AG06222-N
7	75	25	18.5	68	62	HMX32AG07522-N
	88	30	22	80	75	HMX32AG08822-N
	105	40	30	104	88	HMX32AG10522-N
8	140	50	37	130	105	HMX32AG14022-N
	170	60	45	154	140	HMX32AG17022-N
	205	75	55	192	170	HMX32AG20522-N
9	261	100	75	248	205	HMX32AG26122-N
	310	125	90	N/A	261	HMX32AG31022-N

Note

① For sizing reference.

H-Max Series Drives—480 Vac**NEMA Type 1****NEMA Type 1/IP21**

FS Frame Size	Drive Output Current Low Overload Full Load Amps at 40°C	Assigned Motor Ratings Drive kW 400 Vac/50 Hz	480 Vac NEC Amps ①	Low Overload Full Load Amps at 50°C	Catalog Number
4	3.4	1.5	1.1	2.1	HMX34AG3D421-N
	4.8	2	1.5	3.4	HMX34AG4D821-N
	5.6	3	2.2	5.6	HMX34AG5D621-N
	8.0	4	3.0	N/A	HMX34AG8D021-N
	9.6	5	4	7.6	HMX34AG9D621-N
	12	7.5	5.5	11	HMX34AG01221-N
	16	10	7.5	14	HMX34AG01621-N
	23	15	11	21	HMX34AG02321-N
	31	20	15	27	HMX34AG03121-N
	38	25	18.5	34	HMX34AG03821-N
6	46	30	22	40	HMX34AG04621-N
	61	40	30	52	HMX34AG06121-N
	72	50	37	65	HMX34AG07221-N
7	87	60	45	77	HMX34AG08721-N
	105	75	55	96	HMX34AG10521-N
	140	100	75	124	HMX34AG14021-N
8	170	125	90	156	HMX34AG17021-N
	205	150	110	180	HMX34AG20521-N
	261	200	132	240	HMX34AG26121-N
9	310	250	160	302	HMX34AG31021-N

NEMA Type 12**NEMA Type 12/IP54**

FS Frame Size	Drive Output Current Low Overload Full Load Amps at 40°C	Assigned Motor Ratings Drive kW 400 Vac/50 Hz	480 Vac NEC Amps ①	Low Overload Full Load Amps at 50°C	Catalog Number
4	3.4	1.5	1.1	2.1	HMX34AG3D422-N
	4.8	2	1.5	3.4	HMX34AG4D822-N
	5.6	3	2.2	5.6	HMX34AG5D622-N
	8.0	4	3.0	N/A	HMX34AG8D022-N
	9.6	5	4	7.6	HMX34AG9D622-N
	12	7.5	5.5	11	HMX34AG01222-N
	16	10	7.5	14	HMX34AG01622-N
	23	15	11	21	HMX34AG02322-N
	31	20	15	27	HMX34AG03122-N
	38	25	18.5	34	HMX34AG03822-N
6	46	30	22	40	HMX34AG04622-N
	61	40	30	52	HMX34AG06122-N
	72	50	37	65	HMX34AG07222-N
7	87	60	45	77	HMX34AG08722-N
	105	75	55	96	HMX34AG10522-N
	140	100	75	124	HMX34AG14022-N
8	170	125	90	156	HMX34AG17022-N
	205	150	110	180	HMX34AG20522-N
	261	200	132	240	HMX34AG26122-N
9	310	250	160	302	HMX34AG31022-N

Note

① For sizing reference.

Onboard Network Communications**Johnson Controls****Metasys N2**

H-Max Series provides communication between the drive and a Johnson Controls Metasys™ N2 network. With this connection, the drive can be controlled, monitored and programmed from the Metasys system. N2 can be selected and programmed by the drive keypad.

BACnet

H-Max Series provides communication to BACnet networks. Data transfer is master-slave/token passing (MS/TP) RS-485.

BACnet IP

100Base-T interface.

Modbus TCP

Ethernet based protocol.

Modbus RTU

H-Max Series provides communication to Modbus RTU RS-485 as a slave on a Modbus network. Other communication parameters include an address range from 1–247; a parity of None, Odd or Even; and the stop bit is 1.

H-Max Series Option Board Kits Available for Slot B

The factory issued relay option board can be replaced with the following option

boards to customize the drive for your application needs.

The standard board provides 2 Form C RO (NO/NC) and 1 Form A RO (NO).

Option Boards Mounted in Slot B

Option Kit Description	Option Kit Catalog Number
I/O expander card, 2 RO and thermistor input	Relay Board 2

H-Max Series Option Board Kits Available for Slots D and E

The H-Max Series drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your

application needs. The drive's control unit is designed to accept a total of two option boards.

The H-Max Series factory-installed standard board configuration includes an I/O board and a relay output board.

Option Boards Mounted in Slots D and E

Option Kit Description	Option Kit Catalog Number
6 x DI /DO, each digital input can be individually programmed as digital output	XMX-I0-B1-A
1RO Form C (NO/NC), 1RO Form A (NO), 1 thermistor	XMX-I0-B2-A
1 x AI, 2 x AO (isolated)	XMX-I0-B4-A
3 x RO Form A (NO)	XMX-I0-B5-A
1RO Form A (NO), 5DI 42–240 Vac input	XMX-I0-B9-A
1 x AO, 1 x DO, 1 x RO	XMX-I0-BF-A
LonWorks®	XMX-COM-C4-A

NEMA Type 1 to NEMA Type 12/IP54 Conversion Kit

The NEMA Type 12/IP54 option kit is used to convert a NEMA Type 1 to a NEMA Type 12 drive.

Kit consists of a drive cover, fan kit and plugs.

NEMA Type 12/IP54 Cover

Option Kit Description	Option Kit Catalog Number
FS4-branded N12/IP54 cover with gasket, plastic plug, fans, Eaton logos	FS4-N12KIT
FS5-branded N12/IP54 cover with gasket, plastic plug, fans, Eaton logos	FS5-N12KIT
FS6-branded N12/IP54 cover with gasket, plastic plug, fans, Eaton logos	FS6-N12KIT

Accessories**Flange Kits**

The flange kit is used when the power section heat sink is mounted through the back panel of an enclosure.

Flange Kit NEMA Type 12/IP54

Includes flange, mounting brackets, NEMA Type 12 fan components, air shroud screws and plugs.

Frames FS4–FS7^{①②}

Description	Catalog Number
NEMA Type 12/IP54	
FS4 N12/IP54 flange kit (mounting N1 drive into N12 enclosure)	FS4-Flange-N12KIT
FS5 N12/IP54 flange kit (mounting N1 drive into N12 enclosure)	FS5-Flange-N12KIT
FS6 N12/IP54 flange kit (mounting N1 drive into N12 enclosure)	FS6-Flange-N12KIT
FS7 N12/IP54 flange kit (mounting N1 drive into N12 enclosure)	FS7-Flange-N12KIT

Keypad Accessories**Remote Mounting Keypad Kit****Frames FS4–FS9**

Description	Catalog Number
Remote mounting keypad kit—bezel and cable	OPTRMT-BP-HMAX

Drive Demo**H-Max Series Drive Demo****Demos and Power Supply**

Description	Catalog Number
H-Max Series bypass demo	H-MAX-BYPASS-DEMO
Hand-held 24V auxiliary power supply—used to supply power to the control module in order to perform keypad programming before the drive is connected to line voltage	9000XAUX24V

Notes

- ① For installation of a NEMA Type 1 drive into a NEMA Type 12 oversized enclosure.
- ② Frame size 8 and 9 must be ordered from the factory as a flange mount unit.

Replacement Parts**Control Board/Keypad**

Description	Catalog Number
H-Max Series graphic bypass, HOA	KeypadbypassHOA
H-Max Series graphic back, HOA	KeypadbackHOA

PC Cable

Description	Catalog Number
Remote download USB to RJ-45 cable with software driver disk	REM-USB-Down

Replacement Relay Board in Slot B

Description	Catalog Number
Replacement relay board qty 2 Form C relay, qty 1 Form A relay	Relay board 1

Main Fan

Description	Catalog Number
FS4 main fan	FS4-Main Fan
FS5 main fan	FS5-Main Fan
FS6 main fan	FS6-Main Fan
FS7 main fan	FS7-Main Fan

Internal Fan

Description	Catalog Number
FS4 internal fan (IP54/NEMA 12)	FS4-Internal Fan
FS5 internal fan (IP54/NEMA 12)	FS5-Internal Fan
FS6 internal fan (IP54/NEMA 12)	FS6-Internal Fan
FS7 internal fan (IP54/NEMA 12)	FS7-Internal Fan

Technical Data and Specifications

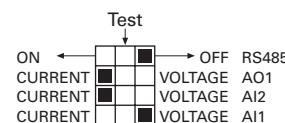
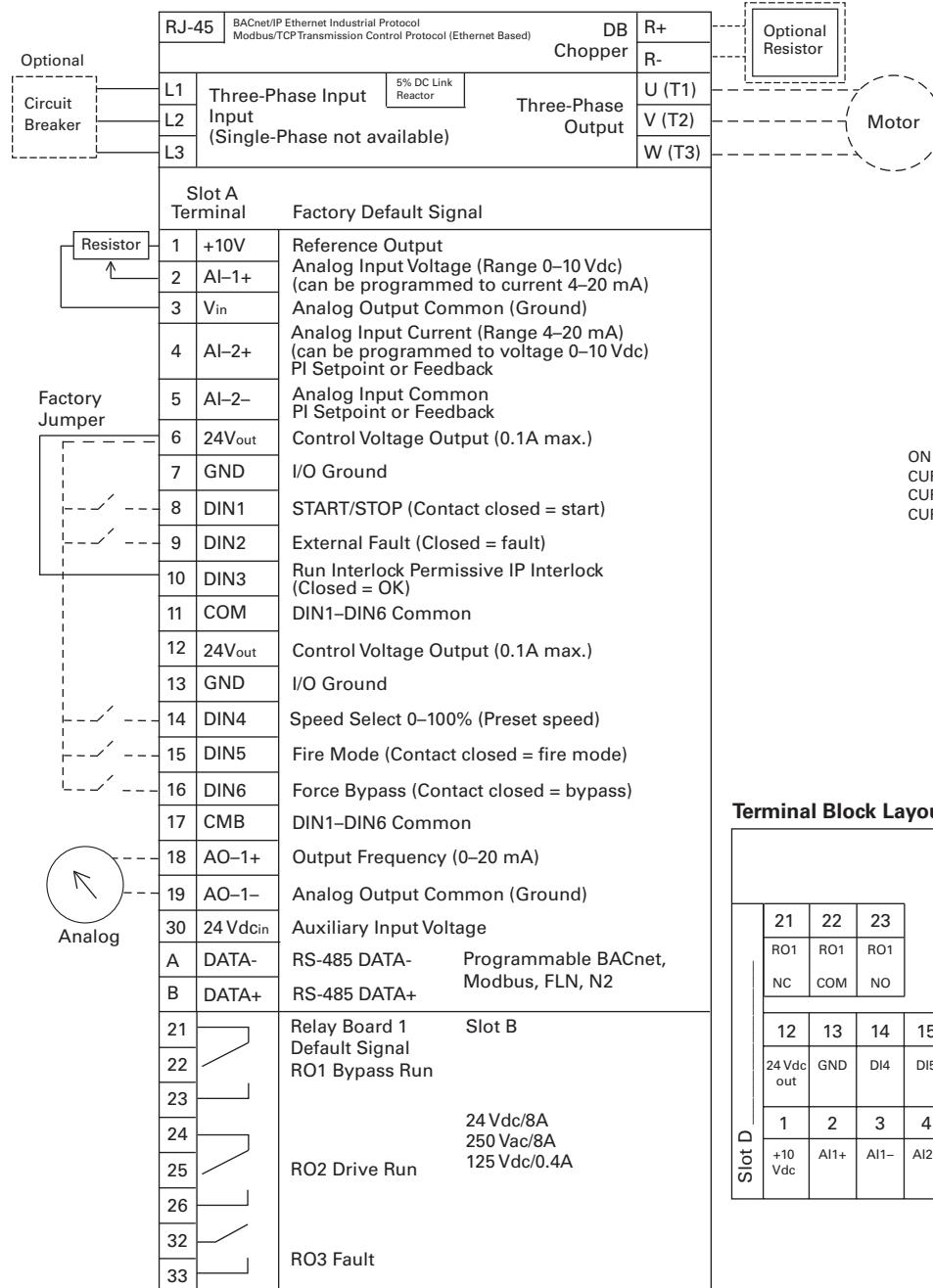
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H-Max Series Drives

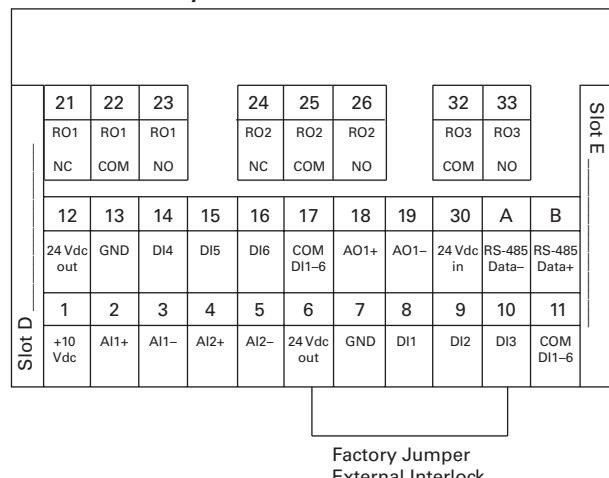
Description	Specification	Description	Specification
Input Ratings			
Input voltage (V_{in})			200–240 Vac, 380–480 Vac, –10%/+10%
Input frequency (f_{in})			50/60 Hz (variation up to 47–66 Hz)
Connection to power			Once per minute or less (typical operation)
Short-circuit withstand rating			100 kAIC
Output Ratings			
Output voltage			0 to V_{in}/U_{in} line voltage in
Continuous output current			Ambient temperature max. 104°F (40°C)
I_L overload			1.1 x I_L (1 min./10 min.)
Overload current			110% (1 min./10 min.)
Initial output current			150% for two seconds
Output frequency			0 to 320 Hz
Frequency resolution			0.01 Hz
Control Characteristics			
Control method			Frequency control (V/f) open loop sensorless vector control
Switching frequency			1–310 amps FS4–9: default 6 kHz
Frequency reference			Analog input: Resolution 0.1% (10-bit), accuracy ±1% Panel reference: Resolution 0.01 Hz
Field weakening point			8 to 320 Hz
Acceleration time			0.1 to 3000 seconds
Deceleration time			0.1 to 3000 seconds
Braking torque			DC brake: 30% x T_n
Ambient Conditions			
Ambient operating temperature			FS4–FS9: 14°F (–10°C), no frost to 104°F (40°C) (Drive can operate at 122°F (50°C), see Pages V6-T2-134 and V6-T2-135)
Storage temperature			–40° to 158°F (–40° to 70°C)
Relative humidity			0 to 95% RH, noncondensing, non-corrosive, no dripping water
Air quality			Chemical vapors: IEC 60721-3-3, unit in operation, Class 3C2; Mechanical particles: IEC 60721-3-3, unit in operation, Class 3S2
Altitude			100% load capacity (no derating) up to 3280 ft (1000m); 1% derating for each 328 ft (100m) above 3280 ft (1000m); max. 9842 ft (3000m); 380–480V
Vibration			FS4–FS9: EN 61800-5-1, EN 60068-2-6; 5 to 150 Hz, displacement amplitude 1 mm (peak) at 5 to 15.8 Hz, max. acceleration amplitude 1G at 15.8 to 150 Hz
Shock			EN 61800-5-1, EN 60068-2-27 UPS Drop test (for applicable UPS weights) Storage and shipping: max. 15G, 11 ms (in package)
Enclosure class			NEMA Type 1/IP21 or NEMA Type 12/IP54 (keypad required for IP54/Type 12)
Standards			
EMC			Immunity: Fulfils all EMC immunity requirements; Emissions: EN 61800-3, LEVEL H (EMC C2)
Emissions			EMC level dependent— +EMC 2: EN61800-3 (2004) Category C2 Delivered with Class C2 EMC filtering as default.
Control Connections			
Analog input voltage			0 to 10V, $R = 200$ ohms differential Resolution 0.1%; Accuracy ±1% DIP switch selection (voltage/current)
Analog input current			0(4) to 20 mA; $R_i = 250$ ohms differential
Digital inputs (6)			Positive or negative logic; 18 to 30 Vdc
Auxiliary voltage			+24V ±10%, max. 250 mA
Output reference voltage			+10V +3%, max. load 10 mA
Analog output			0–10V, 0(4) to 20 mA; R_L max. 500 ohms; Resolution 10 bit; Accuracy ±2% DIP switch selection (voltage/current)
Relay outputs			3 programmable, 2 Form C, 1 Form A relay outputs Switching capacity: 24 Vdc/8A, 250 Vac/8A, 125 Vdc/0.4A
Hard wire jumper			Between terminal 6 and 10 factory default
DIP switch setting default			RS-485 = off A01 = current A12 = current A11 = voltage
Protections			
Overcurrent protection			Yes
Overvoltage protection			Yes
DC bus regulation anti-trip			Yes (accelerates or decelerates the load)
Undervoltage protection			Yes
Earth fault protection			Yes (in case of earth fault in motor or motor cable, only the frequency converter is protected)
Input phase supervision			Yes (trips if any of the input phases are missing)
Motor phase supervision			Yes (trips if any of the output phases are missing)
Overtemperature protection			Yes
Motor overload protection			Yes
Motor stall protection			Yes
Motor underload protection			Yes
Short-circuit protection			Yes
Surge protection			Yes (varistor input)
Conformed coated (varnished) boards			Yes (prevents corrosion)

Wiring Diagram

Control Input/Output, PID Application



Terminal Block Layout



Standards

- Digital inputs D1–D6, relay out, analog in/out are freely programmed
- The user can assign a single input to multiple functions

Includes

- Six digital input
- Two analog input
- One analog output
- Three relay output
- RS-485
- Ethernet (BACnet and Modbus)

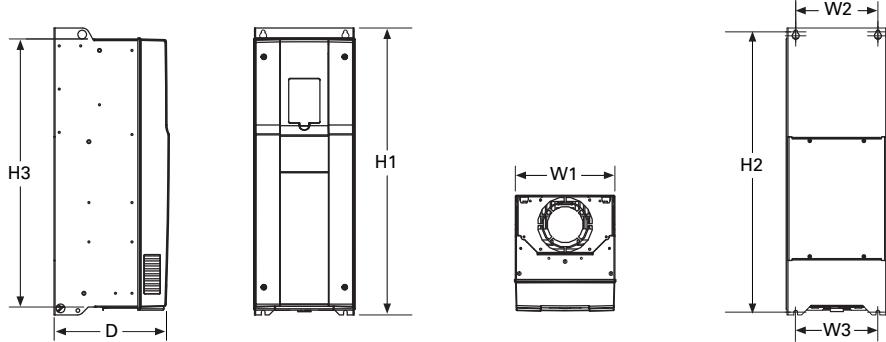
Reliability

- Pretested components
- Conformal coated (varnished) boards
- 40°C rated
- 110% overload for one minute
- Eaton Electrical Services & Systems national network of AF drive specialists

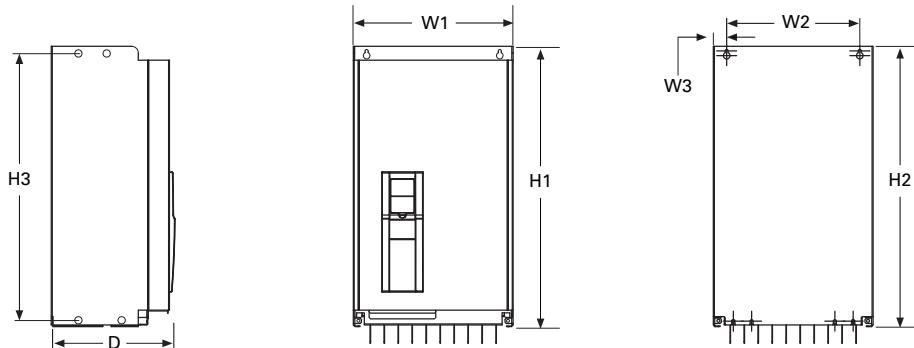
Dimensions

Approximate Dimensions in Inches (mm)

2

H-Max Series Frames FS4–FS7

Voltage	hp	kW	Amps	D	H1	Hole Center-to-Center H2	H3	W1	W2	W3	Weight in Lbs (kg)
FS4											
230 Vac	0.75–4	0.55–3.0	3.7–12.5	7.77	12.89	12.32	11.22	5.04	3.94	3.94	13.2
480 Vac	1.5–7.5	1.1–5.5	3.4–12	(197.3)	(327.5)	(313.0)	(285.0)	(128.0)	(100.0)	(100.0)	(6)
FS5											
230 Vac	5–10	4–7.5	18–31	8.73	16.50	15.98	15.04	5.67	4.53	3.94	22.0
480 Vac	10–20	7.5–15	16–31	(221.6)	(419.0)	(406.0)	(382.0)	(144.0)	(115.0)	(100.0)	(10)
FS6											
230 Vac	15–20	11–15	48–62	9.29	21.93	21.28	20.24	7.68	5.83	5.83	44.1
480 Vac	25–40	18.5–30	38–61	(236.0)	(557.0)	(540.5)	(514.0)	(195.0)	(148.0)	(148.0)	(20)
FS7											
230 Vac	25–30	18.5–30	75–105	10.49	25.98	25.39	24.29	9.06	7.48	7.48	82.6
480 Vac	50–75	37–55	72–105	(266.5)	(660.0)	(645.0)	(617.0)	(230.0)	(190.0)	(190.0)	(37.5)

H-Max Series Frames FS8 and FS9

Voltage	hp	kW	Amps	D	H1	Hole Center-to-Center H2	H3	W1	W2	W3	Weight in Lbs (kg)
FS8											
230 Vac	50–75	37–55	140–205	13.76	38.02	37.26	37.26	11.42	9.29	1.42	154.3
480 Vac	100–150	75–110		(349.6)	(965.7)	(946.4)	(946.4)	(290.1)	(236.0)	(36.0)	(70)
FS9											
230 Vac	100–120	75–90	261–310	14.63	33.09	31.89	31.89	18.90	15.75	1.57	238.1
480 Vac	200–250	132–160		(371.6)	(890.4)	(810.0)	(810.0)	(480.0)	(400.0)	(40.0)	(108)

Note: For flange dimension, please reference User Manual.

H-Max IntelliPass and IntelliDisconnect Drives**Contents**

Description	Page
H-Max Drives	V6-T2-132
H-Max IntelliPass and IntelliDisconnect Drives	
Catalog Number Selection	V6-T2-142
Product Selection	V6-T2-143
Technical Data and Specifications	V6-T2-151
Wiring Diagrams	V6-T2-152
Dimensions	V6-T2-154

H-Max IntelliPass and IntelliDisconnect Drives**Product Description**

The IntelliPass electronic bypass is a two or optional three contactor design using a 24 Vdc **XT** Series contactor with an optional manual override switch that allows the unit to run in bypass without the H-Max Series drive.

The IntelliPass software parameters utilize engineering units common to the HVAC industry. Onboard startup wizard guarantees flawless commissioning with plug-and-play screen entry. Available in NEMA/UL Type 1, Type 12 and Type 3R with optional pre-engineered operator devices to meet all customized specification requirements.

The IntelliPass construction features allow for easy installation, reliable operation and serviceability with additional onboard wire space, and removable conduit plates with knockouts.

Features and Benefits

Industry-leading energy saving solution—uses the Eaton H-Max drive with Active Energy Control algorithm.

Built to be as tough as the application—Eaton's robust design boasts an industrial grade enclosure and industry proven components.

- Industrial Power Supply
- **XT** Contactors
- 22 mm Pilot Devices

Standards and Certifications**Product**

- IEC 61800-5-1
- UL508C
- cUL
- OSHPD Seismic Certified

**Designed with Our Customers in Mind**

- Removable top and bottom entry panels
- Door-mounted graphic display and keypad
- Easily accessible connection terminals with removable I/O terminal connections

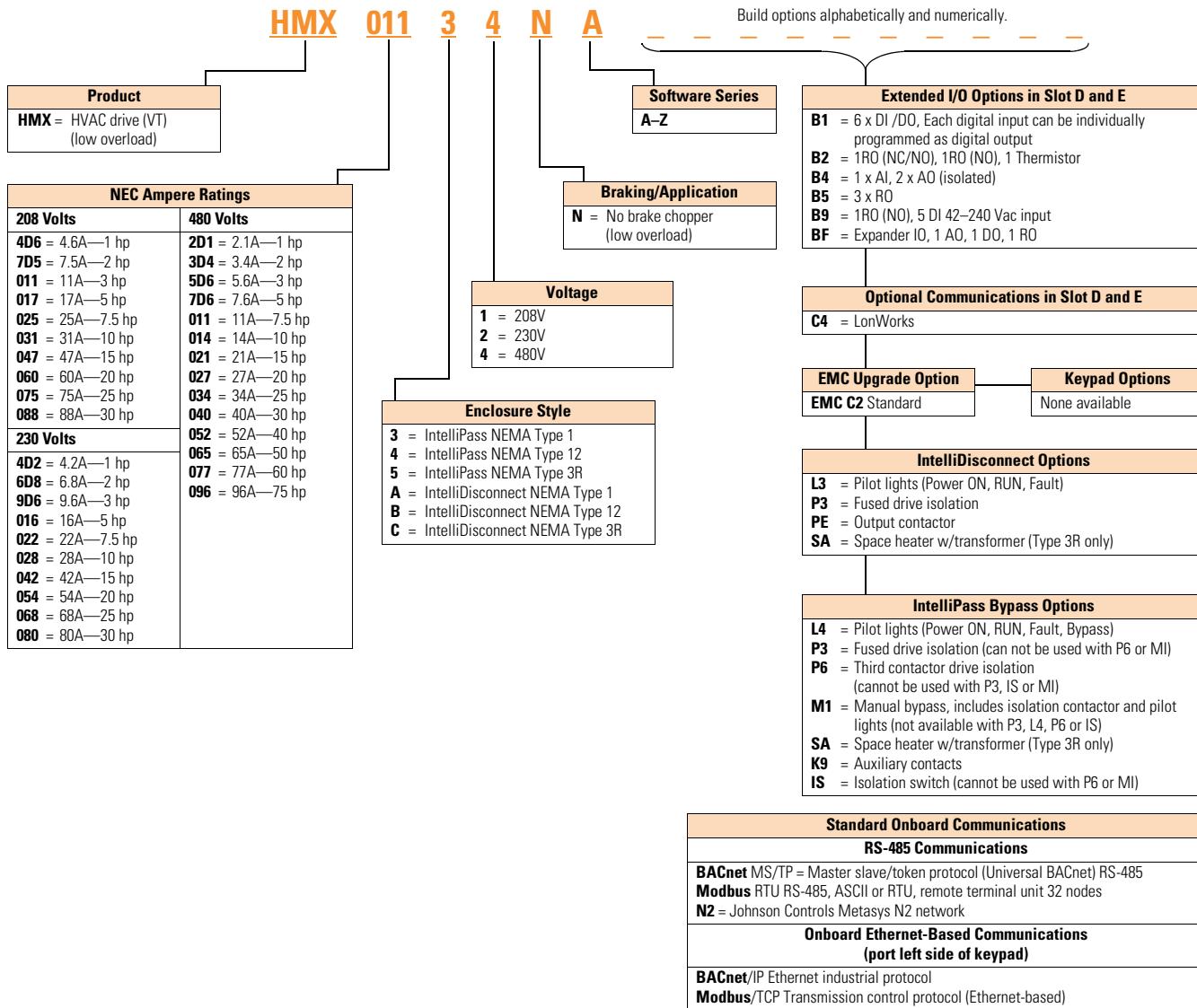
Engineered Product Solution

- The Eaton H-Max IntelliPass and IntelliDisconnect products are available with a variety of factory tested and certified options meeting or exceeding UL508C requirements

Catalog Number Selection

H-Max Series IntelliPass and IntelliDisconnect Drives

2



Notes

IntelliPass—two contactor electronic bypass standard.

All boards are varnished. Corrosion resistant.

Battery included in all drives for real-time clock. Three year lifetime.

Keypad kit includes HOA bypass.

EMI/RFI filters included.

DC link choke included.

Product Selection**H-Max Series IntelliPass NEMA Type 1—Two Contactor Bypass Standard**

2

**208 Vac**

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.6	HMX4D631NA
	2	7.5	HMX7D531NA
	3	10.6	HMX01131NA
5	5	16.7	HMX01731NA
	7.5	24.2	HMX02531NA
	10	30.8	HMX03131NA
6	15	46.2	HMX04731NA
	20	59.4	HMX06031NA
	25	74.9	HMX07531NA
7	30	88	HMX08831NA

230 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.2	HMX4D232NA
	2	6.8	HMX6D832NA
	3	9.6	HMX9D632NA
5	5	15.2	HMX01632NA
	7.5	22	HMX02232NA
	10	28	HMX02832NA
6	15	42	HMX04232NA
	20	54	HMX05432NA
	25	68	HMX06832NA
7	30	80	HMX08032NA

480 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	2.1	HMX2D134NA
	2	3.4	HMX3D434NA
	3	5.6	HMX5D634NA
	5	7.6	HMX7D634NA
	7.5	11	HMX01134NA
	10	14	HMX01434NA
5	15	21	HMX02134NA
	20	27	HMX02734NA
	25	34	HMX03434NA
6	30	40	HMX04034NA
	40	52	HMX05234NA
	50	65	HMX06534NA
7	60	77	HMX07734NA
	75	96	HMX09634NA

NotesFor Wiring Diagrams, see **Page V6-T2-153**.For NEMA 12 or 3R enclosures, see Catalog Number Selection on **Page V6-T2-142**.

Call Technical Support for NEMA 3R specifics. Enclosure size and weight differ from NEMA 1 and 12 products.

H-Max Series IntelliPass NEMA Type 12—Two Contactor Bypass Standard

2

**208 Vac**

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.6	HMX4D641NA
	2	7.5	HMX7D541NA
	3	10.6	HMX01141NA
5	5	16.7	HMX01741NA
	7.5	24.2	HMX02541NA
	10	30.8	HMX03141NA
6	15	46.2	HMX04741NA
	20	59.4	HMX06041NA
7	25	74.9	HMX07541NA
	30	88	HMX08841NA

230 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.2	HMX4D242NA
	2	6.8	HMX6D842NA
	3	9.6	HMX9D642NA
5	5	15.2	HMX01642NA
	7.5	22	HMX02242NA
	10	28	HMX02842NA
6	15	42	HMX04242NA
	20	54	HMX05442NA
7	25	68	HMX06842NA
	30	80	HMX08042NA

480 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	2.1	HMX2D144NA
	2	3.4	HMX3D444NA
	3	5.6	HMX5D644NA
	5	7.6	HMX7D644NA
	7.5	11	HMX01144NA
5	10	14	HMX01444NA
	15	21	HMX02144NA
	20	27	HMX02744NA
6	25	34	HMX03444NA
	30	40	HMX04044NA
	40	52	HMX05244NA
7	50	65	HMX06544NA
	60	77	HMX07744NA
	75	96	HMX09644NA

NotesFor Wiring Diagrams, see **Page V6-T2-153**.For NEMA 12 or 3R enclosures, see Catalog Number Selection on **Page V6-T2-142**.

Call Technical Support for NEMA 3R specifics. Enclosure size and weight differ from NEMA 1 and 12 products.

H-Max Series IntelliPass NEMA Type 3R—Two Contactor Bypass Standard**208 Vac**

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.6	HMX4D651NA
	2	7.5	HMX7D551NA
	3	10.6	HMX01151NA
5	5	16.7	HMX01751NA
	7.5	24.2	HMX02551NA
	10	30.8	HMX03151NA
6	15	46.2	HMX04751NA
	20	59.4	HMX06051NA
7	25	74.9	HMX07551NA
	30	88	HMX08851NA

230 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.2	HMX4D252NA
	2	6.8	HMX6D852NA
	3	9.6	HMX9D652NA
5	5	15.2	HMX01652NA
	7.5	22	HMX02252NA
	10	28	HMX02852NA
6	15	42	HMX04252NA
	20	54	HMX05452NA
7	25	68	HMX06852NA
	30	80	HMX08052NA

480 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	2.1	HMX2D154NA
	2	3.4	HMX3D454NA
	3	5.6	HMX5D654NA
	5	7.6	HMX7D654NA
	7.5	11	HMX01154NA
5	10	14	HMX01454NA
	15	21	HMX02154NA
	20	27	HMX02754NA
6	25	34	HMX03454NA
	30	40	HMX04054NA
	40	52	HMX05254NA
7	50	65	HMX06554NA
	60	77	HMX07754NA
	75	96	HMX09654NA

NotesFor Wiring Diagrams, see **Page V6-T2-153**.For NEMA 12 or 3R enclosures, see Catalog Number Selection on **Page V6-T2-142**.

Call Technical Support for NEMA 3R specifics. Enclosure size and weight differ from NEMA 1 and 12 products.

H-Max Series IntelliDisconnect NEMA Type 1—Main Disconnect Standard

2

**208 Vac**

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.6	HMX4D6A1NA
	2	7.5	HMX7D5A1NA
	3	11	HMX011A1NA
5	5	17	HMX017A1NA
	7.5	25	HMX025A1NA
	10	31	HMX031A1NA
6	15	47	HMX047A1NA
	20	60	HMX060A1NA
7	25	75	HMX075A1NA
	30	88	HMX088A1NA

230 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.2	HMX4D2A2NA
	2	6.8	HMX6D8A2NA
	3	9.6	HMX9D6A2NA
5	5	15.2	HMX016A2NA
	7.5	22	HMX022A2NA
	10	28	HMX028A2NA
6	15	42	HMX042A2NA
	20	54	HMX054A2NA
7	25	68	HMX068A2NA
	30	80	HMX080A2NA

480 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	2.1	HMX2D1A4NA
	2	3.4	HMX3D4A4NA
	3	5.6	HMX5D6A4NA
	5	7.6	HMX7D6A4NA
	7.5	11	HMX011A4NA
5	10	14	HMX014A4NA
	15	21	HMX021A4NA
	20	27	HMX027A4NA
6	25	34	HMX034A4NA
	30	40	HMX040A4NA
	40	52	HMX052A4NA
7	50	65	HMX065A4NA
	60	77	HMX077A4NA
	75	96	HMX096A4NA

NotesFor Wiring Diagrams, see [Page V6-T2-153](#).For NEMA 12 or 3R enclosures, see Catalog Number Selection on [Page V6-T2-142](#).

Call Technical Support for NEMA 3R specifics. Enclosure size and weight differ from NEMA 1 and 12 products.

H-Max Series IntelliDisconnect NEMA Type 12—Main Disconnect Standard**208 Vac**

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.6	HMX4D6B1NA
	2	7.5	HMX7D5B1NA
	3	11	HMX011B1NA
5	5	17	HMX017B1NA
	7.5	25	HMX025B1NA
	10	31	HMX031B1NA
6	15	47	HMX047B1NA
	20	60	HMX060B1NA
	25	75	HMX075B1NA
7	30	88	HMX088B1NA

230 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.2	HMX4D2B2NA
	2	6.8	HMX6D8B2NA
	3	9.6	HMX9D6B2NA
5	5	15.2	HMX016B2NA
	7.5	22	HMX022B2NA
	10	28	HMX028B2NA
6	15	42	HMX042B2NA
	20	54	HMX054B2NA
	25	68	HMX068B2NA
7	30	80	HMX080B2NA

480 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	2.1	HMX2D1B4NA
	2	3.4	HMX3D4B4NA
	3	5.6	HMX5D6B4NA
	5	7.6	HMX7D6B4NA
	7.5	11	HMX011B4NA
5	10	14	HMX014B4NA
	15	21	HMX021B4NA
	20	27	HMX027B4NA
6	25	34	HMX034B4NA
	30	40	HMX040B4NA
	40	52	HMX052B4NA
7	50	65	HMX065B4NA
	60	77	HMX077B4NA
	75	96	HMX096B4NA

NotesFor Wiring Diagrams, see **Page V6-T2-153**.For NEMA 12 or 3R enclosures, see Catalog Number Selection on **Page V6-T2-142**.

Call Technical Support for NEMA 3R specifics. Enclosure size and weight differ from NEMA 1 and 12 products.

H-Max Series IntelliDisconnect NEMA Type 3R—Main Disconnect Standard

2

**208 Vac**

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.6	HMX4D6C1NA
	2	7.5	HMX7D5C1NA
	3	11	HMX011C1NA
5	5	17	HMX017C1NA
	7.5	25	HMX025C1NA
	10	31	HMX031C1NA
6	15	47	HMX047C1NA
	20	60	HMX060C1NA
7	25	75	HMX075C1NA
	30	88	HMX088C1NA

230 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	4.2	HMX4D2C2NA
	2	6.8	HMX6D8C2NA
	3	9.6	HMX9D6C2NA
5	5	15.2	HMX016C2NA
	7.5	22	HMX022C2NA
	10	28	HMX028C2NA
6	15	42	HMX042C2NA
	20	54	HMX054C2NA
7	25	68	HMX068C2NA
	30	80	HMX080C2NA

480 Vac

FS Frame Size	Horsepower	Drive Rated NEC Amps	Catalog Number
4	1	2.1	HMX2D1C4NA
	2	3.4	HMX3D4C4NA
	3	5.6	HMX5D6C4NA
	5	7.6	HMX7D6C4NA
	7.5	11	HMX011C4NA
5	10	14	HMX014C4NA
	15	21	HMX021C4NA
	20	27	HMX027C4NA
6	25	34	HMX034C4NA
	30	40	HMX040C4NA
	40	52	HMX052C4NA
7	50	65	HMX065C4NA
	60	77	HMX077C4NA
	75	96	HMX096C4NA

NotesFor Wiring Diagrams, see [Page V6-T2-153](#).For NEMA 12 or 3R enclosures, see Catalog Number Selection on [Page V6-T2-142](#).

Call Technical Support for NEMA 3R specifics. Enclosure size and weight differ from NEMA 1 and 12 products.

Onboard Network Communications**Johnson Controls****Metasys N2**

H-Max Series provides communication between the drive and a Johnson Controls Metasys™ N2 network. With this connection, the drive can be controlled, monitored and programmed from the Metasys system. N2 can be selected and programmed by the drive keypad.

BACnet

H-Max Series provides communication to BACnet networks. Data transfer is master-slave/token passing (MS/TP) RS-485.

BACnet IP

100Base-T interface.

Modbus TCP

Ethernet based protocol.

Modbus RTU

H-Max Series provides communication to Modbus RTU RS-485 as a slave on a Modbus network. Other communication parameters include an address range from 1 to 247; a parity of None, Odd or Even; and the stop bit is 1.

H-Max Series Option Board Kits Available for Slots D and E

The H-Max Series drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your

application needs. The drive's control unit is designed to accept a total of two option boards.

The H-Max Series factory-installed standard board configuration includes an I/O board and a relay output board.

Option Boards Mounted in Slots D and E

Option Kit Description	Option Kit Catalog Number
6 x DI /DO, each digital input can be individually programmed as digital output	XMX-IO-B1-A
1RO Form C (NO/NC), 1RO Form A (NO), 1 thermistor	XMX-IO-B2-A
1 x AI, 2 x AO (isolated)	XMX-IO-B4-A
3 x RO Form A (NO)	XMX-IO-B5-A
1RO Form A (NO), 5DI 42–240 Vac input	XMX-IO-B9-A
LonWorks	XMX-COM-C4-A
1 x AO, 1 x DO, 1 x RO	XMX-IO-BF-A

Extended I/O Options in Slot D and E

Description	Suffix Number
6 x DI /DO, Each digital input can be individually programmed as digital output	B1
1RO (NC/NO), 1RO (NO), 1 Thermistor	B2
1 x AI, 2 x AO (isolated)	B4
3 x RO	B5
1RO (NO), 5 DI 42–240 Vac input	B9
Expander IO, 1 AO, 1 DO, 1 RO	BF

Optional Communications in Slot D and E

Description	Suffix Number
LonWorks	C4

IntelliDisconnect Options

Description	Suffix Number
Pilot lights (Power ON, RUN, Fault)	L3
Fused drive isolation (cannot be used with PE)	P3
Output contactor (cannot be used with P3)	PE
Space heater w/transformer (Type 3R only)	SA

IntelliPass Bypass Options

Description	Suffix Number
Pilot lights (Power ON, RUN, Fault)	L4
Fused drive isolation (can not be used with P6)	P3
Third contactor drive isolation (cannot be used with P3 or IS)	P6
Manual bypass switch located on front door	M1
Space heater w/transformer (Type 3R only)	SA
Auxiliary contacts	K9
Isolation switch	IS

Standard Onboard Communications

Description	Suffix Number
RS-485 Communications	
BACnet MS/TP = Master slave/token protocol (Universal BACnet) RS-485	BACnet
Modbus RTU RS-485, ASCII or RTU, remote terminal unit 32 nodes	Modbus
Johnson Controls Metasys N2 network	N2
Onboard Ethernet-Based Communications (port left side of keypad)	
BACnet/IP Ethernet industrial protocol	BACnet
Modbus/TCP Transmission control protocol (Ethernet-based)	Modbus

Technical Data and Specifications

Primary Design Features

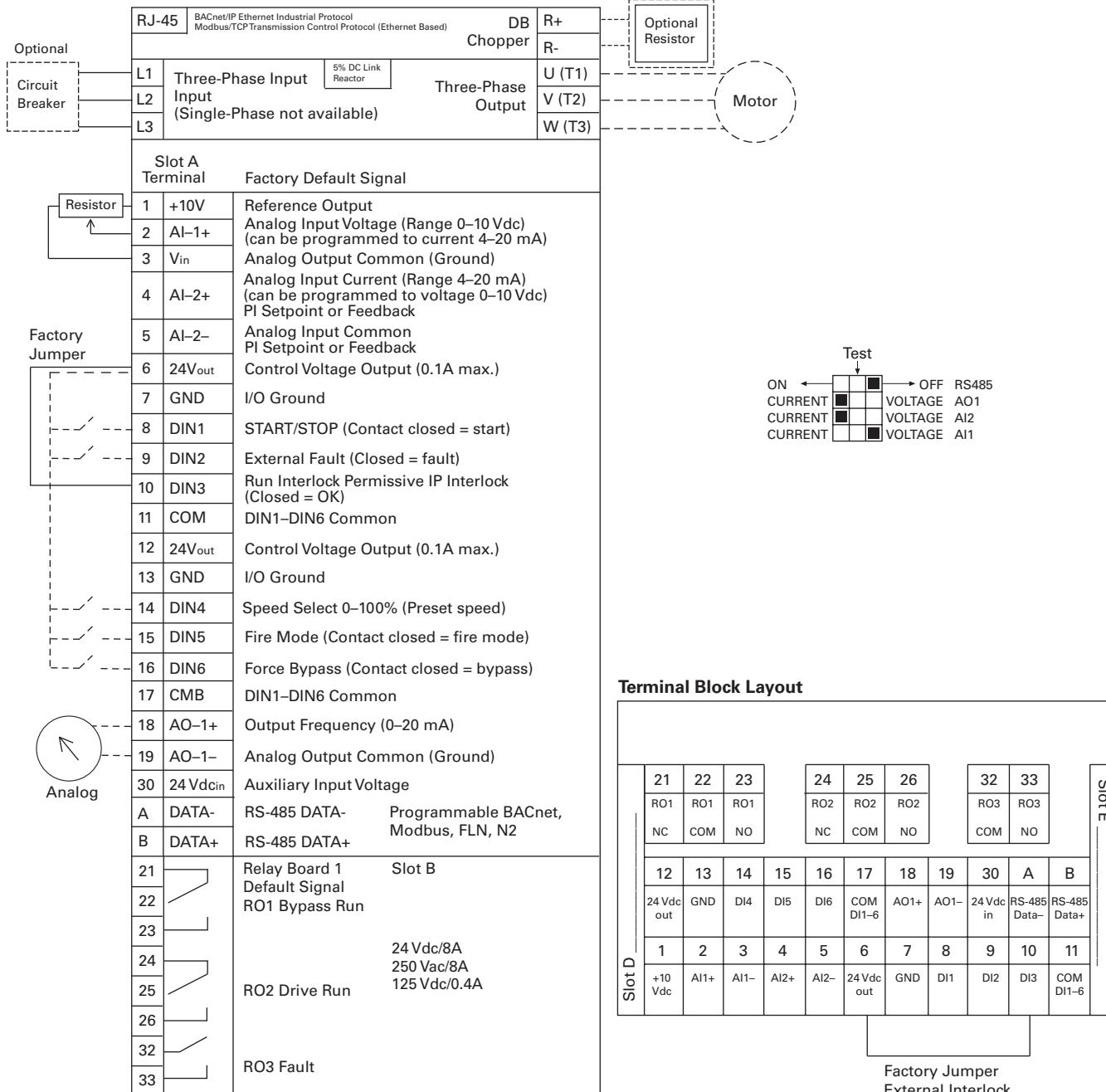
Description	IntelliPass	IntelliDisconnect
CB MMP	Standard	Standard
2 contactor bypass	Standard	N/A
Electrical interlock	Standard	N/A
Third contactor (isolation)	Optional	N/A

H-Max Series Drives

Description	Specification
Input Ratings	
Input voltage (V_{in})	208, 230, 480 Vac, -10%/+10%
Input frequency (f_{in})	50/60 Hz (variation up to 47–66 Hz)
Connection to power	Once per minute or less (typical operation)
Short-circuit withstand rating	65 kAIC combination
Output Ratings	
Output voltage	0 to V_{in}/U_{in} line voltage in
Continuous output current	Ambient temperature max. 104°F (40°C)
I_L overload	1.1 x I_L (1 min./10 min.)
Overload current	110% (1 min./10 min.)
Initial output current	150% for two seconds
Output frequency	0 to 320 Hz
Frequency resolution	0.01 Hz
Control Characteristics	
Control method	Frequency control (V/f) open loop sensorless vector control
Switching frequency	1–310 amps; adjustable with parameter 2.6.9 FS4–FS7: default 6 kHz
Frequency reference	Analog input: Resolution 0.1% (10-bit), accuracy ±1% Panel reference: Resolution 0.01 Hz
Field weakening point	8 to 320 Hz
Acceleration time	0.1 to 3000 seconds
Deceleration time	0.1 to 3000 seconds
Braking torque	DC brake: 30% x T_n
Ambient Conditions	
Ambient operating temperature	FS4–FS7: 14°F (–10°C), no frost to 104°F (40°C) (Drive can operate at 122°F (50°C))
Storage temperature	–40° to 158°F (–40° to 70°C)
Relative humidity	0 to 95% RH, noncondensing, non-corrosive, no dripping water
Air quality	Chemical vapors: IEC 60721-3-3, unit in operation, Class 3C2; Mechanical particles: IEC 60721-3-3, unit in operation, Class 3S2
Altitude	100% load capacity (no derating) up to 3280 ft (1000m); 1% derating for each 328 ft (100m) above 3280 ft (1000m); max. 9842 ft (3000m); 380–480V
Vibration	FS4–FS7: IEC 60068-2-6, 10–150 Hz Displacement amplitude = 1 mm peak-to-peak from 10–15.8 Hz Max. acceleration amplitude = 1G peak from 15.8–150 Hz
Shock	FS4–FS7: IEC 60068-2-27, 15G peak acceleration at 11 ms duration, 1/2-sine. ISTA 1A Certified
Enclosure class	NEMA Type 1/IP21 or NEMA Type 12/IP54 (keypad required for IP54/Type 12)

Description	IntelliPass	IntelliDisconnect
Isolation switch	Optional	N/A
Top entry (power)	Standard	Standard
Bottom entry (power)	Standard	Standard
Output contactor	Standard	Optional

Description	Specification
Standards	
EMC	Immunity: Fulfills all EMC immunity requirements; Emissions: EN 61800-3, LEVEL H (EMC C2)
Emissions	EMC level dependent— +EMC 2: EN61800-3 (2004) Category C2 Delivered with Class C2 EMC filtering as default.
Control Connections	
Analog input voltage	0 to 10V, $R = 200$ ohms differential Resolution 0.1%; Accuracy ±1% DIP switch selection (voltage/current)
Analog input current	0(4) to 20 mA; $R_i = 250$ ohms differential
Digital inputs (6)	Positive or negative logic; 18 to 30 Vdc
Auxiliary voltage	+24V ±10%, max. 250 mA
Output reference voltage	+10V +3%, max. load 10 mA
Analog output	0–10V, 0(4) to 20 mA; R_i max. 500 ohms; Resolution 10 bit; Accuracy ±2%; DIP switch selection (voltage/current)
Relay outputs	3 programmable, 2 Form C, 1 Form A relay outputs Switching capacity: 24 Vdc/8A, 250 Vac/8A, 125 Vdc/0.4A
Hard wire jumper	Between terminal 6 and 10 factory default
DIP switch setting default	RS-485 = off A01 = current A12 = current A11 = voltage
Protections	
Overcurrent protection	Yes
Oversupply protection	Yes
DC bus regulation anti-trip	Yes (accelerates or decelerates the load)
Undervoltage protection	Yes
Earth fault protection	Yes (in case of earth fault in motor or motor cable, only the frequency converter is protected)
Input phase supervision	Yes (trips if any of the input phases are missing)
Motor phase supervision	Yes (trips if any of the output phases are missing)
Overtemperature protection	Yes
Motor overload protection	Yes
Motor stall protection	Yes
Motor underload protection	Yes
Short-circuit protection	Yes
Surge protection	Yes (varistor input)
Conformed coated (varnished) board	Yes (prevents corrosion)

Wiring Diagrams**Control Input/Output, PID Application****Standards**

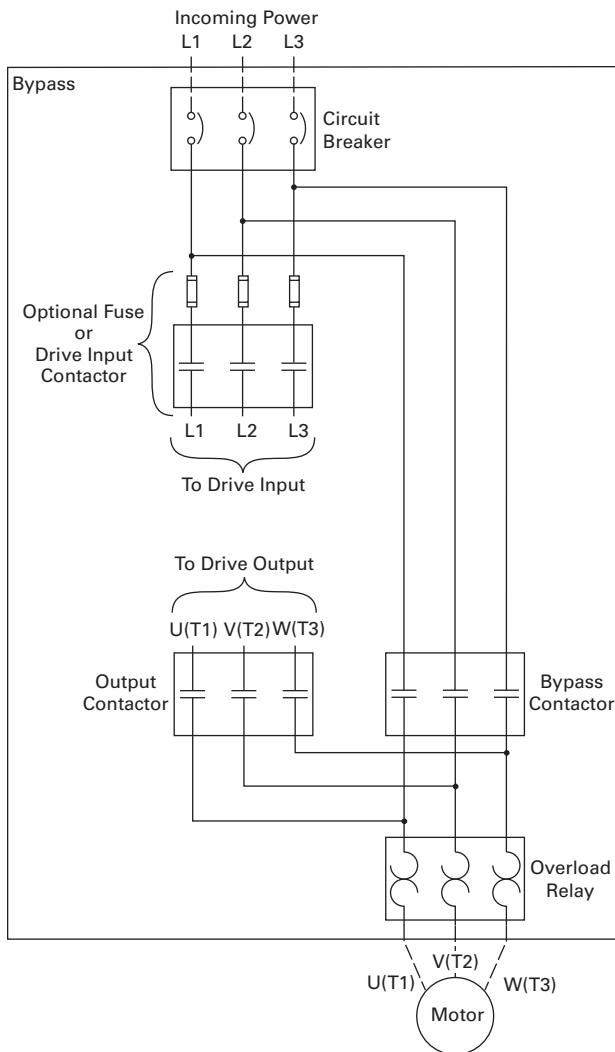
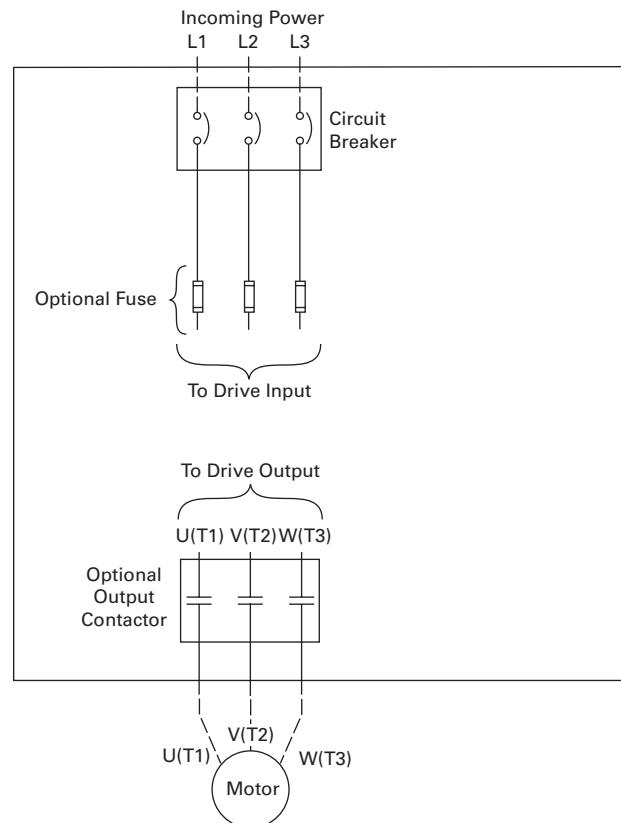
- Digital inputs D1–D6, relay out, analog in/out are freely programmed
- The user can assign a single input to multiple functions

Includes

- Six digital input
- Two analog input
- One analog output
- Three relay output
- RS-485
- Ethernet

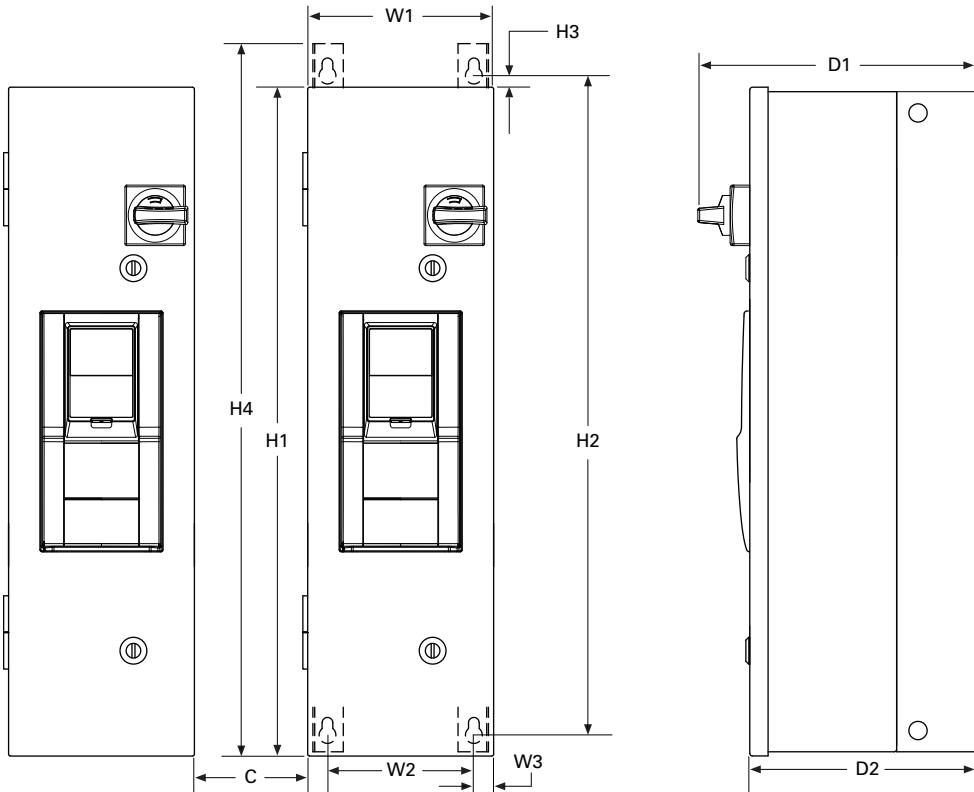
Reliability

- Pretested components
- Conformal coated (varnished) boards
- 40°C rated
- 110% overload for one minute
- Eaton Electrical Services & Systems national network of AF drive specialists

H-Max Series IntelliPass**H-Max Series IntelliDisconnect Power Wiring**

Dimensions

Approximate Dimensions in Inches (mm)

2**H-Max Series IntelliPass and IntelliDisconnect Drives**

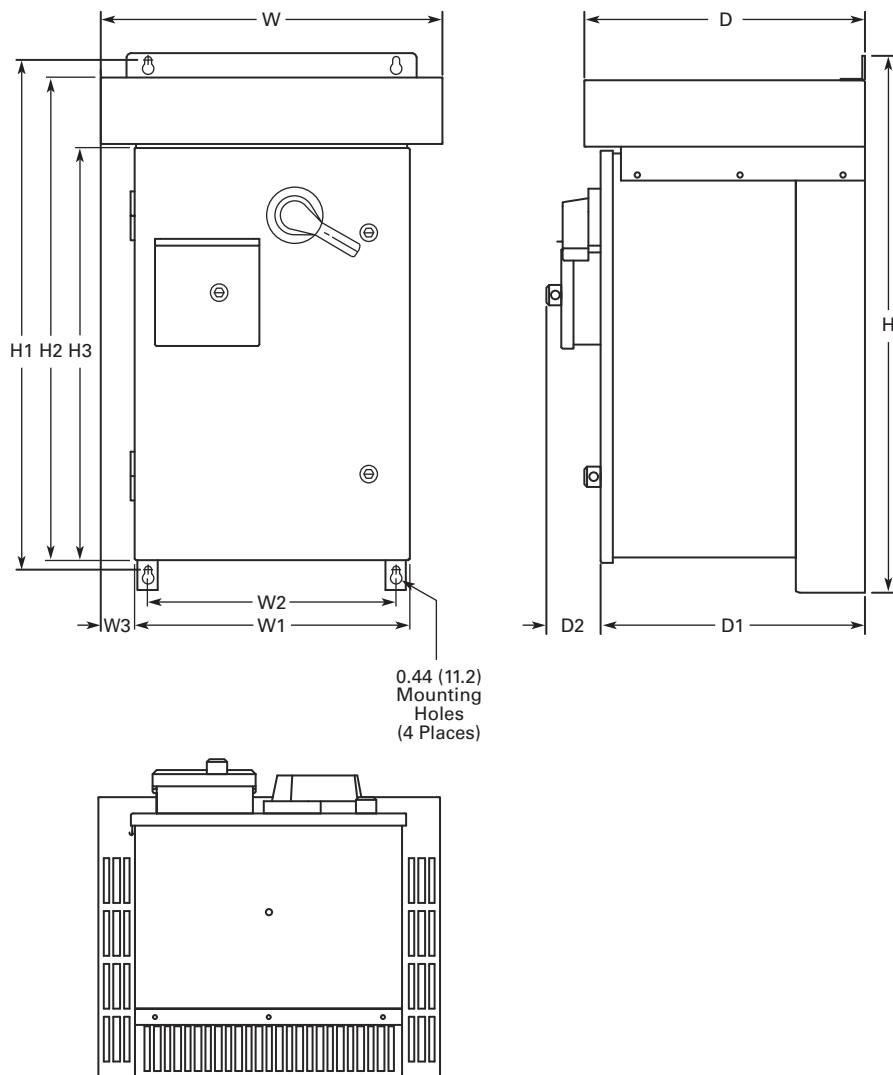
Consult factory or use manual for final dimensions.

Frame Size	Voltage	Horsepower (I _L)	H1	H2	H3	H4	C	W1	W2	W3	D1	D2	Weight in Lbs (kg)
FS4	208	1-3	30.00 (762.0)	29.41 (747.1)	0.25 (6.35)	31.00 (787.4)	3.00 (76.2)	7.88 (200.2)	6.25 (158.8)	0.75 (19.1)	12.49 (317.2)	10.36 (263.1)	45 (20.41)
	230	1-3											
	480	1-7.5											
FS5	208	5-10	37.00 (939.8)	38.72 (932.7)	0.25 (6.35)	38.31 (973.0)	3.00 (76.2)	9.60 (243.8)	7.97 (202.4)	0.75 (19.1)	15.35 (390.0)	13.22 (335.8)	57.5 (26.10)
	230	5-10											
	480	10-20											
FS6	208	15-20	45.45 (1154.4)	44.81 (1138.2)	0.25 (6.35)	46.4 (1178.6)	4.00 (101.6)	11.44 (290.6)	9.75 (247.6)	0.75 (19.1)	15.80 (401.3)	13.67 (347.2)	98.0 (44.45)
	230	15-20											
	480	25-40											
FS7	208	25-30	58.51 (1486.2)	57.87 (1470.0)	0.25 (6.35)	59.46 (1510.3)	5.00 (127.0)	14.52 (368.8)	12.83 (325.9)	0.75 (19.1)	15.68 (398.3)	13.72 (348.5)	165.0 (74.84)
	230	25-30											
	480	50-75											

Note: C distance is spacing required to mount multiple drives.

Approximate Dimensions in Inches (mm)

Enclosure Box A NEMA Type 3R

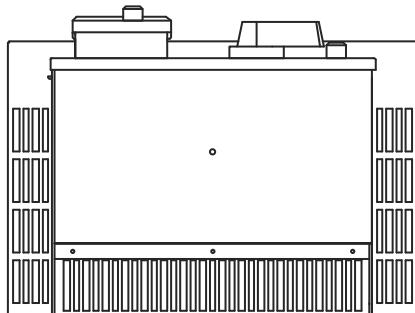
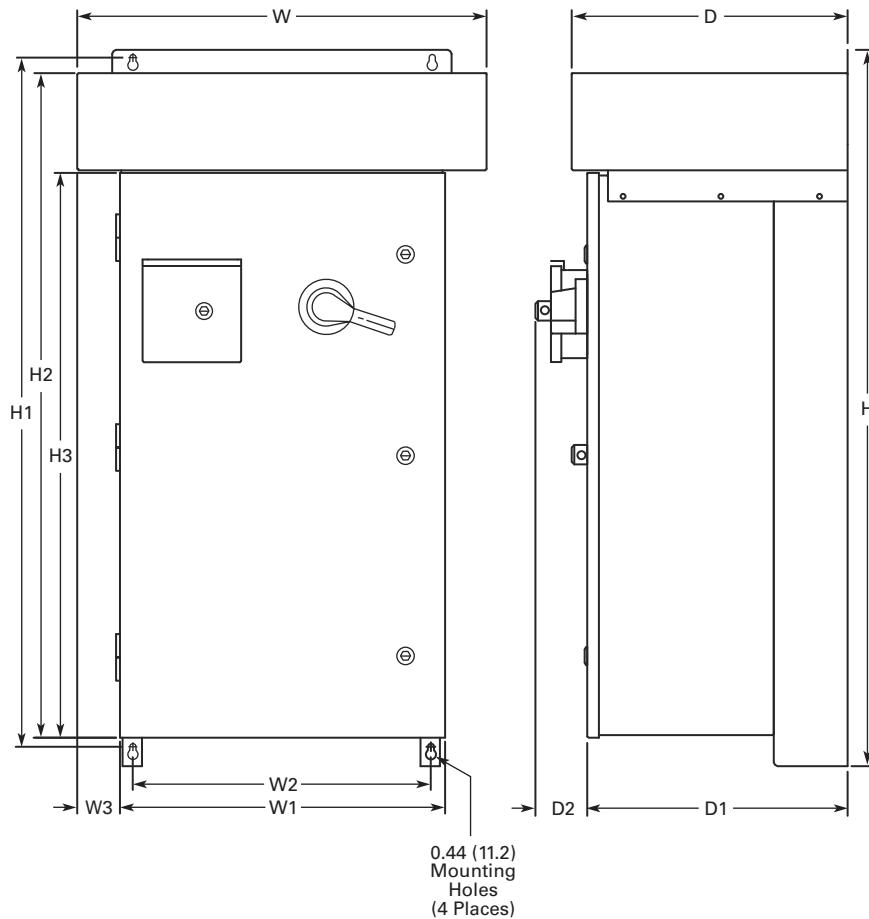


Voltage AC	hp (L ₁)	H	H1	H2	H3	W	W1	W2	W3	D	D1	D2	Approx. Weight Lbs (kg)	Approx. Shipping Weight Lbs (kg)
Three-Phase														
208V	1-10	33.00	31.36	29.67	25.35	21.05	16.92	15.30	2.07	17.24	16.26	3.31	170 (77)	215 (98)
230V	1-10	(838.2)	(796.5)	(753.6)	(643.9)	(534.7)	(429.8)	(388.6)	(52.6)	(437.9)	(413.0)	(84.1)		
480V	1-20													

Approximate Dimensions in Inches (mm)

Enclosure Box B NEMA Type 3R

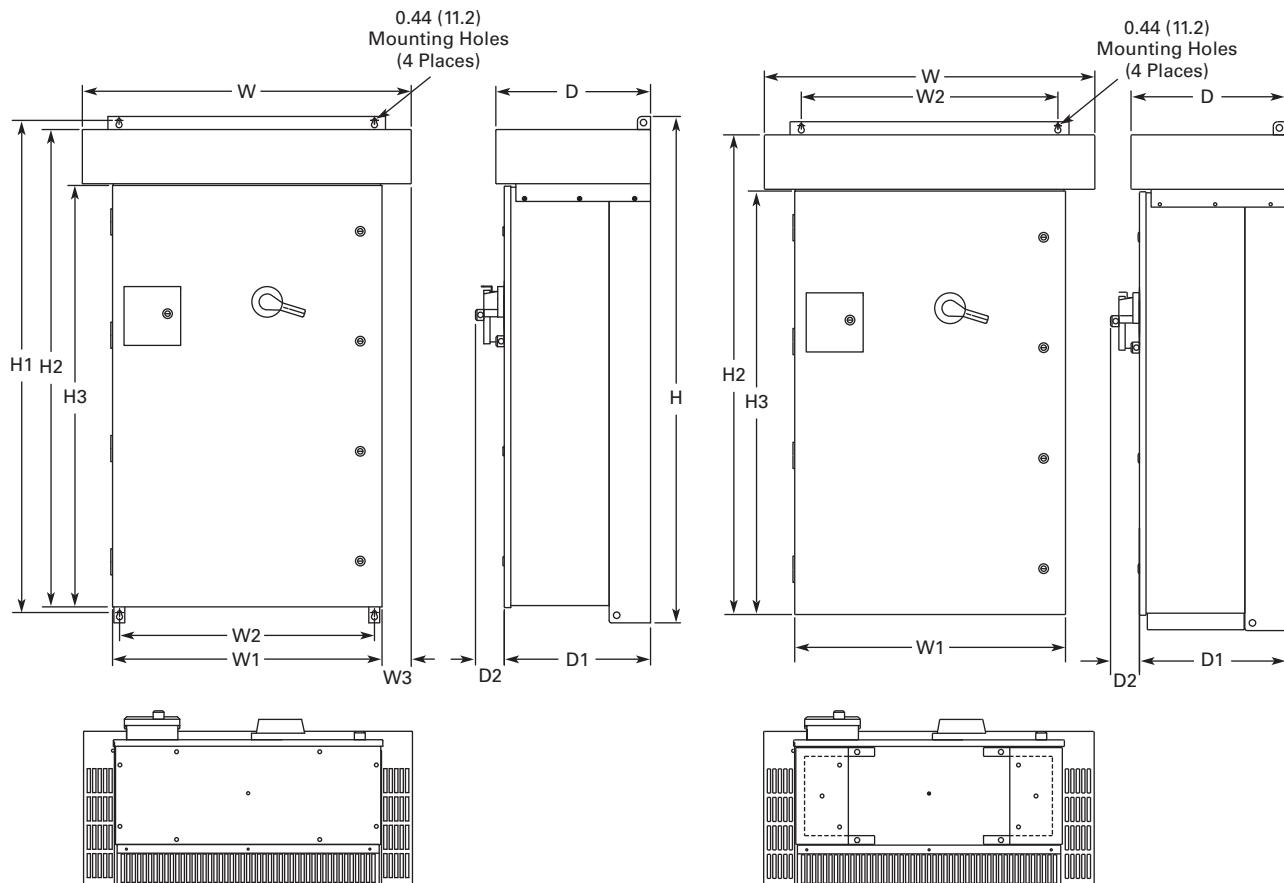
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Voltage AC	hp (L ₁)	H	H1	H2	H3	W	W1	W2	W3	D	D1	D2	Approx. Weight Lbs (kg)	Approx. Shipping Weight Lbs (kg)
Three-Phase														
208V	15	46.09 (1170.7)	44.45 (1129.0)	42.77 (1086.4)	36.35 (923.3)	26.31 (668.3)	20.92 (531.4)	19.30 (490.2)	2.69 (68.3)	17.74 (450.6)	16.76 (425.7)	3.31 (84.1)	235 (107)	290 (132)
230V	15													
480V		25-40												

Approximate Dimensions in Inches (mm)

Enclosure Box C NEMA Type 3R



Voltage AC	hp (I _L)	H	H1	H2	H3	W	W1	W2	W3	D	D1	D2	Approx. Weight Lbs (kg)
Three-Phase													
208	20–30	58.09	56.45	54.77	48.35	37.73	30.92	29.30	3.34	17.74	16.77	3.31	①
		(1475.5)	(1433.8)	(1391.2)	(1228.1)	(958.3)	(785.4)	(744.2)	(84.8)	(450.6)	(426.0)	(84.1)	
480	50–75												

Note

① Consult factory.

SPX9000 Drives**2****Product Description**

The SPX9000 Series Adjustable Frequency Drives from Eaton's Electrical Sector are specifically designed for high performance applications. Equipped with high processing power, the SPX9000 can use information from an encoder or a resolver in order to provide very precise motor control. Sensorless vector and simple frequency control are also supported. Typical applications requiring high performance are: master-slave drives, positioning applications, winder tension control and synchronization.

The core of the SPX9000 is a fast microprocessor, providing high dynamic performance for applications where good motor handling and reliability are required. It can be used both in open loop applications as well as in applications requiring encoder feedback.

The SPX9000 supports fast drive-to-drive communication. It also offers an integrated data logger functionality for analysis of dynamic events without the need of additional hardware. Simultaneous fast monitoring of several drives can be done by using the 9000Xdrive tool and CAN communication. In applications where reliability and quality are essential for high-performance, the SPX9000 is the logical choice.

Contents**Description****Page**

SPX9000 Drives	V6-T2-159
Features and Benefits	V6-T2-159
Standards and Certifications	V6-T2-160
Catalog Number Selection	V6-T2-161
Product Selection	V6-T2-166
Accessories	V6-T2-167
Options	V6-T2-174
Replacement Parts	V6-T2-183
Technical Data and Specifications	V6-T2-184
Dimensions	V6-T2-184

The Eaton family of drives includes DA1, DC1, H-Max, M-Max, SVX9000 and SPX9000. 9000X Series drive ratings are rated for either high overload (I_H) or low overload (I_L). I_L indicates 110% overload capacity for 1 minute out of 10 minutes. I_H indicates 150% overload capacity for 1 minute out of 10 minutes.

Features and Benefits

- Speed error <0.01%, depending on the encoder
- Incremental or absolute encoder support
- Encoder voltages of 5V (RS-422), 15V or 24V, depending on the option card
- Full torque control at all speeds, including zero
- Torque accuracy <2%; <5% down to zero speed
- Starting torque >200%, depending on motor and drive sizing
- Integrated datalogger for system analysis
- Fast multiple drive monitoring with PC
- Full capability for master/slave configurations
- High-speed bus (12 Mbit/s) for fast inter-drive communication
- High-speed applications (up to 7200 Hz) possible
- Robust design—proven 500,000 hours MTBF
- Integrated 3% line reactors standard on drives from FR4 through FR9
- Line reactor is included but is separated from chassis
- EMI/RFI Filters H standard up to 200 hp I_H 480V, 100 hp I_H 230V
- Simplified operating menu allows for typical programming changes, while programming mode provides control of everything
- Quick Start Wizard built into the programming of the drive ensures a smooth start-up
- Keypad can display up to three monitored parameters simultaneously
- LOCAL/REMOTE operation from keypad
- Copy/paste function allows transfer of parameter settings from one drive to the next
- Standard NEMA Type 12/IP54 keypad on all drives
- Hand-held auxiliary 240 power supply allows programming/monitoring of control module without applying full power to the drive
- The SPX can be flexibly adapted to a variety of needs using our pre-installed "Seven in One" precision application programs consisting of:
 - Basic
 - Standard
 - Local/remote
 - Multi-step speed control
 - PID control
 - Multi-purpose control
 - Pump and fan control with auto change
- Additional I/O and communication cards provide plug and play functionality
- I/O connections with simple quick connection terminals
- Control logic can be powered from an external auxiliary control panel, internal drive functions and fieldbus if necessary
- Brake chopper standard from: 1–30 hp/380–500V 3/4–15 hp/208–230V
- NEMA Type 1/IP21 enclosures available Frame Sizes FR4–FR11, NEMA Type 12/IP54 enclosures available Frame Sizes FR4–FR10 (FR10 and FR11 freestanding drives)
- Open chassis FR10 and greater
- Standard option board configuration includes an A9 I/O board and an A2 relay output board installed in slots A and B

Standards and Certifications

Product

- IEC 61800-2

Safety

- UL 508C

EMC (at default settings)

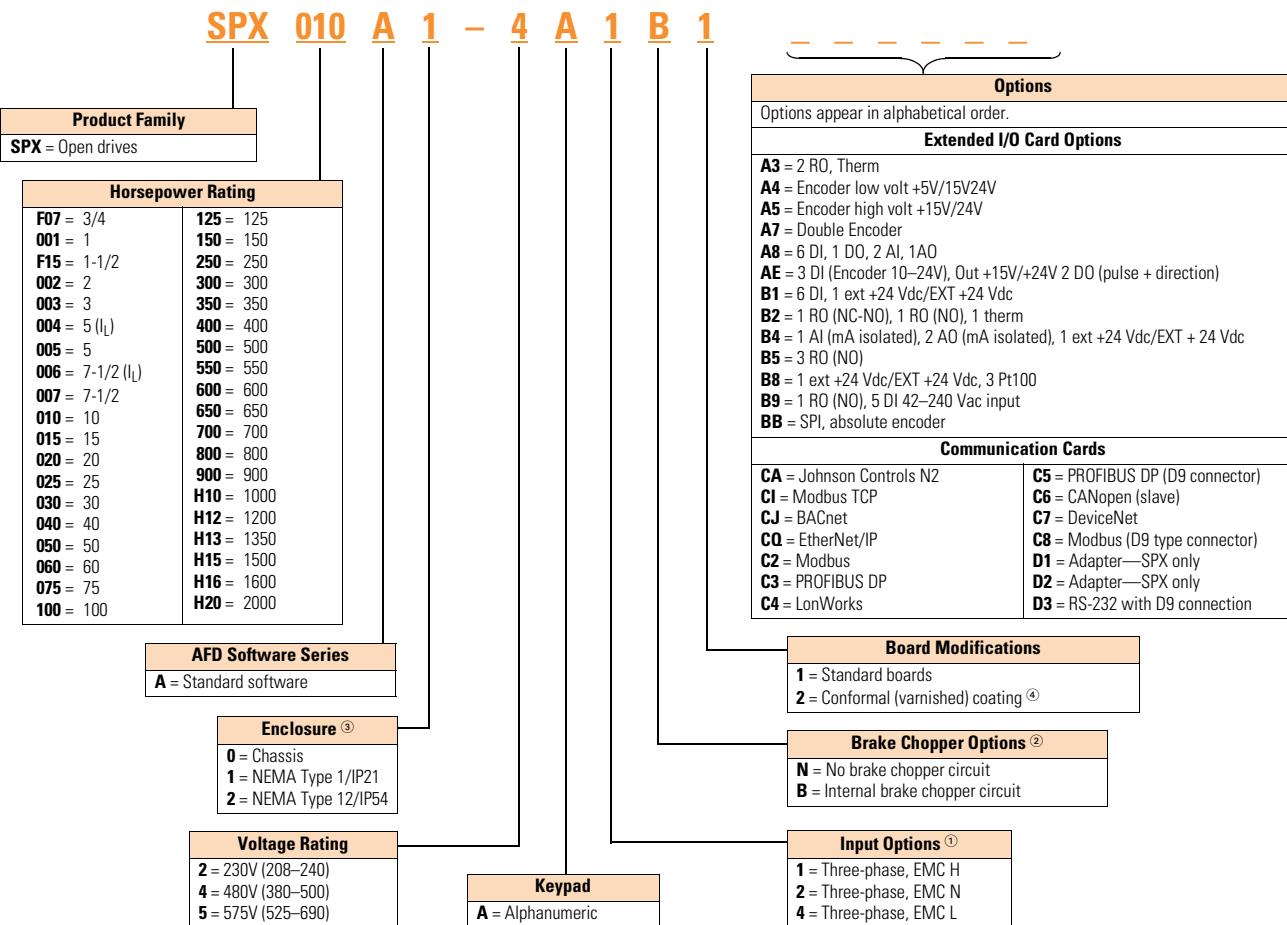
- Immunity: Fulfills all EMC immunity requirements; Emissions: EN 61800-3, LEVEL H

- UL Listed
- CE



Catalog Number Selection**SPX9000 Adjustable Frequency Drives**

2

**Notes**

- ① All 230V drives and 480V drives up to 200 hp (I_H) are only available with input option 1 (EMC level H). 480V drives 250 hp (I_H) or larger are available with input option 2 (EMC level N). 575V drives 200 hp (I_H) or larger are available with input option 2. 575V drives up to 150 hp (I_H) are available with input option 4 (EMC level L). 480V and 690V freestanding drives are available with input option 4 (EMC level L).
- ② 480V drives up to 30 hp (I_H) are only available with brake chopper option B. 480V drives 40 hp (I_H) or larger come standard with brake chopper option N. 230V drives up to 15 hp (I_H) are only available with brake chopper option B. 230V drives 20 hp and larger come standard with brake chopper option N. All 575V drives come standard without brake chopper option (N). N = No brake chopper.
- ③ 480V drives 250–350 hp (I_H) and 690V drives 200–300 hp (I_H) are available with enclosure style 0 (chassis). 480V and 690V FR10 freestanding drives are available with 1 (NEMA Type 1/IP21) or 2 (NEMA Type 12/IP54). FR11 freestanding drives are only available with enclosure style 1 (NEMA Type 1/IP21).
- ④ Factory promise delivery. Consult sales office for availability.

Product Selection**230V Drives****SPX9000 Open Drives****208–240V, NEMA Type 1/IP21 Drives**

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR4	3/4	3.7	1	4.8	SPXF07A1-2A1B1
	1	4.8	1-1/2	6.6	SPX001A1-2A1B1
	1-1/2	6.6	2	7.8	SPXF15A1-2A1B1
	2	7.8	3	11	SPX002A1-2A1B1
	3	11	—	12.5	SPX003A1-2A1B1
FR5	—	12.5	5	17.5	SPX004A1-2A1B1
	5	17.5	7-1/2	25	SPX005A1-2A1B1
	7-1/2	25	10	31	SPX007A1-2A1B1
FR6	10	31	15	48	SPX010A1-2A1B1
	15	48	20	61	SPX015A1-2A1B1
FR7	20	61	25	75	SPX020A1-2A1N1
	25	75	30	88	SPX025A1-2A1N1
	30	88	40	114	SPX030A1-2A1N1
FR8	40	114	50	140	SPX040A1-2A1N1
	50	140	60	170	SPX050A1-2A1N1
	60	170	75	205	SPX060A1-2A1N1
FR9	75	205	100	261	SPX075A1-2A1N1
	100	261	—	—	SPX100A1-2A1N1

208–240V, NEMA Type 12/IP54 Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR4	3/4	3.7	1	4.8	SPXF07A2-2A1B1
	1	4.8	1-1/2	6.6	SPX001A2-2A1B1
	1-1/2	6.6	2	7.8	SPXF15A2-2A1B1
	2	7.8	3	11	SPX002A2-2A1B1
	3	11	—	12.5	SPX003A2-2A1B1
FR5	—	12.5	5	17.5	SPX004A2-2A1B1
	5	17.5	7-1/2	25	SPX005A2-2A1B1
	7-1/2	25	10	31	SPX007A2-2A1B1
FR6	10	31	15	48	SPX010A2-2A1B1
	15	48	20	61	SPX015A2-2A1B1
FR7	20	61	25	75	SPX020A2-2A1N1
	25	75	30	88	SPX025A2-2A1N1
	30	88	40	114	SPX030A2-2A1N1
FR8	40	114	50	140	SPX040A2-2A1N1
	50	140	60	170	SPX050A2-2A1N1
	60	170	75	205	SPX060A2-2A1N1
FR9	75	205	100	261	SPX075A2-2A1N1
	100	261	—	—	SPX100A2-2A1N1

480V Drives**2****SPX9000 Open Drives****380–500V, NEMA Type 1/IP21 Drives**

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR4	1	2.2	1-1/2	3.3	SPX001A1-4A1B1
	1-1/2	3.3	2	4.3	SPXF15A1-4A1B1
	2	4.3	3	5.6	SPX002A1-4A1B1
	3	5.6	5	7.6	SPX003A1-4A1B1
	5	7.6	—	9	SPX005A1-4A1B1
	—	9	7-1/2	12	SPX006A1-4A1B1
FR5	7-1/2	12	10	16	SPX007A1-4A1B1
	10	16	15	23	SPX010A1-4A1B1
	15	23	20	31	SPX015A1-4A1B1
FR6	20	31	25	38	SPX020A1-4A1B1
	25	38	30	46	SPX025A1-4A1B1
	30	46	40	61	SPX030A1-4A1B1
FR7	40	61	50	72	SPX040A1-4A1N1
	50	72	60	87	SPX050A1-4A1N1
	60	87	75	105	SPX060A1-4A1N1
FR8	75	105	100	140	SPX075A1-4A1N1
	100	140	125	170	SPX100A1-4A1N1
	125	170	150	205	SPX125A1-4A1N1
FR9	150	205	200	261	SPX150A1-4A1N1
	200	245	250	300	SPX200A1-4A1N1

380–500V, NEMA Type 1/IP21 Freestanding Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR10	250	330	300	385	SPX250A1-4A4N1
	300	385	350	460	SPX300A1-4A4N1
	350	460	400	520	SPX350A1-4A4N1
FR11	400	520	500	590	SPX400A1-4A4N1
	500	590	550	650	SPX500A1-4A4N1
	550	650	600	730	SPX550A1-4A4N1

Note

Integrated fuses as standard. Limited option selection available; 115V transformer (KB), light kit (L1), HOA (K4), speed potentiometer w/HOA (K2), Disconnect switch (P2). See Freestanding Option selection on **Page V6-T2-173**.

SPX9000 Open Drives



380–500V, NEMA Type 12/IP54 Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR4	1	2.2	1-1/2	3.3	SPX001A2-4A1B1
	1-1/2	3.3	2	4.3	SPXF15A2-4A1B1
	2	4.3	3	5.6	SPX002A2-4A1B1
	3	5.6	5	7.6	SPX003A2-4A1B1
	5	7.6	—	9	SPX005A2-4A1B1
	—	9	7-1/2	12	SPX006A2-4A1B1
FR5	7-1/2	12	10	16	SPX007A2-4A1B1
	10	16	15	23	SPX010A2-4A1B1
	15	23	20	31	SPX015A2-4A1B1
FR6	20	31	25	38	SPX020A2-4A1B1
	25	38	30	46	SPX025A2-4A1B1
	30	46	40	61	SPX030A2-4A1B1
FR7	40	61	50	72	SPX040A2-4A1N1
	50	72	60	87	SPX050A2-4A1N1
	60	87	75	105	SPX060A2-4A1N1
FR8	75	105	100	140	SPX075A2-4A2N1
	100	140	125	170	SPX100A2-4A1N1
	125	170	150	205	SPX125A2-4A1N1
FR9	150	205	200	261	SPX150A2-4A1N1
	200	245	250	300	SPX200A2-4A1N1

380–500V, NEMA Type 12/IP54 Freestanding Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR10	250	330	300	385	SPX250A2-4A4N1
	300	385	350	460	SPX300A2-4A4N1
	350	460	400	520	SPX350A2-4A4N1

380–500V, Open Chassis Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR10	250	330	300	385	SPX250A0-4A2N1
	300	385	—	460	SPX300A0-4A2N1
	350	460	400	520	SPX350A0-4A2N1
FR11	400	520	500	590	SPX400A0-4A2N1
	500	590	—	650	SPX500A0-4A2N1
	—	650	600	730	SPX550A0-4A2N1
FR12	600	730	—	820	SPX600A0-4A2N1
	—	820	700	920	SPX650A0-4A2N1
	700	920	800	1030	SPX700A0-4A2N1
FR13	800	1030	900	1150	SPX800A0-4A2N1
	900	1150	1000	1300	SPX900A0-4A2N1
	1000	1300	1200	1450	SPXH10A0-4A2N1
FR14	1200	1600	1500	1770	SPXH12A0-4A2N1
	1600	1940	1800	2150	SPXH16A0-4A2N1

Notes

Integrated fuses as standard. Limited option selection available; 115V transformer (KB), light kit (L1), HOA (K4), speed potentiometer w/HOA (K2), disconnect switch (P2). See Freestanding Option selection on **Page V6-T2-173**.

① FR10–FR14 includes 3% line reactor, but it is not integral to chassis.

575V Drives**2****SPX9000 Open Drives****525–690V, NEMA Type 1/IP21 Drives**

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR6	2	3.3	3	4.5	SPX002A1-5A4N1
	3	4.5	—	5.5	SPX003A1-5A4N1
	—	5.5	5	7.5	SPX004A1-5A4N1
	5	7.5	7-1/2	10	SPX005A1-5A4N1
	7-1/2	10	10	13.5	SPX007A1-5A4N1
	10	13.5	15	18	SPX010A1-5A4N1
	15	18	20	22	SPX015A1-5A4N1
	20	22	25	27	SPX020A1-5A4N1
	25	27	30	34	SPX025A1-5A4N1
FR7	30	34	40	41	SPX030A1-5A4N1
	40	41	50	52	SPX040A1-5A4N1
FR8	50	52	60	62	SPX050A1-5A4N1
	60	62	75	80	SPX060A1-5A4N1
	75	80	100	100	SPX075A1-5A4N1
FR9	100	100	125	125	SPX100A1-5A4N1
	125	125	150	144	SPX125A1-5A4N1
	150	144	—	170	SPX150A1-5A4N1
	—	170	200	208	SPX175A1-5A4N1

525–690V, NEMA Type 1/IP21 Freestanding Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR10	200	208	250	261	SPX200A1-5A4N1
	250	261	300	325	SPX250A1-5A4N1
	300	325	400	385	SPX300A1-5A4N1
FR11	400	385	450	460	SPX400A1-5A4N1
	450	460	500	502	SPX450A1-5A4N1
	500	502	550	590	SPX500A1-5A4N1

Note

Integrated fuses as standard. Limited option selection available; 115V transformer (KB), light kit (L1), HOA (K4), speed potentiometer w/HOA (K2), disconnect switch (P2). See Freestanding Option selection on **Page V6-T2-173**.

SPX9000 Open Drives



525–690V, NEMA Type 12/IP54 Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR6	2	3.3	3	4.5	SPX002A2-5A4N1
	3	4.5	—	5.5	SPX003A2-5A4N1
	—	5.5	5	7.5	SPX004A2-5A4N1
	5	7.5	7-1/2	10	SPX005A2-5A4N1
	7-1/2	10	10	13.5	SPX007A2-5A4N1
	10	13.5	15	18	SPX010A2-5A4N1
	15	18	20	22	SPX015A2-5A4N1
	20	22	25	27	SPX020A2-5A4N1
	25	27	30	34	SPX025A2-5A4N1
FR7	30	34	40	41	SPX030A2-5A4N1
	40	41	50	52	SPX040A2-5A4N1
FR8	50	52	60	62	SPX050A2-5A4N1
	60	62	75	80	SPX060A2-5A4N1
	75	80	100	100	SPX075A2-5A4N1
FR9	100	100	125	125	SPX100A2-5A4N1
	125	125	150	144	SPX125A2-5A4N1
	150	144	—	170	SPX150A2-5A4N1
	—	170	200	208	SPX175A2-5A4N1

525–690V, NEMA Type 12/IP54 Freestanding Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR10	200	208	250	261	SPX200A2-5A4N1
	250	261	300	325	SPX250A2-5A4N1
	300	325	400	385	SPX300A2-5A4N1

525–690V, Open Chassis Drives

Frame Size	hp (I _H)	Current (I _H)	hp (I _L)	Current (I _L)	Catalog Number
FR10	200	208	250	261	SPX200A0-5A2N1
	250	261	300	325	SPX250A0-5A2N1
	300	325	400	385	SPX300A0-5A2N1
FR11	400	385	450	460	SPX400A0-5A2N1
	450	460	500	502	SPX450A0-5A2N1
	500	502	—	590	SPX500A0-5A2N1
FR12	—	590	600	650	SPX550A0-5A2N1
	600	650	700	750	SPX600A0-5A2N1
	700	750	800	820	SPX700A0-5A2N1
FR13	800	820	900	920	SPX800A0-5A2N1
	900	920	1000	1030	SPX900A0-5A2N1
	1000	1030	1250	1180	SPXH10A0-5A2N1
FR14	1350	1300	1500	1500	SPXH13A0-5A2N1
	1500	1500	2000	1900	SPXH15A0-5A2N1
	2000	1900	2300	2250	SPXH20A0-5A2N1

Notes

Integrated fuses as standard. Limited option selection available; 115V transformer (KB), light kit (L1), HOA (K4), speed potentiometer w/HOA (K2), disconnect switch (P2). See Freestanding Option selection on **Page V6-T2-173**.

① FR10–FR14 includes 3% line reactor, but it is not integral to chassis.

Accessories

2

Demo Drive and Power Supply

Demo Drive and Power Supply

Description	Catalog Number
9000X demo drive	9000XDEMO

NEMA Type 12/IP54 Conversion Kit

The NEMA Type 12/IP54 kit option is used to convert a NEMA Type 1/IP21 to a NEMA Type 12/IP54 drive. The NEMA Type 12/IP54

kit consists of a metal drive shroud, fan kit for some frames, adaptor plate and plugs.

NEMA Type 12/IP54 Conversion Kit

Frame Size	Delivery Code	Approximate Dimensions in Inches (mm)			Approximate Weight Lb (kg)	Catalog Number
		Length	Width	Height		
FR4	W	13 (330)	7 (178)	4 (102)	4 (1.8)	OPTN12FR4
FR5		16 (406)	8 (203)	7 (178)	5 (2.3)	OPTN12FR5
FR6		21 (533)	10 (254)	5 (127)	7 (3.2)	OPTN12FR6

Flange Kits

Flange Kit NEMA Type 12/IP54

The flange kit is utilized when the power section is mounted through the back panel of an enclosure. Includes flange mount brackets and NEMA Type 12/IP54 fan components. Metal shroud not included.

Flange kits for NEMA Type 12/IP54 enclosure drive rating are determined by rating of drive.

Flange Kit NEMA Type 12/IP54—Frames 4, 5 and 6^①

Frame Size	Delivery Code	Catalog Number
FR4	W	OPTTHRFR4
FR5		OPTTHRFR5
FR6		OPTTHRFR6

Flange Kit NEMA Type 12/IP54—Frames 4–9

Frame Size	Delivery Code	Catalog Number
FR4	FP	OPTTHR4
FR5		OPTTHR5
FR6		OPTTHR6
FR7		OPTTHR7
FR8		OPTTHR8
FR9		OPTTHR9

Note

^① For installation of an SPX9000 NEMA Type 1/IP21 drive into a NEMA Type 12/IP54 oversized enclosure.

Options

9000X Series Option Board Kits

The 9000X Series drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of five option boards.

The 9000X Series factory installed standard board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B.

Option Boards		Option Board Kits		Field Installed	Factory Installed	SVX Ready Programs			MSS	PID	Multi-P.	PFC
Option Kit Description ^①	Allowed Slot Locations ^②	Catalog Number	Option Designator	Basic	Local/Remote	Standard						
Standard I/O Cards												
6 DI, 1 DO, 2 AI, 1AO, 1+10 Vdc ref, 2 ext +24 Vdc/EXT +24 Vdc	A	OPTA9		—	■	■	■	■	■	■	■	
2 RO (NC-NO)	B	OPTA2		—	■	■	■	■	■	■	■	
Extended I/O Cards												
2 RO, therm	B	OPTA3	A3	—	■	■	■	■	■	■	■	
Encoder low volt +5V/15V/24V	C	OPTA4	A4	—	■	■	■	■	■	■	■	
Encoder high volt +15V/24V	C	OPTA5	A5	—	■	■	■	■	■	■	■	
Double encoder—SPX only	C	OPTA7	A7	■	■	■	■	■	■	■	■	
6 DI, 1 DO, 2 AI, 1 AO	A	OPTA8	A8	—	■	■	■	■	■	■	■	
6 DI, 1 DO, 2 AI, 1AO, 1+10 Vdc ref, 2 ext +24 Vdc/EXT +24 Vdc	A	OPTA1		—	■	■	■	■	■	■	■	
3 DI (encoder 10–24V), out +15V/+24V, 2 DO (pulse+direction)—SPX only	C	OPTAE	AE	■	■	■	■	■	■	■	■	
6 DI, 1 DO, 2 AI, 1AO, 1+10 Vdc ref, 2 ext +24 Vdc/EXT +24 Vdc	A	OPTAFA1		—	■	■	■	■	■	■	■	
6 DI, 1 ext +24 Vdc/EXT +24 Vdc	B, C, D , E	OPTB1	B1	—	—	—	—	—	■	■	—	
1 RO (NC-NO), 1 RO (NO), 1 therm	B, C, D , E	OPTB2	B2	—	—	—	—	—	■	■	—	
1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24 Vdc/EXT +24 Vdc	B, C, D , E	OPTB4	B4	—	■	■	■	■	■	■	■	
3 RO (NO)	B, C, D , E	OPTB5	B5	—	—	—	—	—	■	■	—	
1 ext +24 Vdc/EXT +24 Vdc, 3 Pt100	B, C, D , E	OPTB8	B8	—	—	—	—	—	—	—	—	
1 RO (NO), 5 DI 42–240 Vac input	B, C, D , E	OPTB9	B9	—	—	—	—	—	■	■	—	
SPI, absolute encoder	C	OPTBB	BB	—	—	—	—	—	—	—	—	
Communication Cards												
Modbus ^③	D, E	OPTC2	C2	■	■	■	■	■	■	■	■	
Johnson Controls N2 ^③	D, E	OPTC2	CA	—	—	—	—	—	—	—	—	
Modbus TCP	D, E	OPTCI	C1	■	■	■	■	■	■	■	■	
BACnet	D, E	OPTCJ	C4	■	■	■	■	■	■	■	■	
EtherNet/IP	D, E	OPTCQ	CQ	■	■	■	■	■	■	■	■	
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■	■	■	■	
LonWorks	D, E	OPTC4	C4	■	■	■	■	■	■	■	■	
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■	■	■	■	
CANopen (slave)	D, E	OPTC6	C6	■	■	■	■	■	■	■	■	
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■	■	■	■	
Modbus (D9 type connector)	D, E	OPTC8	C8	■	■	■	■	■	■	■	■	
Adapter—SPX only	D, E	OPTD1	D1	■	■	■	■	■	■	■	■	
Adapter—SPX only	D, E	OPTD2	D2	■	■	■	■	■	■	■	■	
RS-232 with D9 connection	D, E	OPTD3	D3	■	■	■	■	■	■	■	■	

Notes

^① AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

^② Option card must be installed in one of the slots listed for that card. Slot indicated in bold is the preferred location.

^③ OPTC2 is a multi-protocol option card.

Modbus RTU Network Communications

The Modbus Network Card OPTC2 is used for connecting the 9000X Drive as a slave on a Modbus network. The interface is connected by a 9-pin DSUB connector (female) and the baud rate ranges from 300 to 19200 baud. Other communication parameters include an address range from 1 to 247; a parity of None, Odd or Even; and the stop bit is 1.

PROFIBUS Network Communications

The PROFIBUS Network Card OPTC3 is used for connecting the 9000X Drive as a slave on a PROFIBUS-DP network. The interface is connected by a 9-pin DSUB connector (female). The baud rates range from 9.6K baud to 12M baud, and the addresses range from 1 to 127.

LonWorks Network Communications

The LonWorks Network Card OPTC4 is used for connecting the 9000X Drive on a LonWorks network. This interface uses Standard Network Variable Types (SNVT) as data types. The channel connection is achieved using a FTT-10A Free Topology transceiver via a single twisted transfer cable. The communication speed with LonWorks is 78 kBits/s.

CANopen (Slave) Communications

The CANopen (Slave) Network Card OPTC6 is used for connecting the 9000X Drive to a host system. According to ISO11898 standard cables to be chosen for CAN bus should have a nominal impedance of 120 ohms, and specific line delay of nominal 5 nS/m. 120 ohms line termination resistors required for installation.

DeviceNet Network Communications

The DeviceNet Network Card OPTC7 is used for connecting the 9000X Drive on a DeviceNet Network. It includes a 5.08 mm pluggable connector. Transfer method is via CAN using a two-wire twisted shielded cable with two-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud.

Johnson Controls Metasys N2 Network Communications

The OPTC2 fieldbus board provides communication between the 9000X Drive and a Johnson Controls Metasys™ N2 network. With this connection, the drive can be controlled, monitored and programmed from the Metasys system. The N2 fieldbus is available as a factory installed option and as a field installable kit.

Modbus/TCP Network Communications

The Modbus/TCP Network Card OPTCI is used for connecting the 9000X Drive to Ethernet networks utilizing Modbus protocol. It includes an RJ-45 pluggable connector. This interface provides a selection of standard and custom register values to communicate drive parameters. The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable over Ethernet using a supplied software tool.

BACnet Network Communications

The BACnet Network Card OPTCJ is used for connecting the 9000X Drive to BACnet networks. It includes a 5.08 mm pluggable connector. Data transfer is Master-Slave/Token Passing (MS/TP) RS-485. This interface uses a collection of 30 Binary Value Objects (BVOs) and 35 Analog Value Objects (AVOs) to communicate drive parameters. The card supports 9.6, 19.2 and 38.4 Kbaud communication speeds and supports network addresses 1–127.

EtherNet/IP Network Communications

The EtherNet/IP Network Card OPTCK is used for connecting the 9000X Drive to Ethernet/Industrial Protocol networks. It includes an RJ-45 pluggable connector. The interface uses CIP objects to communicate drive parameters (CIP is "Common Industrial Protocol", the same protocol used by DeviceNet). The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable by Static, BOOTP and DHCP methods.

Control Panel Options

Factory Options

Description	Factory Installed Option Code	Field Installed NEMA Type 1/IP21 Catalog Number
Local/Remote Keypad SVX9000 Control Panel —This option is standard on all drives and consists of an RS-232 connection, backlit alphanumeric LCD display with nine indicators for the RUN status and two indicators for the control source. The nine pushbuttons on the panel are used for panel programming and monitoring of all SVX9000 parameters. The panel is detachable and isolated from the input line potential. Include LOC/REM key to choose control location.	A	KEYPAD-LOC/REM
Keypad Remote Mounting Kit —This option is used to remote mount the SVX9000 keypad. The footprint is compatible to the SV9000 remote mount kit. Includes 10 ft cable, keypad holder and mounting hardware.	—	OPTRMT-KIT-9000X
Keypad Blank —9000X Series select keypad for use with special and custom applications.	—	KEYPAD-BLANK

Miscellaneous Options

Description	Catalog Number
9000XDrive —A PC-based tool for controlling and monitoring of the SVX9000. Features include: loading parameters that can be saved to a file or printed, setting references, starting and stopping the motor, monitoring signals in graphical or text form, and real-time display. To avoid damage to the drive or computer, SVDrivecable must be used.	9000XDRIVE
SVDrivecable —6 ft (1.8m) RS-232 cable (22 gauge) with a 7-pin connector on each end. Should be used in conjunction with the 9000XDrive option to avoid damage to the SVX9000 or computer. The same cable can be used for downloading specialized applications to the drive.	SVDRIVECABLE
External Dynamic Braking Resistors —Used with the dynamic braking chopper circuit to absorb motor regenerative energy for stopping the load and to dissipate the energy flowing back into the drive. Resistors are separated into standard duty and heavy-duty. Standard duty is defined as 20% duty or less with 100% braking torque, while heavy-duty is defined as 50% duty or less with 150% braking torque.	See Page V6-T2-170

SPX9000 Drive Options**2**

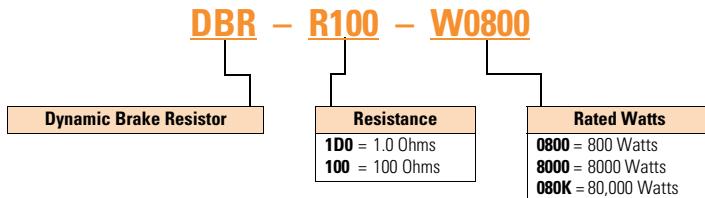
The brake chopper circuit option is used for applications that require dynamic braking. Dynamic braking resistors are not included with drive purchase. Consult the factory for additional dynamic braking resistor selections that are supplied separately. A list of common resistors are listed below and are complete indoor assemblies, include a pre-wired terminal block and a thermal switch, and are not UL Listed.

Duty Cycle

The duty cycle rating is based on a 60-second period. For example, the 20% duty cycle resistor can carry 100% current for 12 seconds out of every 60 seconds, while the 50% duty cycle resistor can carry 150% current for 30 seconds out of every 60 seconds.

Torque

If the braking torque required is less than 15%, dynamic braking is not required because the regenerated energy will be dissipated in the drive and motor losses.

Dynamic Brake Resistor—Catalog Number Selection**230V Brake Resistors**

Drive hp (CT/IH)	Minimum Ohms	20% Duty Cycle, 100% Torque		50% Duty Cycle, 150% Torque	
		Catalog Number	Dimensions (Inches)	Catalog Number	Dimensions (Inches)
0.75	30.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1	30.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1.5	30.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R036-W1200	12W x 10D x 5H
2	30.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R036-W1200	12W x 10D x 5H
3	30.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R036-W2000	12W x 16D x 5H
4	30.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R030-W2400	19W x 10D x 5H
5	30.0	DBR-R036-W0800	12W x 7D x 5H	DBR-R030-W2800	19W x 13D x 5H
7.5	20.0	DBR-R020-W1200	12W x 10D x 5H	DBR-R020-W4800	26.5W x 13D x 5H
10	10.0	DBR-R015-W1600	12W x 13D x 5H	DBR-R112-W6000	26.5W x 13D x 5H
15	10.0	DBR-R012-W2400	19W x 10D x 5H	DBR-R010-W9000	28W x 10D x 10H
20	3.3	DBR-R9D3-W3200	19W x 10D x 5H	DBR-R3D4-W012K	28W x 10D x 10H
25	3.3	DBR-R5D5-W4000	26.5W x 10D x 5H	DBR-R5D1-W015K	28W x 16D x 10H
30	3.3	DBR-R4D8-W4800	26.5W x 10D x 5H	DBR-R4D1-W020K	28W x 16D x 10H
40	1.4	DBR-R004-W6000	26.5W x 13D x 5H	DBR-R3D4-W025K	30W x 18D x 16H
50	1.4	DBR-R3D1-W7500	26.5W x 16D x 5H	DBR-R2D1-W030K	30W x 18D x 24H
60	1.4	DBR-R2D8-W9000	26.5W x 16D x 5H	DBR-R002-W036K	30W x 18D x 24H
75	1.4	DBR-R2D6-W012K	28W x 10D x 10H	DBR-R1D5-W045K	30W x 18D x 32H
100	1.4	DBR-R002-W015K	28W x 16D x 10H	DBR-R1D4-W060K	30W x 18D x 40H

480V Brake Resistors

Drive hp (CT/I _H)	Minimum Ohms	20% Duty Cycle, 100% Torque		50% Duty Cycle, 150% Torque	
		Catalog Number	Dimensions (Inches)	Catalog Number	Dimensions (Inches)
1	63.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W0800	12W x 7D x 5H
1.5	63.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W1200	12W x 10D x 5H
2	63.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W1200	12W x 10D x 5H
3	63.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2000	12W x 16D x 5H
5	63.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2800	19W x 13D x 5H
6	63.0	DBR-R100-W1200	12W x 10D x 5H	DBR-R070-W4000	19W x 16D x 5H
7.5	63.0	DBR-R100-W1200	12W x 10D x 5H	DBR-R063-W4800	26.5W x 13D x 5H
10	63.0	DBR-R063-W1600	12W x 13D x 5H	DBR-R063-W6000	26.5W x 16D x 5H
15	42.0	DBR-R042-W2400	19W x 10D x 5H	DBR-R042-W9000	28W x 10D x 10H
20	21.0	DBR-R030-W3200	19W x 13D x 5H	DBR-R023-W012K	28W x 13D x 10H
25	21.0	DBR-R030-W4000	19W x 16D x 5H	DBR-R021-W015K	28W x 13D x 10H
30	14.0	DBR-R020-W4800	26.5W x 13D x 5H	DBR-R014-W020K	30W x 18D x 24H
40	6.5	DBR-R112-W6000	26.5W x 13D x 5H	DBR-R007-W025K	30W x 18D x 16H
50	6.5	DBR-R013-W7500	26.5W x 16D x 5H	DBR-R8D5-W030K	30W x 18D x 24H
60	6.5	DBR-R010-W9000	28W x 10D x 10H	DBR-R7D3-W036K	30W x 18D x 24H
75	3.3	DBR-R009-W012K	28W x 13D x 10H	DBR-R3D3-W045K	30W x 18D x 32H
100	3.3	DBR-R5D1-W015K	28W x 16D x 10H	DBR-R004-W060K	30W x 18D x 40H
125	3.3	DBR-R4D1-W020K	28W x 16D x 10H	DBR-R004-W070K	30W x 18D x 48H
150	3.3	DBR-R3D4-W025K	30W x 18D x 16H	DBR-R3D5-W085K	30W x 18D x 56H
200	3.3	DBR-R3D3-W030K	30W x 18D x 24H	DBR-R3D3-W110K	30W x 18D x 72H
250	1.4	DBR-R2D5-W036K	30W x 18D x 24H	①	—
300	1.4	DBR-R1D5-W045K	30W x 18D x 32H	①	—
350	1.4	DBR-R1D4-W060K	30W x 18D x 40H	①	—
400	0.9	DBR-R1D4-W060K	30W x 18D x 40H	①	—
500	0.9	DBR-R0D9-W080K	30W x 18D x 48H	①	—
550	0.9	DBR-R001-W085K	30W x 18D x 56H	①	—

Note

① Consult factory.

575V Brake Resistors

Drive hp (CT/I _H)	Minimum Ohms	20% Duty Cycle, 100% Torque		50% Duty Cycle, 150% Torque	
		Catalog Number	Dimensions (Inches)	Catalog Number	Dimensions (Inches)
2	100.0	DBR-R100-W0400	12W x 5D x 5H	DBR-R100-W1200	12W x 10D x 5H
3	100.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2000	12W x 16D x 5H
4	100.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2400	19W x 10D x 5H
5	100.0	DBR-R100-W0800	12W x 7D x 5H	DBR-R100-W2800	19W x 13D x 5H
7.5	100.0	DBR-R100-W1200	12W x 10D x 5H	DBR-R100-W4800	26.5W x 13D x 5H
10	30.0	DBR-R063-W1600	12W x 13D x 5H	DBR-R063-W6000	26.5W x 16D x 5H
15	30.0	DBR-R042-W2400	19W x 10D x 5H	DBR-R042-W9000	28W x 10D x 10H
20	30.0	DBR-R030-W3200	19W x 13D x 5H	DBR-R030-W012K	28W x 13D x 10H
25	30.0	DBR-R030-W4000	19W x 16D x 5H	DBR-R030-W015K	28W x 16D x 10H
30	18.0	DBR-R020-W4800	26.5W x 13D x 5H	DBR-R020-W020K	30W x 18D x 16H
40	18.0	DBR-R030-W6000	26.5W x 16D x 5H	DBR-R184-W025K	30W x 18D x 16H
50	9.0	DBR-R013-W7500	26.5W x 16D x 5H	DBR-R012-W030K	30W x 18D x 24H
60	9.0	DBR-R010-W9000	28W x 10D x 10H	DBR-R010-W036K	30W x 18D x 24H
75	9.0	DBR-R009-W012K	28W x 13D x 10H	DBR-R009-W045K	30W x 18D x 24H
100	7.0	DBR-R013-W015K	28W x 16D x 10H	DBR-R8D4-W060K	30W x 18D x 40H
125	7.0	DBR-R8D2-W020K	30W x 18D x 10H	DBR-R007-W070K	30W x 18D x 40H
150	7.0	DBR-R007-W025K	30W x 18D x 16H	DBR-R006-W085K	30W x 18D x 56H
175	7.0	DBR-R007-W030K	30W x 18D x 24H	DBR-R007-W100K	30W x 18D x 72H
200	2.5	DBR-R3D3-W030K	30W x 18D x 24H	DBR-R2D6-W110K	30W x 18D x 64H
250	2.5	DBR-R2D5-W036K	30W x 18D x 24H	DBR-R003-W140K	30W x 18D x 72H
300	2.5	DBR-R3D3-W045K	30W x 18D x 32H	①	—
400	1.7	DBR-R002-W060K	30W x 18D x 48H	①	—
450	1.7	DBR-R1D8-W070K	30W x 18D x 48H	①	—
500	1.7	DBR-R002-W080K	30W x 18D x 56H	①	—

Note

① Consult factory.

Control/Communication Options**Available Control/Communications Options**

Option	Description	Option Type
K2	Door-Mounted Speed Potentiometer with HOA Selector Switch —Provides the SPX9000 with the ability to start/stop and adjust the speed reference from door-mounted control devices or remotely from customer supplied inputs. In HAND position, the drive will start and the speed is controlled by the door-mounted speed potentiometer. The drive will be disabled in the OFF position. When AUTO is selected, the drive run and speed control commands are via user-supplied dry contact and 4–20 mA signal.	Control
K4	HAND/OFF/AUTO Switch for Non-Bypass Configurations —Provides a three-position selector switch that allows the user to select either a HAND or AUTO mode of operation. HAND mode is defaulted to keypad operation, and AUTO mode is defaulted to control from an external terminal source. These modes of operation can be configured via programming to allow for alternate combinations of start and speed sources. Start and speed sources include keypad, I/O and fieldbus.	Control
KB	115V Control Transformer, 550 VA —Provides a fused control power transformer with additional 550 VA at 115V for customer use.	Control
L1	Power On and Fault Pilot Lights —Provide a white power on light that indicates power to the enclosed cabinet and a red fault light that indicates a drive fault has occurred.	Light
P2	Disconnect Switch —Disconnect switch option is applicable only with NEMA Type 1/IP21 and NEMA Type 12/IP54 Freestanding drives. Allows a convenient means of disconnecting the SPX9000 from the line, and the operating mechanism can be padlocked in the OFF position. This is factory-mounted in the enclosure.	Input

SPX Freestanding Options**480V and 690V Control Options, 200–550 hp ①**

Description	Catalog Number Suffix
Door-mounted speed potentiometer with HOA selector switch	K2
HAND/OFF/AUTO switch (22 mm)	K4
115 volt control transformer 550 VA	KB

480V and 690V Light Options, 200–550 hp ①

Description	Catalog Number Suffix
Power on/fault pilot lights	L1

Input Options, 200–550 hp ①

Description	Catalog Number Suffix
Disconnect switch	P2 ②

Notes

① Consult factory for adder information.

② Applicable with FR10 and FR11 freestanding designs only.

Replacement Parts

2

FR4 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	PP01086	PP01086	—
Control module ②	SPX control module	1	CPBS0000000000	CPBS0000000000	—
	Standard slot A I/O card	1	OPTA9	OPTA9	—
	Standard slot B I/O card	1	OPTA2	OPTA2	—
Converter	Power board ③	1	VB00308-0004-2	VB00208-0003-5	—
		1	VB00308-0007-2	VB00208-0004-5	—
		1	VB00308-0008-2	VB00208-0005-5	—
		1	—	VB00208-0007-5	—
		1	—	VB00208-0009-5	—
		1	—	VB00410-0012-5-ARV	—
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	—
Main fan ②	DC fan (main)	1	PP01060	PP01060	—
Other	Mounting kit, fixing kit	1	FR00040	FR00040	—
	Mounting kit, fixing kit, N12 ①	1	FR00079	FR00079	—
	Control cover, plastic, N1	1	FR00006	FR00006	—

FR5 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	PP01088	PP01088	—
Control module ②	SPX control module	1	CPBS0000000000	CPBS0000000000	—
	Standard slot A I/O card	1	OPTA9	OPTA9	—
	Standard slot B I/O card	1	OPTA2	OPTA2	—
Converter	Power board ③	1	VB00313-0017-2	VB00213-0016-5	—
		1	VB00313-0025-2	VB00213-0022-5	—
		1	VB00313-0031-2	VB00213-0031-5	—
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	—
Main fan ②	DC fan (main)	1	PP01061	PP01061	—
Other	Mounting kit, fixing kit	1	FR00050	FR00050	—
	Mounting kit, fixing kit, N12 ①	1	FR00081	FR00081	—
	Control cover, plastic, N1	1	FR05011	FR05011	—

Notes

- ① Only for NEMA Type 12/IP54 Type drives.
- ② Factory recommended spare parts.
- ③ Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR6 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	PP01049	PP01049	—
Control module ②	SPX control module	1	CPBS0000000000	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	OPTA9	OPTA9	OPTA9
	Standard slot B I/O card	1	OPTA2	OPTA2	OPTA2
Converter	Power board ③	1	VB00316-0048-2	VB00416-0038-5	VB00404-0004-6
		1	VB00316-0061-2	VB00416-0045-5	VB00404-0005-6
		1	—	VB00416-0061-5	VB00404-0007-6
		1	—	—	VB00404-0010-6
		1	—	—	VB00404-0013-6
		1	—	—	VB00404-0018-6
		1	—	—	VB00404-0022-6
		1	—	—	VB00404-0027-6
		1	—	—	VB00404-0034-6
DC section	Bus capacitor	2	—	—	S00930
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main fan ②	DC fan (main)	1	PP01062	PP01062	—
Other	Mounting kit, fixing kit	1	FR00060	FR00060	FR00060
	Mounting kit, fixing kit, N12 ①	1	FR00082	FR00082	FR00082
	Control cover, plastic, N1	1	FR06011	FR06011	FR06011

FR7 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	PP01049	PP01049	PP01049
Control module ②	SPX control module	1	CPBS0000000000	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	OPTA9	OPTA9	OPTA9
	Standard slot B I/O card	1	OPTA2	OPTA2	OPTA2
Converter	Power board ③	1	VB00319-0075-2	VB00619-0072-5	VB00419-0041-6
		1	VB00319-0088-2	VB00619-0087-5	VB00419-0052-6
		1	VB00319-0114-2	VB00619-0105-5	—
DC section	Bus capacitor	2	—	—	PP01041
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main fan ②	DC fan (main)	1	PP01063	PP01063	PP01063
Other	Mounting kit, fixing kit	1	FR07071	FR07071	FR07071
	Mounting kit, fixing kit, N12 ①	1	FR07072	FR07072	FR07072
	Control cover, plastic, N1	1	FR07011	FR07011	FR07011

Notes

- ① Only for NEMA Type 12/IP54 Type drives.
 ② Factory recommended spare parts.
 ③ Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR8 Spare Parts

2

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	NEMA Type 12 control fan ①	1	CP01180	CP01180	CP01180
Control module ②	SPX control module	1	CPBS0000000000	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	OPTA9	OPTA9	OPTA9
	Standard slot B I/O card	1	OPTA2	OPTA2	OPTA2
Converter	Power board ③	1	VB00722-0140-2-ANV	VB00636-0140-4-ANV	VB00422-0062-5-ANV
		1	VB00722-0170-2-ANV	VB00636-0168-4-ANV	VB00422-0080-5-ANV
		1	VB00722-0205-2-ANV	VB00636-0205-4-ANV	VB00422-0100-5-ANV
	IGBT	2	PP01175	PP01175	PP01127
DC section	Bus capacitor	4	S00335	S00335	PP01041
Inverter	Diode	3	CP01268	CP01268	CP01373
	Rectifier board	1	VB00227	VB00227	VB00427
Keypad ②	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan AC	1	PP01123	PP01123	PP01123
	Fan fuse	2	PP20202	PP20202	PP20202
	Starting cap	1	S00734	S00734	S00734
	Fan driver board AC	1	VB00599	VB00799	VB00799
	Isolation transformer (fan)	1	S0000113	S0000113	S0000113
Main DC fan ②	DC fan	1	PP00071	PP00071	PP00071
	DC power supply	1	S01016	S01016	S01016
Other	Front cover, N12 ①	1	FR08079	FR08079	FR08079
	Conduit plate, N12	1	FR08082	FR08082	FR08082
	Front cover, N1	1	FR08106	FR08106	FR08106

Notes

① Only for NEMA Type 12/IP54 Type drives.

② Factory recommended spare parts.

③ Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR9 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control fan	50 mm fan	1	PP09041	PP09041	PP09041
	80 mm fan	1	PP01068	PP01068	PP01068
Control module ①	SPX control module	1	CPBS0000000000	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	OPTA9	OPTA9	OPTA9
	Standard slot B I/O card	1	OPTA2	OPTA2	OPTA2
Converter	Power module ②	1	FR09-0261-2-ANV	FR09-0261-4-ANV	FR09-0125-5-ANV
		1	FR09-0300-2-ANV	FR09-0300-4-ANV	FR09-0144-5-ANV
		1	—	—	FR09-0170-5-ANV
	Driver board	1	S00583	S00583	S00583
Shunt board ②	Shunt board ②	6	—	VB00535	VB00537
		6	—	VB00536	VB00542
		6	—	—	VB00543
DC section	Balancing resistor	3	PP00052	PP00052	PP00052
	Bus capacitor	8	S00335	S00335	PP01041
	DC busbars DC-	1	FR09043	FR09043	FR09043
	DC busbars DC+	1	FR09044	FR09044	FR09044
	DC busbars connection	1	FR09045	FR09045	FR09045
	DC busbars +/– insulator	1	FR09046	FR09046	FR09046
	DC busbars –/con insulator	1	FR09047	FR09047	FR09047
Inverter	Rectifier module	1	FR09826	FR09822	FR09823
	Diode	3	CP01268	CP01268	CP01268
	Rectifier board	1	—	VB00459	VB00460
Keypad ①	SVX/SPX keypad	1	KEYPAD-LOC/REM	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan AC	1	PP01080	PP01080	PP01080
	Fan fuse	2	PP20202	PP20202	PP20202
	Starting cap	1	S00465	S00465	S00465
	Fan driver board AC	1	VB00899	VB00399	VB00299
	Isolation transformer (fan)	1	PP09056	PP09055	PP09055
Main DC fan ①	DC fan	1	PP00072	PP00072	PP00072
	DC power supply	1	S01017	S01017	S01017
Other	Front cover power	1	FR09012	FR09012	FR09012
	Front cover connection	1	FR09013	FR09013	FR09013
	Front power conduit	1	FR09014	FR09014	FR09014

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR10 Spare Parts

2

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	Fiber board	1	—	S00451	S00451
	ASIC board	1	—	S00457	S00457
Control fan	ASIC fan	1	—	PP01096	PP01096
Control module ①	SPX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	1	—	FR10-0385-4-ANV	FR10-0261-5-ANV
		1	—	FR10-0460-4-ANV	FR10-0325-5-ANV
		1	—	FR10-0520-4-ANV	FR10-0385-5-ANV
		1	—	—	FR10-0416-5-ANV
	Driver board	1	—	S00450	S00450
	Driver adapter board	1	—	VB00330	VB00330
Shunt board ②	Shunt board ②	6	—	VB00497	VB00510
		6	—	VB00498	VB00511
		6	—	VB00537	VB00545
Covers	Top cover	1	—	FR10340	FR10340
	Side cover	2	—	FR10341	FR10341
DC section	Balancing resistor	2	—	PP13027	PP13028
	DC busbars kit (right)	1	—	S0000005	S0000005
	Bus capacitor	12	—	S00335	S00336
Inverter	Rectifier module	1	—	FR10823	FR10823
	Charging resistor	1	—	PP00066	PP00066
	Diode	3	—	PP01177	PP01177
	Rectifier board	1	—	S00591	S00592
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (left)	1	—	FR10846	FR10846
	Fan assembly (right)	1	—	FR10847	FR10847
	Fan AC	2	—	PP01080	PP01080
	Fan fuse	4	—	PP20202	PP20202
	Starting cap	2	—	S00528	S00528
	Fan driver board AC	2	—	VB00299	VB00299
	Isolation transformer (left)	1	—	FR10844	FR10844
	Isolation transformer (right)	1	—	FR10845	FR10845
Main DC fan ①	DC fan	2	—	PP00072	PP00072
	DC power supply	2	—	S01017	S01017

Notes

- ① Factory recommended spare parts.
 ② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR11 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	Fiber board	1	—	S00451	S00451
	ASIC board	1	—	S00457	S00457
Control fan	ASIC fan	1	—	PP01096	PP01096
Control module ①	SPX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	1	—	FR11-0590-4-ANV	FR11-0460-5-ANV
		1	—	FR11-0650-4-ANV	FR11-0502-5-ANV
		1	—	FR11-0730-4-ANV	FR11-0590-5-ANV
	Driver board	1	—	S00452	S00452
	Driver adapter board	1	—	VB00330	VB00330
	Shunt board ②	9	—	VB00513	VB00512
		9	—	VB00514	VB00546
		9	—	VB00538	VB00547
Covers	Top cover	1	—	FR11345	FR11345
DC section	Balancing resistor	3	—	PP13027	PP13027
	DC busbars kit (right)	3	—	S000005	S000005
	Bus capacitor	18	—	S00335	S00335
Inverter	Rectifier module	1	—	FR10823	FR10823
	Diode	3	—	PP01177	PP01177
	Rectifier board	1	—	S00591	S00591
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (right)	3	—	FR10847	FR10847
	Fan AC	3	—	PP01080	PP01080
	Fan fuse	4	—	PP20202	PP20202
	Starting cap	3	—	S00530	S00530
	Fan driver board AC	3	—	VB00299	VB00299
	Isolation transformer (right)	3	—	FR10845	FR10845
Main DC fan ①	DC fan	2	—	PP00072	PP00072
	DC power supply	2	—	S01017	S01017

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR12 Spare Parts

2

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	Fiber board	2	—	S00451	S00451
	ASIC board	2	—	S00457	S00457
	Star coupler	1	—	S00593	S00593
Control fan	ASIC fan	2	—	PP01096	PP01096
Control module ①	SPX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	1	—	FR12-0820-4-ANV	FR12-0650-5-ANV
		1	—	FR12-0920-4-ANV	FR12-0750-5-ANV
		1	—	FR12-1030-4-ANV	FR12-0820-5-ANV
	Driver board	2	—	S00450	S00450
	Driver adapter board	2	—	VB00330	VB00330
	Shunt board	12	—	VB00498	VB00511
Covers	Top cover	2	—	FR10340	FR10340
	Side cover	4	—	FR10341	FR10341
DC section	Balancing resistor	4	—	PP13027	PP13027
	DC busbars kit (right)	2	—	S0000005	S0000005
	Bus capacitor	24	—	S00335	S00336
Inverter	Rectifier module	2	—	FR10823	FR10823
	Diode	3	—	PP01177	PP01177
	Rectifier board	2	—	S00591	S00591
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (left)	2	—	FR10846	FR10846
	Fan assembly (right)	2	—	FR10847	FR10847
	Fan AC	4	—	PP01080	PP01080
	Fan fuse	8	—	PP20202	PP20202
	Starting cap	4	—	S00528	S00528
	Fan driver board AC	4	—	VB00299	VB00299
	Isolation transformer (left)	2	—	FR10844	FR10844
Main DC fan ①	Isolation transformer (right)	2	—	FR10845	FR10845
	DC fan	4	—	PP00072	PP00072
	DC power supply	4	—	S01017	S01017

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR13 Spare Parts

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	ASIC board	1	—	S00457	S00457
	ASIC assembly	1	—	60S01030	60S01030
Control fan	ASIC fan	1	—	PP01096	PP01096
Control module ①	SPX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	3	—	FI13-1150-4-ANV	FR13-1030-5-ANV
		3	—	FI13-1300-4-ANV	FR13-1180-5-ANV
		3	—	FI13-1450-4-ANV	FR13-920-5-ANV
	Driver board	3	—	S00454	S00454
	Driver adapter board	2	—	VB00330	VB00330
	Shunt board ②	18	—	VB00505	VB00516
		18	—	VB00514	VB00517
		18	—	VB00541	VB00547
Covers	Top cover	3	—	FI10001	FI10001
	Side cover	3	—	FI10003	FI10003
DC section	Balancing resistor	6	—	PP13034	PP13034
	Bus capacitor	36	—	S00335	S00336
	DC busbars kit	3	—	FI13329	FI13329
Inverter	Rectifier module	2	—	FR10823	FR10823
	Diode	3	—	PP01177	PP01177
	Rectifier board	2	—	S00591	S00591
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (left)	3	—	FI13301	FI13301
	Fan AC	3	—	PP01080	PP01080
	Fan fuse	6	—	PP20202	PP20202
	Starting cap	3	—	S00520	S00520
	Fan driver board AC	3	—	VB00299	VB00299
	Isolation transformer	3	—	PP10057	PP10057
Main DC fan ①	DC fan	4	—	PP00072	PP00072
	DC power supply	4	—	S01017	S01017

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

FR14 Spare Parts

2

Category	Description	Quantity/ Drive	230V Catalog Number	480V Catalog Number	575V Catalog Number
Control	ASIC board	2	—	S00457	S00457
	Star coupler	1	—	S00593	S00593
	ASIC assembly	2	—	60S01030	60S01030
	Star coupler kit	1	—	FR10860	FR10860
Control fan	ASIC fan	2	—	PP01096	PP01096
Control module ①	SPX control module	1	—	CPBS0000000000	CPBS0000000000
	Standard slot A I/O card	1	—	OPTA9	OPTA9
	Standard slot B I/O card	1	—	OPTA2	OPTA2
Converter	Power module ②	1	—	FR14-1770-4-ANV	FR14-1500-5-ANV
		1	—	FR14-2150-4-ANV	FR14-1900-5-ANV
		1	—	FR14-2700-4-ANV	FR14-2250-5-ANV
	Driver board	6	—	S00454	S00454
	Driver adapter board	2	—	VB00330	VB00330
	Shunt board ②	36	—	VB00541	VB00516
		36	—		VB00517
Covers	Top cover	6	—	FI10001	FI10001
	Side cover	6	—	FI10003	FI10003
DC section	Balancing resistor	6	—	PP13034	PP13034
	Bus capacitor	72	—	S00335	S00336
	DC busbars kit	6	—	FI13329	FI13329
Inverter	Rectifier module	2	—	FR10823	FR10823
	Diode	3	—	PP01177	PP01177
	Rectifier board	2	—	S00591	S00591
Keypad ①	SVX/SPX keypad	1	—	KEYPAD-LOC/REM	KEYPAD-LOC/REM
Main AC fan	Fan assembly (left)	6	—	FI13301	FI13301
	Fan AC	6	—	PP01080	PP01080
	Fan fuse	12	—	PP20202	PP20202
	Starting cap	6	—	S00520	S00520
	Fan driver board AC	6	—	VB00299	VB00299
	Isolation transformer	6	—	PP10057	PP10057
Main DC fan ①	DC fan	6	—	PP00072	PP00072
	DC power supply	6	—	S01017	S01017

Notes

① Factory recommended spare parts.

② Select one part number based on the amperage rating of the drive. Please contact EatonCare at 877-ETN-CARE for assistance.

Technical Data and Specifications

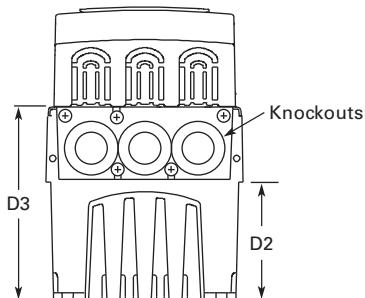
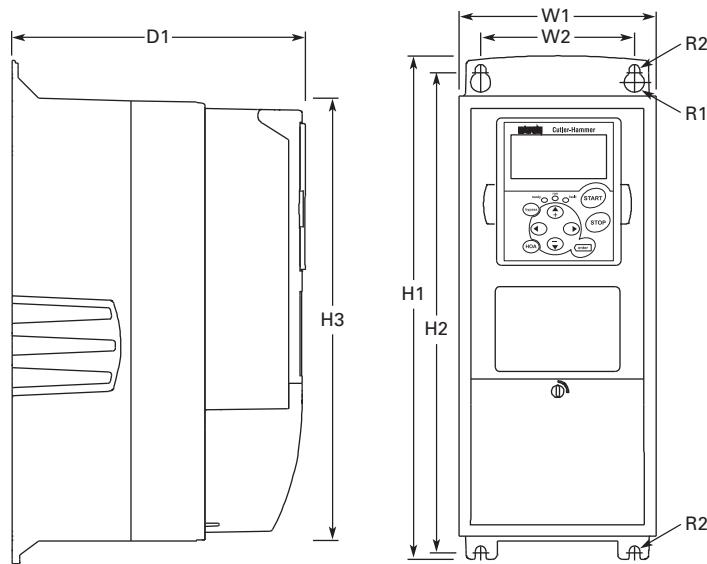
SPX9000 Drives

Description	Specification	Description	Specification		
Input Ratings					
Input voltage (V_{in})	+10%/-15%	Analog input voltage	0 to 10V, $R = 200$ kohms (-10 to 10V joystick control) resolution 0.1%; accuracy ±1%		
Input frequency (f_{in})	50/60 Hz (variation up to 45–66 Hz)	Analog input current	0(4) to 20 mA; $R_L = 250$ ohms differential		
Connection to power	Once per minute or less (typical operation)	Digital inputs (6)	Positive or negative logic; 18 to 30 Vdc		
High withstand rating	100 kAIC	Auxiliary voltage	+24V ±15%, max. 250 mA		
Output Ratings					
Output voltage	0 to V_{in}	Output reference voltage	+10V +3%, max. load 10 mA		
Continuous output current	I_H rated 100% at 122°F (50°C), FR9 and below I_L rated 100% at 104°F (40°C), FR9 and below I_H/I_L 100% at 104°F (40°C), FR10 and above	Analog output	0(4) to 20 mA; R_L max. 500 ohms; resolution 10 bit; Accuracy ±2%		
Overload current (I_H/I_L)	150% I_H , 110% I_L for 1 min.	Digital outputs	Open collector output, 50 mA/48V		
Output frequency	0 to 320 Hz	Relay outputs	2 programmable Form C relay outputs switching capacity: 24 Vdc/8A, 250 Vac/8A, 125 Vdc/0.4A		
Frequency resolution	0.01 Hz				
Initial output current (I_H)	250% for 2 seconds				
Control Characteristics					
Control method	Frequency control (V/f) Open loop: sensorless vector control Closed loop: frequency control Closed loop: vector control	Overcurrent protection	Trip limit $4.0 \times I_H$ instantaneously		
Switching frequency	Adjustable with parameter 2.6.9	Oversupply protection	Yes		
Frame 4–6	1 to 16 kHz; default 10 kHz	Undervoltage protection	Yes		
Frame 7–12	1 to 10 kHz; default 3.6 kHz	Earth fault protection	In case of earth fault in motor or motor cable, only the frequency converter is protected		
Frequency reference	Analog input: Resolution 0.1% (10-bit), accuracy ±1% V/Hz Panel reference: Resolution 0.01 Hz	Input phase supervision	Trips if any of the input phases are missing		
Field weakening point	30 to 320 Hz	Motor phase supervision	Trips if any of the output phases are missing		
Acceleration time	0 to 3000 sec.	Overtemperature protection	Yes		
Deceleration time	0 to 3000 sec.	Motor overload protection	Yes		
Braking torque	DC brake: 30% $\times T_n$ (without brake option)	Motor stall protection	Yes		
Ambient Conditions					
Ambient operating temperature	14°F (-10°C), no frost to 122°F (50°C) I_H (FR4–FR9) 14°F (-10°C), no frost to 104°F (40°C) I_L (FR10 and up) 14°F (-10°C), no frost to 104°F (40°C) I_L (all frames)	Motor underload protection	Yes		
Storage temperature	-40° to 158°F (-40° to 70°C)	Short-circuit protection	Yes (+24V and +10V reference voltages)		
Relative humidity	0 to 95% RH, noncondensing, non-corrosive, no dripping water				
Air quality	Chemical vapors: IEC 721-3-3, unit in operation, class 3C2; Mechanical particles: IEC 721-3-3, unit in operation, class 3S2				
Altitude	100% load capacity (no derating) up to 3280 ft (1000m); 1% derating for each 328 ft (100m) above 3280 ft (1000m); max. 9842 ft (3000m)				
Vibration	EN 50178, EN 60068-2-6; 5 to 50 Hz, displacement amplitude 1 mm (peak) at 3 to 15.8 Hz, max. acceleration amplitude 1G at 15.8 to 150 Hz				
Shock	EN 50178, EN 60068-2-27 UPS Drop test (for applicable UPS weights) Storage and shipping: max. 15G, 11 ms (in package)				
Enclosure class	NEMA 1/IP21 or NEMA 12/IP54, open chassis/IP20				
Control Connections					
Protections					
Speed error	<0.01%, depending on the encoder	High Performance Features			
Encoder support	Incremental or absolute	Speed error	<0.01%, depending on the encoder		
Encoder voltages	5V (RS-422), 15V or 24V, depending on the option card	Encoder support	Incremental or absolute		
Torque control	Full torque control at all speeds, including zero	Encoder voltages	5V (RS-422), 15V or 24V, depending on the option card		
Torque accuracy	<2%; <5% down to zero speed	Torque control	Full torque control at all speeds, including zero		
Starting torque	>200%, depending on motor and drive sizing	Torque accuracy	<2%; <5% down to zero speed		
Master/slave configurations	Full capability	Starting torque	>200%, depending on motor and drive sizing		
System analysis	Integrated data logger	Master/slave configurations	Full capability		
PC communication	Fast multiple drive monitoring with PC	System analysis	Integrated data logger		
Inter-drive communication	High-speed bus (12 Mbits/s)	PC communication	Fast multiple drive monitoring with PC		
High-speed applications	Up to 7200 Hz	Inter-drive communication	High-speed bus (12 Mbits/s)		

Dimensions

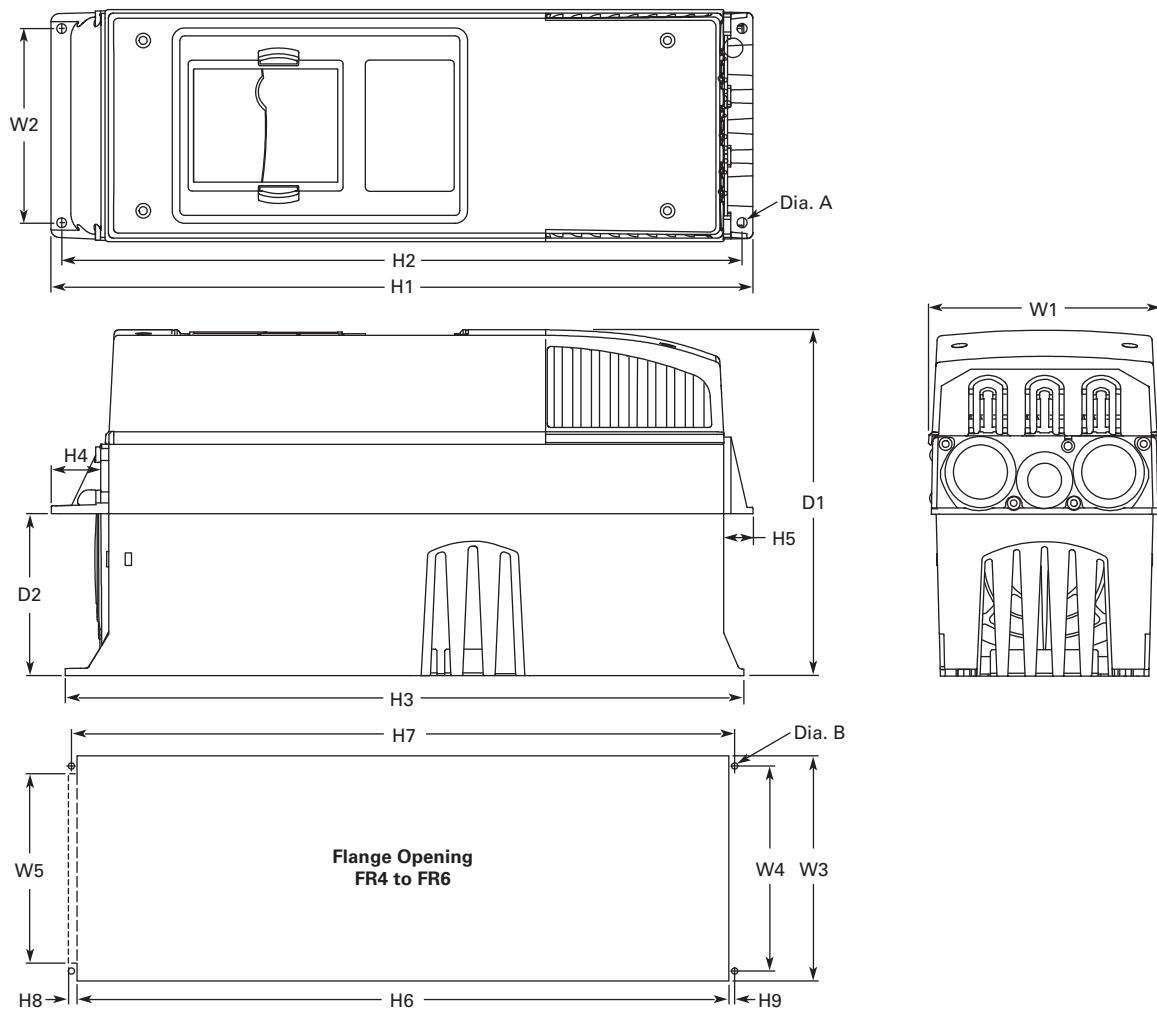
Approximate Dimensions in Inches (mm)

2

9000X Drives**NEMA Type 1/IP21 and NEMA Type 12/IP54, FR4, FR5 and FR6**

Voltage	hp (l _H)	H1	H2	H3	D1	D2	D3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)	Knockouts at Inches (mm) N1 (O.D.)
FR4													
230V	3/4-3	12.9 (327)	12.3 (313)	11.5 (292)	7.5 (190)	3.0 (77)	5.0 (126)	5.04 (128)	3.9 (100)	0.5 (13)	0.3 (7)	11.0 (5)	3 at 10.1 (28)
480V	1-5												
FR5													
230V	5-7-1/2	16.5 (419)	16.0 (406)	15.3 (389)	8.4 (214)	3.9 (100)	5.8 (148)	5.7 (144)	3.9 (100)	0.5 (13)	0.3 (7)	17.9 (8)	2 at 1.5 (37) 1 at 10.1 (28)
480V	7-1/2-15												
FR6													
230V	10-15	22.0 (558)	21.3 (541)	20.4 (519)	9.3 (237)	4.2 (105)	6.5 (165)	7.7 (195)	5.8 (148)	0.6 (15.5)	0.4 (9)	40.8 (19)	3 at 1.5 (37)
480V	20-30												
575V	2-25												

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54 with Flange Kit, FR4, FR5 and FR6**FR4, FR5 and FR6 with Flange Kit**

W1	W2	H1	H2	H3	H4	H5	D1	D2	Dia. A
FR4									
5.0 (128)	4.5 (113)	13.3 (337)	12.8 (325)	12.9 (327)	1.2 (30)	0.9 (22)	7.5 (190)	3.0 (77)	0.3 (7)
FR5									
5.6 (143)	4.7 (120)	17.0 (434)	16.5 (420)	16.5 (419)	1.4 (36)	0.7 (18)	8.4 (214)	3.9 (100)	0.3 (7)
FR6									
7.7 (195)	6.7 (170)	22.0 (560)	21.6 (549)	22.0 (558)	1.2 (30)	0.8 (20)	9.3 (237)	4.2 (106)	0.3 (7)

Flange Opening, FR4 to FR6

W3	W4	W5	H6	H7	H8	H9	Dia. B
FR4							
4.8 (123)	4.5 (113)	—	12.4 (315)	12.8 (325)	—	0.2 (5)	0.3 (7)
FR5							
5.3 (135)	4.7 (120)	—	16.2 (410)	16.5 (420)	—	0.2 (5)	0.3 (7)
FR6							
7.3 (185)	6.7 (170)	6.2 (157)	21.2 (539)	21.6 (549)	0.3 (7)	0.2 (5)	0.3 (7)

2.7

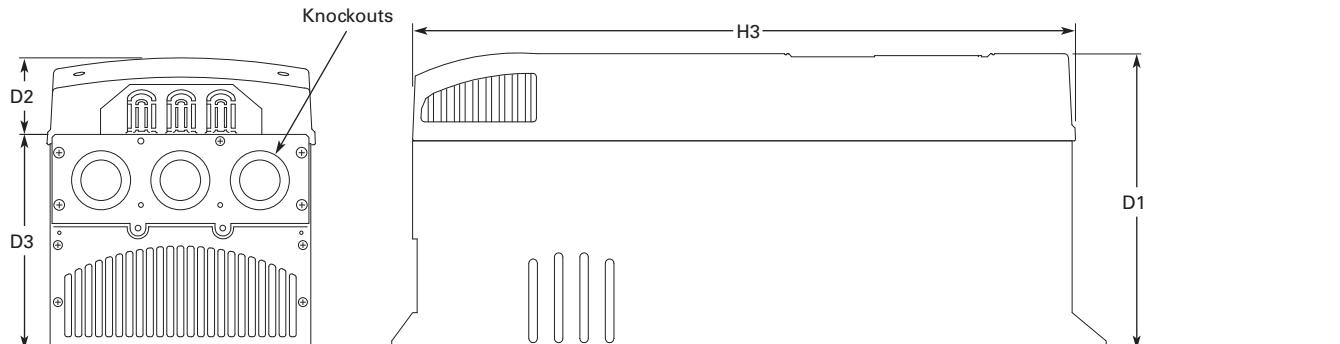
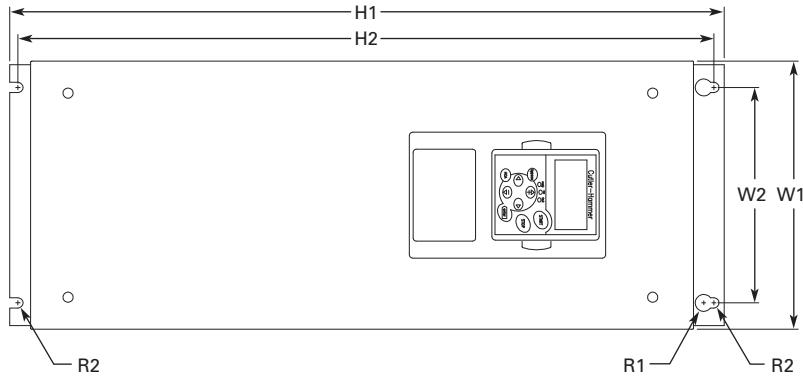
Adjustable Frequency Drives

SPX9000 Drives

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, FR7

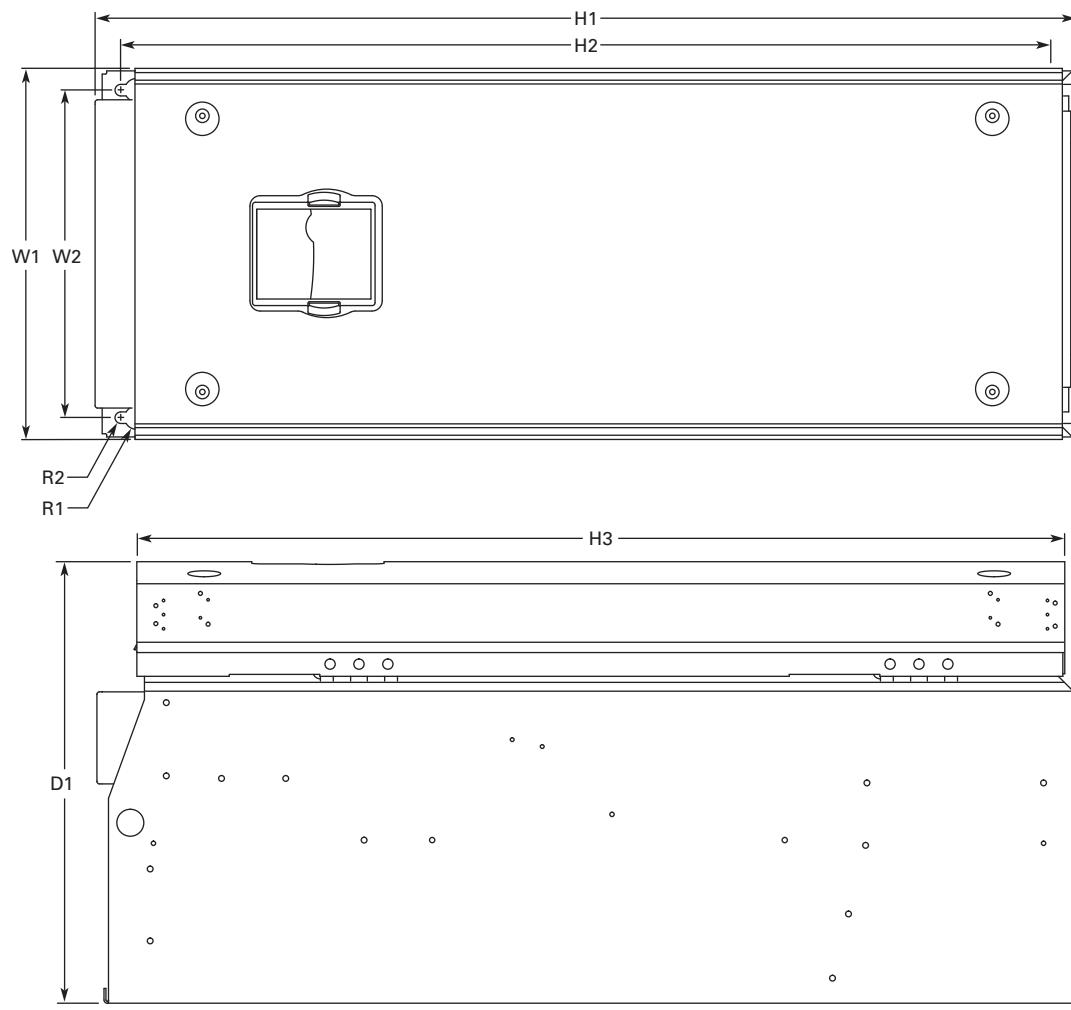
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Voltage	hp (l _H)	H1	H2	H3	D1	D2	D3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)	Knockouts at Inches (mm) N1 (O.D.)
230V	20-30	24.8 (630)	24.2 (614)	23.2 (590)	10.1 (257)	3.0 (77)	7.3 (184)	9.3 (237)	7.5 (190)	0.7 (18)	0.4 (9)	77.2 (35)	3 at 1.5 (37)
480V	40-60												
575V	30-40												

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, FR8

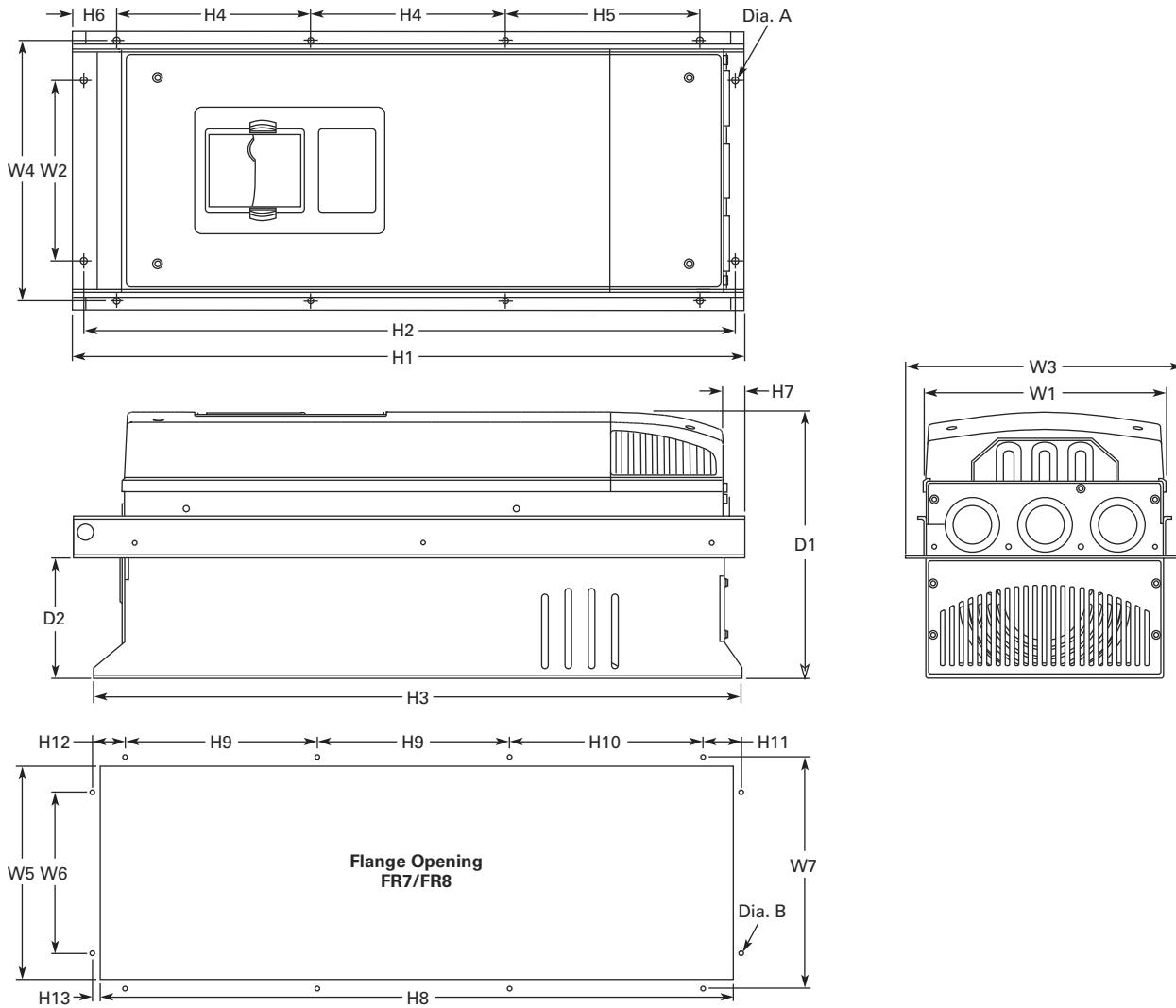


Voltage	hp (kW)	D1	H1	H2	H3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)
230V	40–60	13.5 (344)	300.1 (764)	28.8 (732)	28.4 (721)	11.5 (291)	10 (255)	0.7 (18)	0.4 (9)	127 (58)
480V	75–125									
575V	50–75									

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, with Flange Kit, FR7 and FR8

2



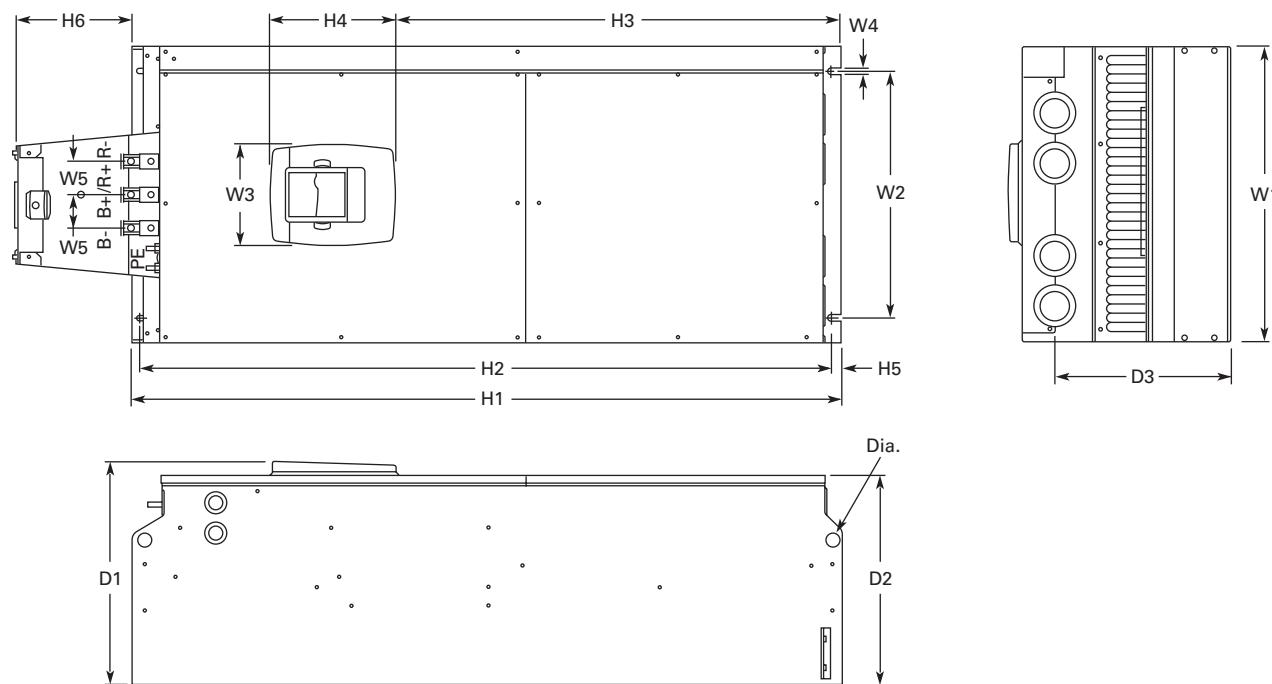
W1	W2	W3	W4	H1	H2	H3	H4	H5	H6	H7	D1	D2	Dia. A
FR7													
9.3 (237)	6.8 (175)	10.6 (270)	10.0 (253)	25.6 (652)	24.9 (632)	24.8 (630)	7.4 (189)	7.4 (189)	0.9 (23)	0.8 (20)	10.1 (257)	4.6 (117)	0.3 (6)
FR8													
11.2 (285)	—	14.0 (355)	13.0 (330)	32.8 (832)	—	29.3 (745)	10.2 (258)	10.4 (265)	1.7 (43)	2.2 (57)	13.5 (344)	4.3 (110)	0.4 (9)

Flange Opening, FR7 and FR8

W5	W6	W7	H8	H9	H10	H11	H12	H13	Dia. B
FR7									
9.2 (233)	6.9 (175)	10.0 (253)	24.4 (619)	7.4 (189)	7.4 (189)	1.4 (35)	1.3 (32)	1.0 (25)	0.3 (6)
FR8									
11.9 (301)	—	13.0 (330)	31.9 (810)	10.2 (258)	10.4 (265)	—	—	1.3 (33)	0.4 (9)

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, FR9



Voltage	hp (I_H)	W1	W2	W3	W4	H1	H2	H3	H4 ①	D1	D2	D3	Dia.	Weight Lbs (kg)
230V	75–100	18.9	15.7	0.4	2.1	45.3	44.1	0.6	7.4	14.2	13.4	11.2	0.8	321.9 (146)
		(480)	(400)	(9)	(54)	(1150)	(1120)	(16)	(188)	(361.5)	(340)	(285)	(21)	
480V	150–200													
575V	100–175													

Note

① Brake resistor terminal box (H6) included when brake chopper ordered.

2.7

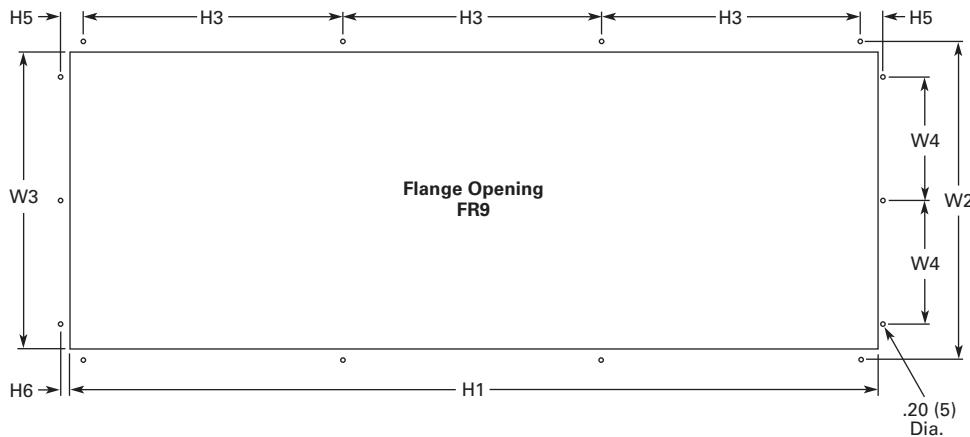
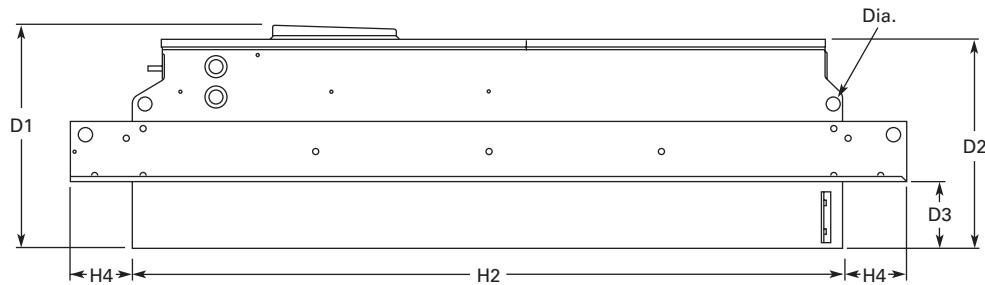
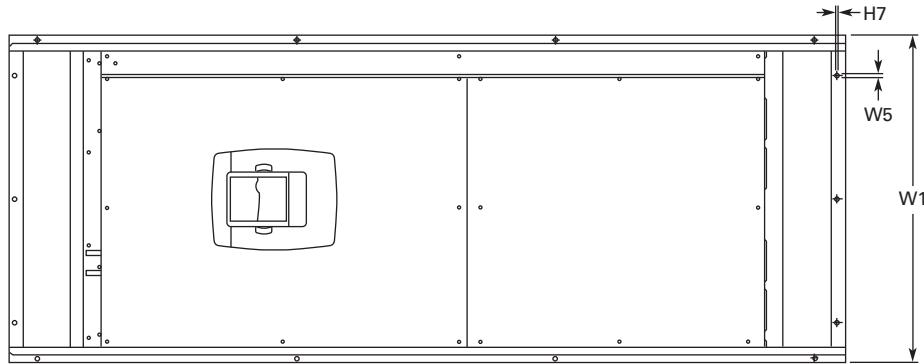
Adjustable Frequency Drives

SPX9000 Drives

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, FR9 with Flange Kit

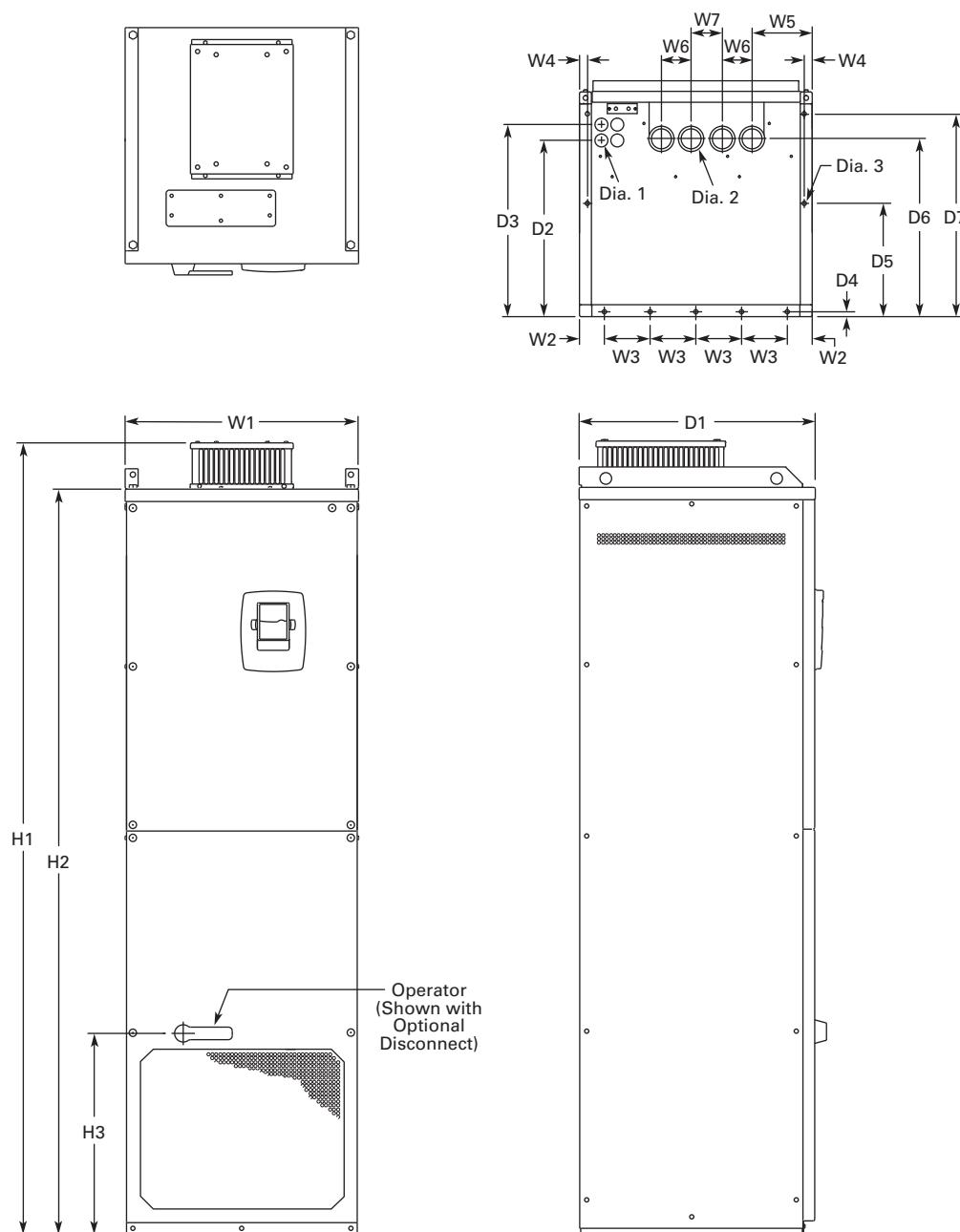
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W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	H6	H7	D1	D2	D3	Dia.
20.9 (530)	20.0 (510)	19.1 (485)	7.9 (200)	0.2 (5.5)	51.7 (1312)	45.3 (1150)	16.5 (420)	3.9 (100)	1.4 (35)	0.4 (9)	0.1 (2)	24.9 (362)	13.4 (340)	4.3 (109)	0.8 (21)

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21 and NEMA Type 12/IP54, FR10 Freestanding

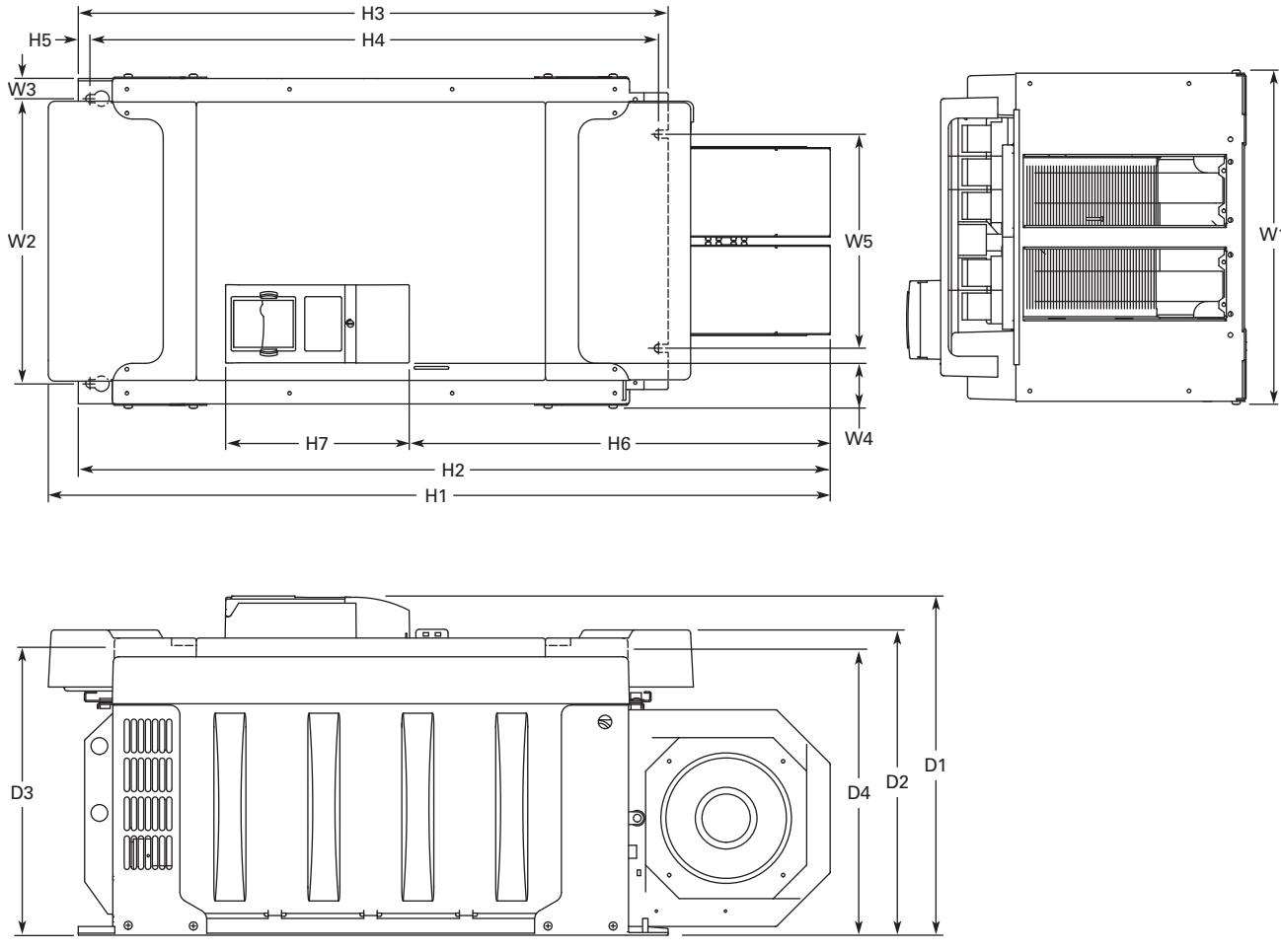


Volts	hp (I_H)	W1	W2	W3	W4	W5	W6	W7	H1	H2	H3	D1	D2	D3	D4	D5	D6	D7	Weight Lbs (kg)
480V	250–350	23.43	2.46	4.53	0.79	5.95	2.95	30.11	79.45	74.80	20.18	23.70	17.44	19.02	0.47	11.22	17.60	20.08	0.83 (21)
690V	200–300	(595)	(62.5)	(115)	(20)	(151)	(75)	(79)	(2018)	(1900)	(512.5)	(602)	(443)	(483)	(12)	(285)	(447)	(510)	1.89 (48) 0.43 (11)

Approximate Dimensions in Inches (mm)

FR10 Open Chassis ①

2



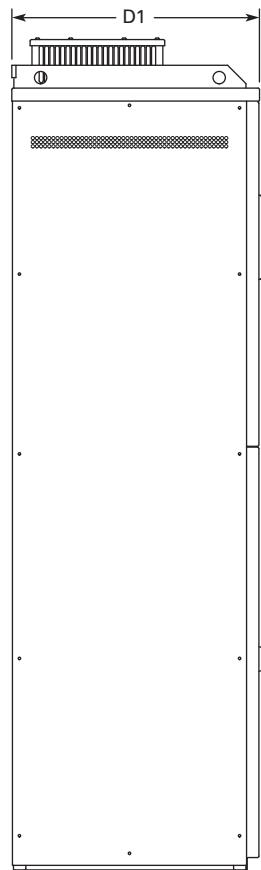
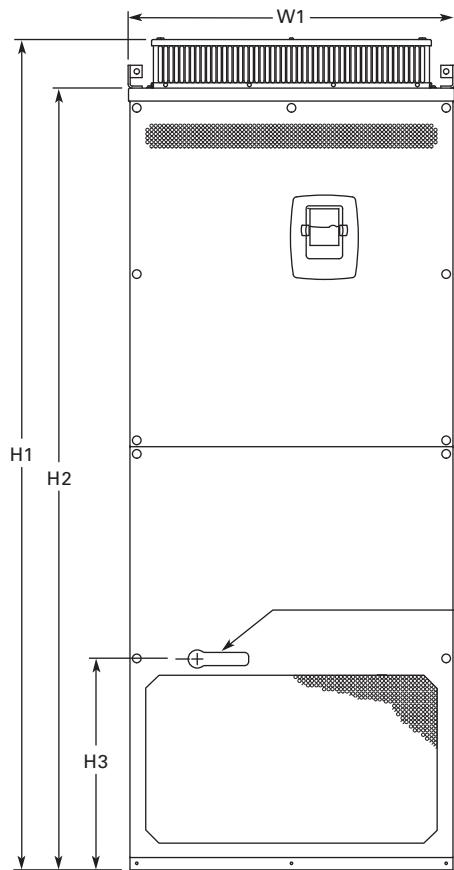
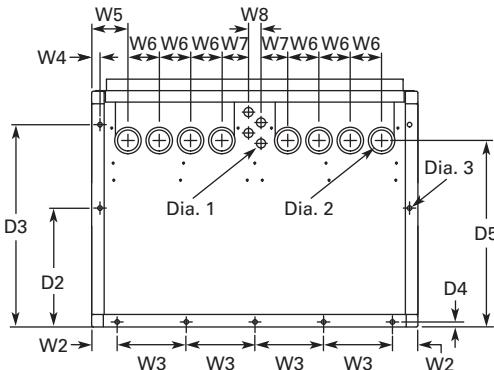
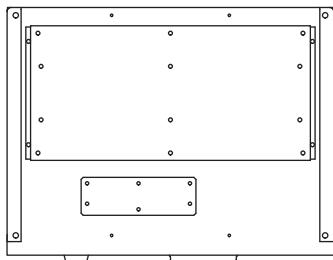
Voltage	hp (I _H)	W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	H6	H7	D1	D2	D3	D4	Weight Lbs (kg)
480V	250–350	19.7 (500)	16.7 (425)	1.2 (30)	2.6 (67)	12.8 (325)	45.9 (1165)	44.1 (1121)	34.6 (879)	33.5 (850)	0.7 (17)	24.7 (627)	10.8 (275)	19.9 (506)	17.9 (455)	16.7 (423)	16.6 (421)	518 (235)
575V	200–300																	

Note

① SPX9000X FR12 is built of two FR10 modules. Please refer to SPX9000 installation manual for mounting instructions.

Approximate Dimensions in Inches (mm)

NEMA Type 1/IP21, FR11 Freestanding Drive



Voltage	hp (kW)	W1	W2	W3	W4	W5	W6	W7	W8	H1	H2	H3	D1	D2	D3	D4	D5	Diag. 1	Diag. 2	Diag. 3	Weight Lbs (kg)
480V	400-550	31.26	2.40	6.50	0.79	3.43	2.95	2.52	1.18	79.45	74.80	20.18	23.70	11.22	19.09	0.47	17.60	0.83	1.89	0.35 x 0.43	526
690V	400-500	(794)	(61)	(165)	(20)	(87)	(75)	(64)	(30)	(2018)	(1900)	(512.5)	(602)	(285)	(485)	(12)	(447)	(21)	(48)	(9 x 11)	(239)

2.7

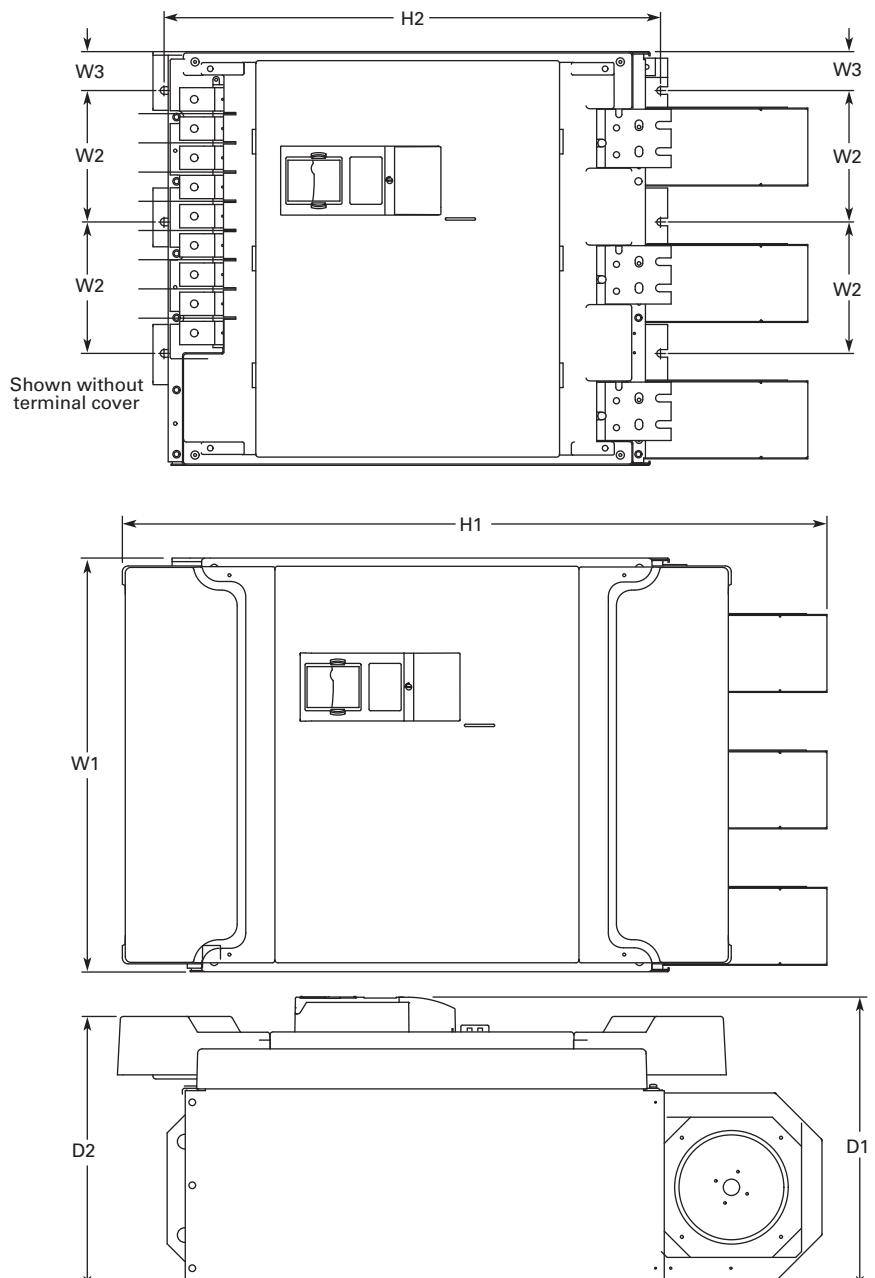
Adjustable Frequency Drives

SPX9000 Drives

Approximate Dimensions in Inches (mm)

FR11 Open Chassis

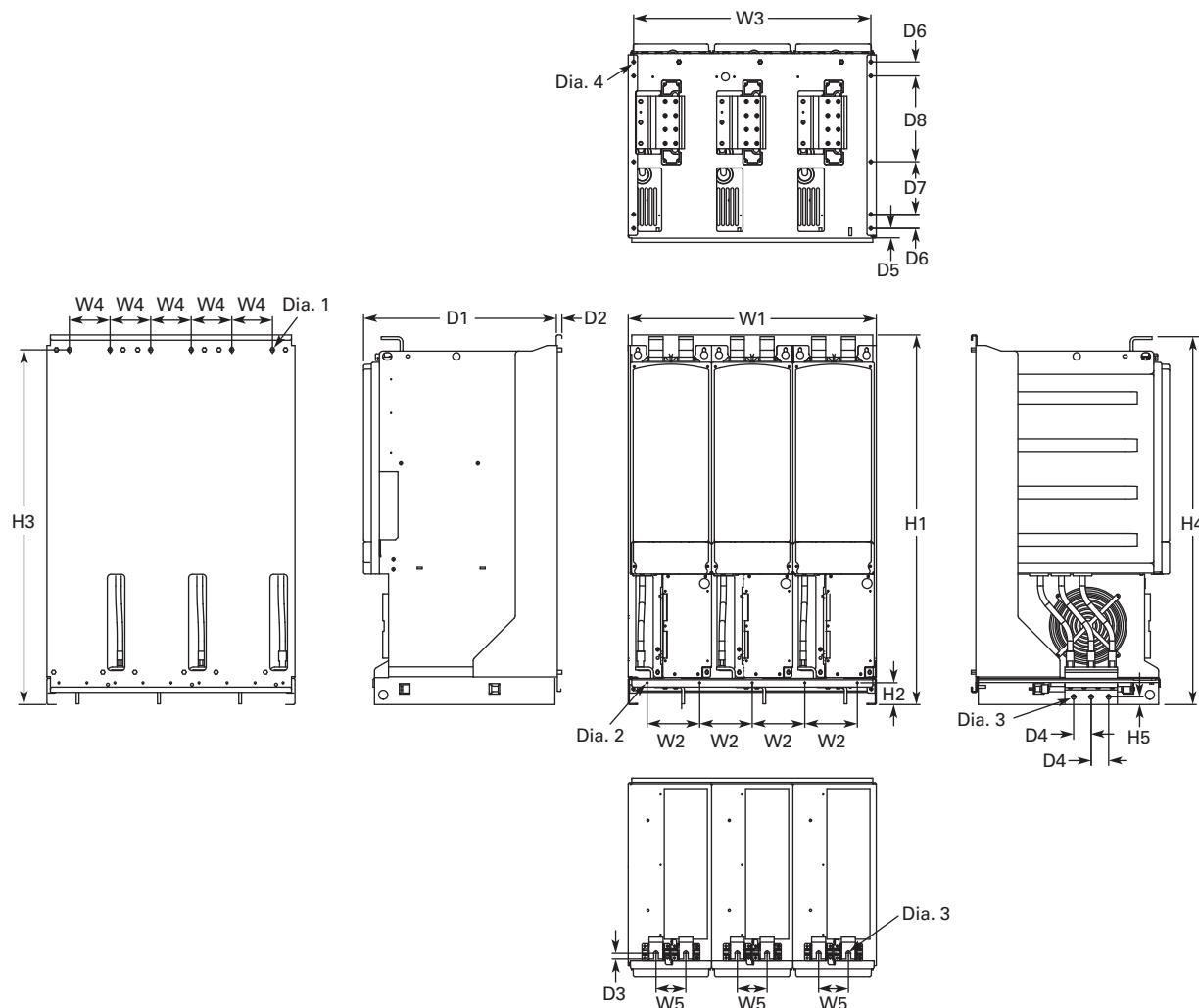
2



Voltage	hp (I_H)	W1	W2	W3	H1	H2	D1	D2	Weight Lbs (kg)
480V	400–550	27.9 (709)	8.6 (225)	2.6 (67)	45.5 (1155)	33.5 (850)	19.8 (503)	18.4 (468)	833 (378)
575V	400–500								

Approximate Dimensions in Inches (mm)

FR13, Open Chassis Inverter



W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	D1	D2	D3	D4	D5	D6	D7	D8	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Weight Lbs (kg)
27.87 (708)	5.91 (150)	26.65 (677)	4.57 (116)	3.35 (85)	41.54 (1055)	2.46 (62.5)	39.86 (1012.5)	41.34 (1050)	0.79 (20)	21.77 (553)	0.51 (13)	0.63 (16)	1.97 (50)	1.06 (27)	1.57 (40)	5.91 (150)	9.64 (244.8)	0.35x0.59 (9x15)	0.18 (4.6)	0.51 (13)	0.37 (9.5)	683 (310)

Notes

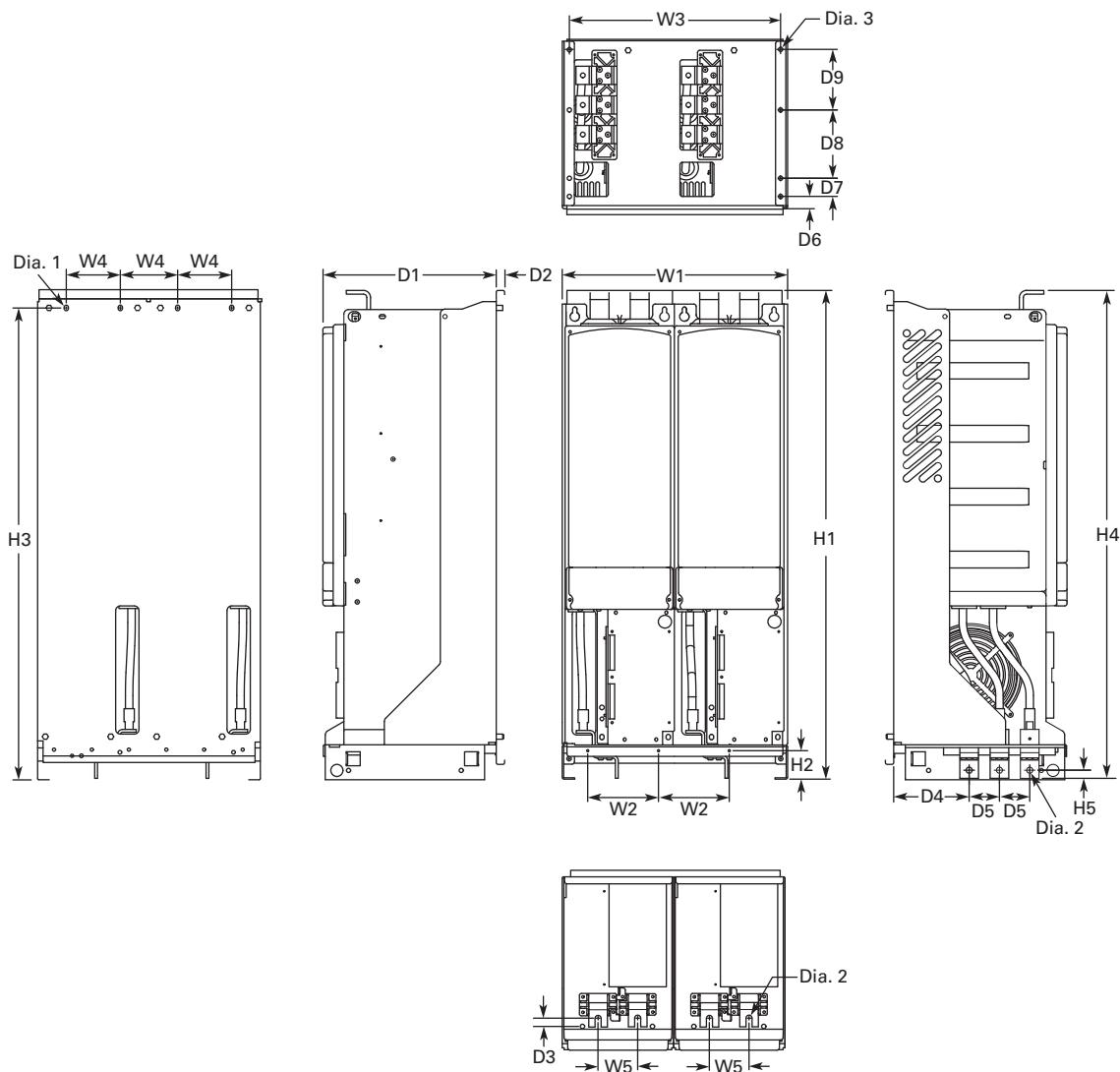
9000X FR14 is built of two FR13 modules. Please refer to SPX9000 installation manual for mounting instructions.

FR13 is built from an inverter module and a converter module. Please refer to SPX9000 installation manual for mounting instructions.

Approximate Dimensions in Inches (mm)

FR13, Open Chassis Converter

2



W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	D1	D2	D3	D4	D5	D6	D7	D8	D9	Di. 1	Di. 2	Di. 3	Weight Lbs (kg)
18.74 (476)	5.91 (150)	17.52 (445)	4.57 (116)	3.35 (85)	41.54 (1055)	2.46 (62.5)	39.86 (1012.5)	41.34 (1050)	0.69 (17.5)	14.69 (373)	0.51 (13)	0.73 (18.5)	6.42 (163)	2.56 (65)	1.06 (27)	1.57 (40)	5.91 (150)	5.24 (133)	0.35x0.59 (9x15)	0.51 (13)	0.37 (9.5)	295 (134)

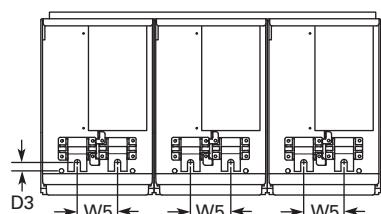
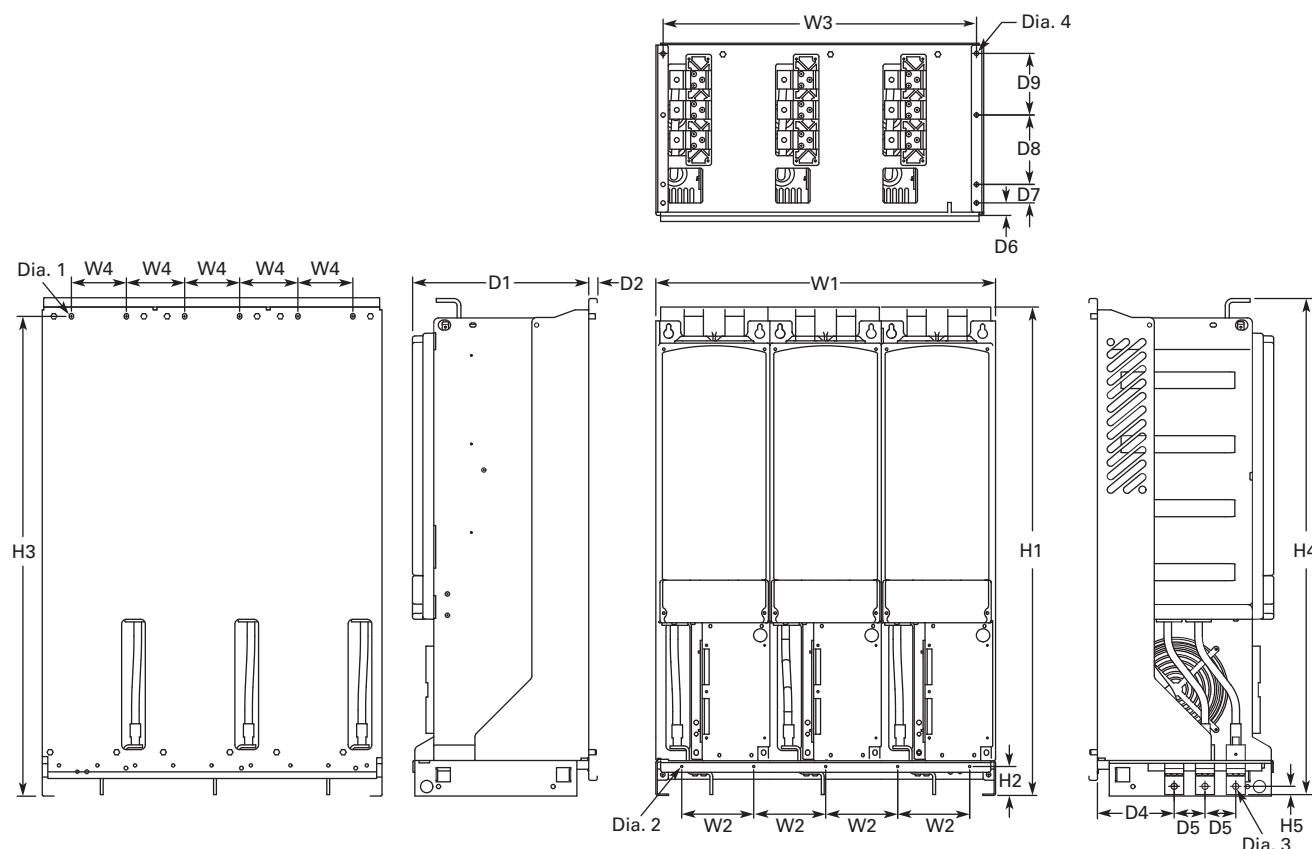
Number of Input Units

480V Catalog Number	hp	Input Modules
SPX800A0-4A2N1	800	2

690V Catalog Number	hp	Input Modules
SPX800A0-5A2N1	800	2
SPX900A0-5A2N1	900	2
SPXH10A0-5A2N1	1000	2

Approximate Dimensions in Inches (mm)

FR13, Open Chassis Converter—900/1000 hp 480V



W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	D1	D2	D3	D4	D5	D6	D7	D8	D9	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Weight Lbs (kg)
27.87 (708)	5.91 (150)	26.65 (677)	4.57 (116)	3.35 (85)	41.54 (1055)	2.46 (62.5)	39.86 (1012.5)	41.34 (1050)	0.69 (17.5)	14.69 (373)	0.51 (13)	0.73 (18.5)	6.42 (163)	2.56 (65)	1.06 (27)	1.57 (40)	5.91 (150)	5.24 (133)	0.35x0.59 (9x15)	0.18 (4.6)	0.51 (13)	0.37 (9.5)	443 (201)

Number of Input Units

480V Catalog Number	hp	Input Modules
SPX900A0-4A2N1	900	3
SPXH10A0-4A2N1	1000	3

Approximate Dimensions in Inches (mm)

2

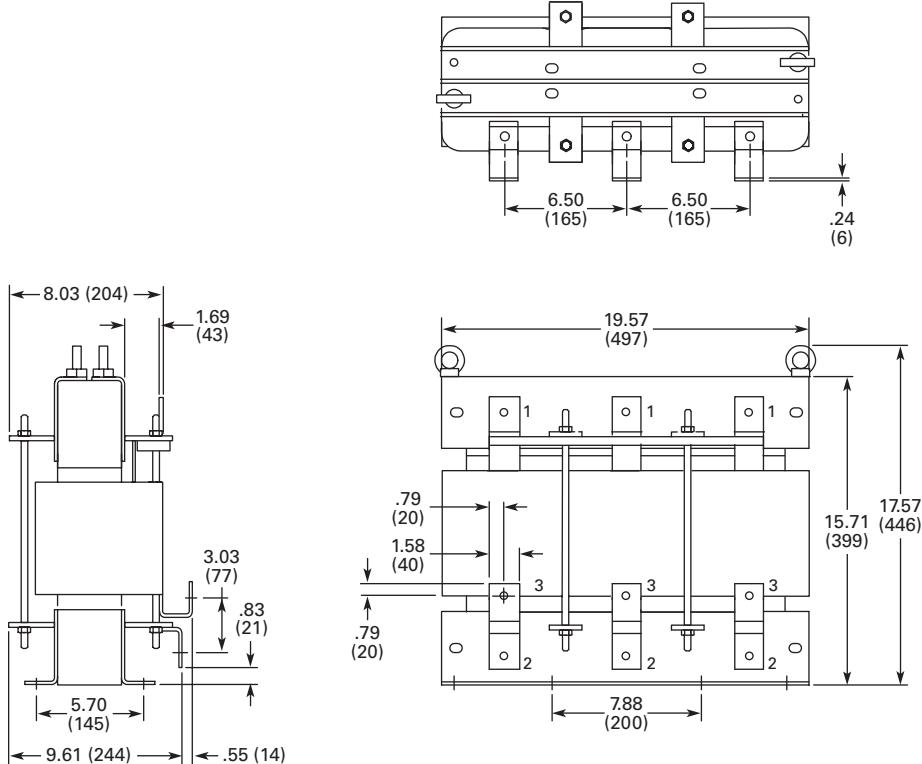
AC Choke Dimensions

Choke Types

Catalog Number	Frame Size	Choke Type ①
Voltage Range 380–500V		
SPX 250 4	FR10	CHK0400
SPX 300 4		CHK0520
SPX 350 4		CHK0520
SPX 400 4	FR11	2 x CHK0400
SPX 500 4		2 x CHK0400
SPX 550 4		2 x CHK0400
SPX 600 4	FR12	2 x CHK0520
SPX 650 4		2 x CHK0520
SPX 700 4		2 x CHK0520
SPX 800 4	FR13	2 x CHK0400
SPX 900 4		3 x CHK0520
SPX H10 4		3 x CHK0520
SPX H12 4	FR14	4 x CHK0520
SPX H16 4		6 x CHK0400

Catalog Number	Frame Size	Choke Type ①
Voltage Range 525–690V		
SPX 200 5	FR10	CHK0261
SPX 250 5		CHK0400
SPX 300 5		CHK0400
SPX 400 5	FR11	CHK0520
SPX 450 5		CHK0520
SPX 500 5		2 x CHK0400
SPX 550 5	FR12	2 x CHK0400
SPX 600 5		2 x CHK0400
SPX 700 5		2 x CHK0400
SPX 800 5	FR13	2 x CHK0400
SPX 900 5		2 x CHK0400
SPX H10 5		2 x CHK0400
SPX H13 5	FR14	4 x CHK0400
SPX H15 5		6 x CHK0400

CHK0520

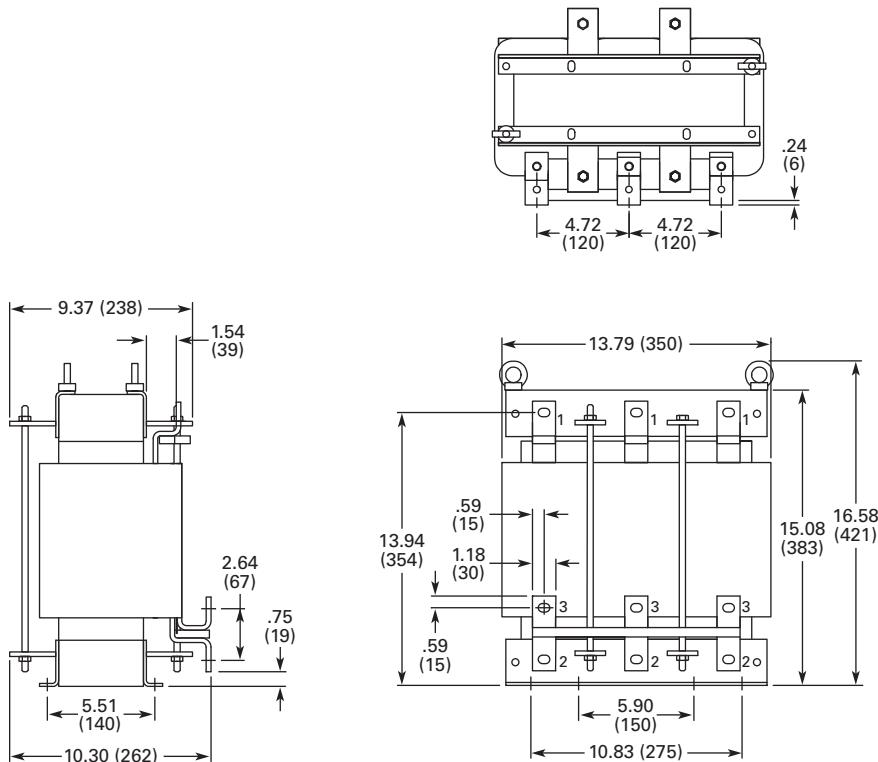


Note

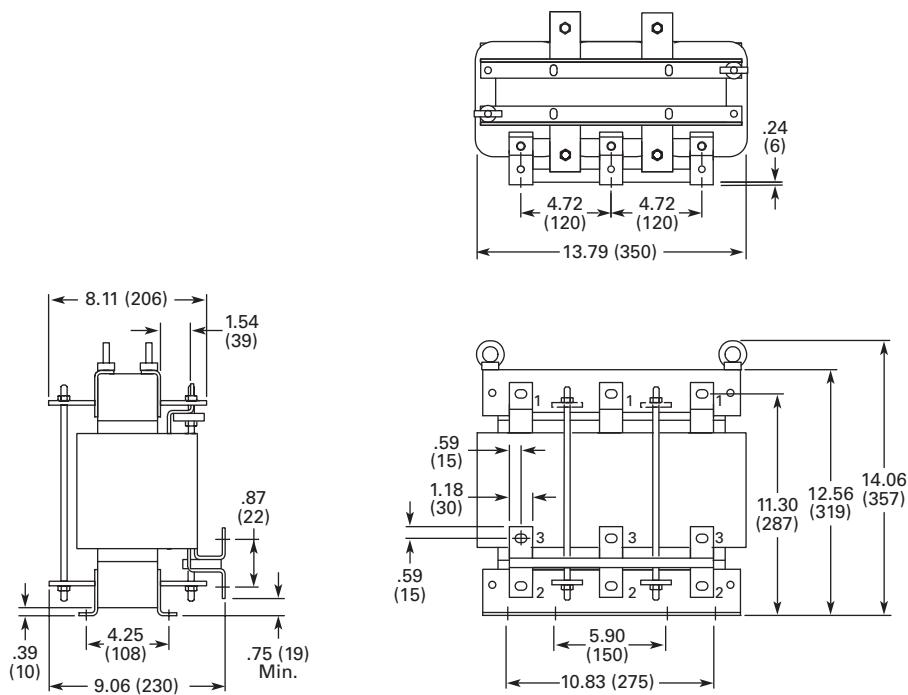
① Chokes are provided with all FR10–FR14 drives.

Approximate Dimensions in Inches (mm)

CHK0400



CHK0261



Enclosed Passive Filtered Drives**2****Enclosed Passive Filtered Drives****Product Description**

The enclosed passive filtered clean power drives from Eaton's Electrical Sector use tuned passive filters to significantly reduce line harmonics at the drive input terminals.

The enclosed passive filtered drive also delivers True Power Factor—in addition to reducing harmonic distortion, the enclosed passive filtered drive prevents transformer overheating and overloading of breakers and feeders, which enables the application of adjustable frequency drives on generators and other high impedance power systems.

The 9000X family of drives includes HVX9000, SVX9000, SLX9000, and SPX9000. 9000X Series drive ratings are rated for either high overload (I_H) or low overload (I_L). I_L indicates 110% overload capacity for 1 minute out of 10 minutes. I_H indicates 150% overload capacity for 1 minute out of 10 minutes.

Contents**Description****Page**

Enclosed Passive Filtered Drives	V6-T2-201
Application Description	V6-T2-207
Features and Benefits	V6-T2-207
Standards and Certifications	V6-T2-207
Product Identification	V6-T2-208
Catalog Number Selection	V6-T2-209
Product Selection	V6-T2-216
Options	V6-T2-221
Technical Data and Specifications	V6-T2-223
Wiring Diagram	V6-T2-224
Dimensions	V6-T2-233
Enclosed 18-Pulse Drives	

Enclosed Passive Filtered Drive Products

- **Standard Enclosed**—covers a wide range of the most commonly ordered options. Pre-engineering eliminates the lead time normally associated with customer specific options. Available configurations are listed on **Pages V6-T2-207 to V6-T2-222**.

- **Modified Standard Enclosed**—applies to specific customer requirements that vary from the Standard Enclosed offering, such as the need for an additional indicating light or minor modifications to drawings. *Contact your local sales office for assistance in pricing and lead time.*

- **Custom Engineered**—for those applications with more unique or complex requirements, these are individually engineered to the customer's needs. *Contact your local sales office for assistance in pricing and lead time.*

Application Description

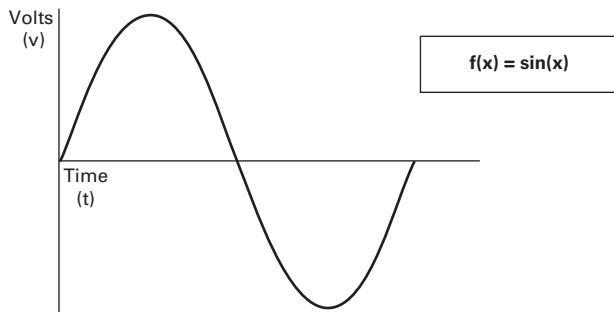
Designed to meet the IEEE® 519-1992 requirements for harmonic distortion, the enclosed passive filtered

drive is an excellent choice for small and midsize drives applications where harmonics are a concern.

What Are Harmonics?

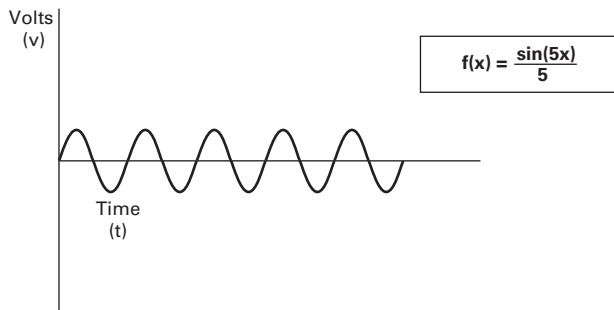
Take a perfect wave with a fundamental frequency of 60 Hz, which is close to what is supplied by the power company.

Perfect Wave



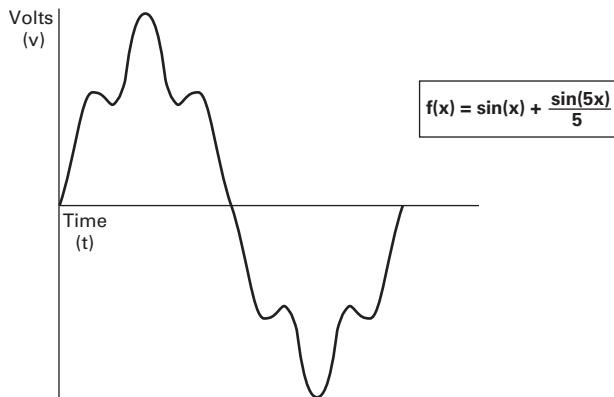
Add a second wave that is five times the fundamental frequency—300 Hz (typical of frequency added to the line by a fluorescent light).

Second Wave



Combine the two waves. The result is a 60 Hz supply rich in fifth harmonics.

Resulting Supply



What Causes Harmonics?

Harmonics are the result of nonlinear loads that convert AC line voltage to DC. Examples of equipment that are non-linear loads are listed below:

- AC variable frequency drives
- DC drives
- Fluorescence lighting, computers, UPS systems
- Industrial washing machines, punch presses, welders, etc.

How Can Harmonics Due to VFDs Be Diminished?

By applying drives from the Eaton Clean Power Drives Family; The HCX9000, enclosed passive filtered drive and enclosed 18-pulse drive.

What Are Linear Loads?

Linear loads are primarily devices that run across the line and do not add harmonics. Motors are prime examples. The downside to having large motor linear loads is that they draw more energy than a VFD, because of their inability to control motor speed. In most applications there is a turn down valve used with the motor which will reduce the flow of the material, without significantly reducing the load to the motor. While this provides some measure of speed control, it is extremely inefficient.

Why Be Concerned About Harmonics?

1. Installation and utility costs increase.

Harmonics cause damage to transformers and lower efficiencies due to the IR loss. These losses can become significant (from 16.6–21.6%) which can have a dramatic effect on the HVAC systems that are controlling the temperatures of the building where the transformer and drive equipment reside.

2. Downtime and loss of productivity.

Telephones and data transmissions links may not be guaranteed to work on the same power grids polluted with harmonics.

3. Downtime and nuisance trips of drives and other equipment.

Emergency generators have up to three times the impedance that is found in a conventional utility source. Thus the harmonic voltage can be up to three times as large, causing risk of operation problems.

4. Larger motors must be used.

Motors running across the line that are connected on polluted power distribution grids can overheat or operate at lower efficiency due to harmonics.

5. Higher installation costs.

Transformers and power equipment must be oversized to accommodate the loss of efficiencies. This is due to the harmonic currents circulating through the distribution without performing useful work.

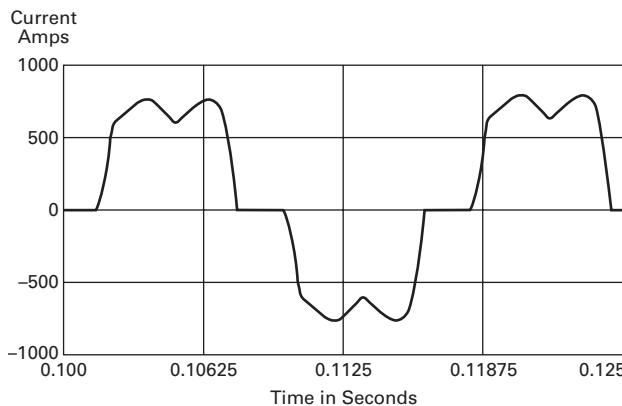
How Does a VFD Convert Three-Phase AC to a Variable Output Voltage and Frequency?

2

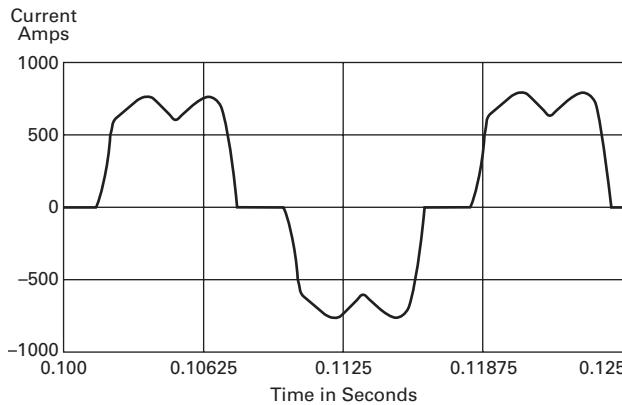
The six-pulse VFD: The majority of all conventional drives that are built consist of a six-pulse configuration. The figure below represents a six-diode rectifier design that converts three-phase utility power to DC. The inverter section uses IGBTs to convert DC power to a simulated AC sine wave that can vary in frequency from 0–400 Hz.

The six-pulse VFD drive creates harmonic current distortion. The harmonic current that is created is energy that can not be used by customers and causes external heat and losses to all components including other drives that are on the same power distribution. The figure is a 100 hp drive with 45A of damaging harmonic current.

100 hp Six-Diode Rectifier Design



100 hp Six-Pulse Nonproductive Harmonic Current



Six-Pulse Nonproductive Harmonic Current

Six-Pulse Circuit

Current harmonics

$I_1 = 100\%$	$I_{11} = 6.10\%$	$I_{19} = 1.77\%$
$I_5 = 22.5\%$	$I_{13} = 4.06\%$	$I_{23} = 1.12\%$
$I_7 = 9.38\%$	$I_{17} = 2.26\%$	$I_{25} = 0.86\%$

Power = 100 hp

Harmonic current = 45 amps

Guidelines of Meeting IEEE Std. 519-1992 Harmonic Distortion Limits

The IEEE 519-1992 Specification is a standard that provides guidelines for commercial and industrial

users that are implementing medium and low voltage equipment.

Maximum Harmonic Current Distortion in % of the Fundamental (120V through 69,000V)

I_{SC}/I_L	Harmonic Order (Odd Harmonics)					TDD
	$h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h$	
<20	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

The ratio I_{SC}/I_L is the ratio of the short-circuit current available at the point of common coupling (PCC), to the maximum fundamental load current. Consequently, as the size of the user load decreases with respect to the size of the system, the percentage of harmonic current that the user is allowed to inject into the utility system increases.

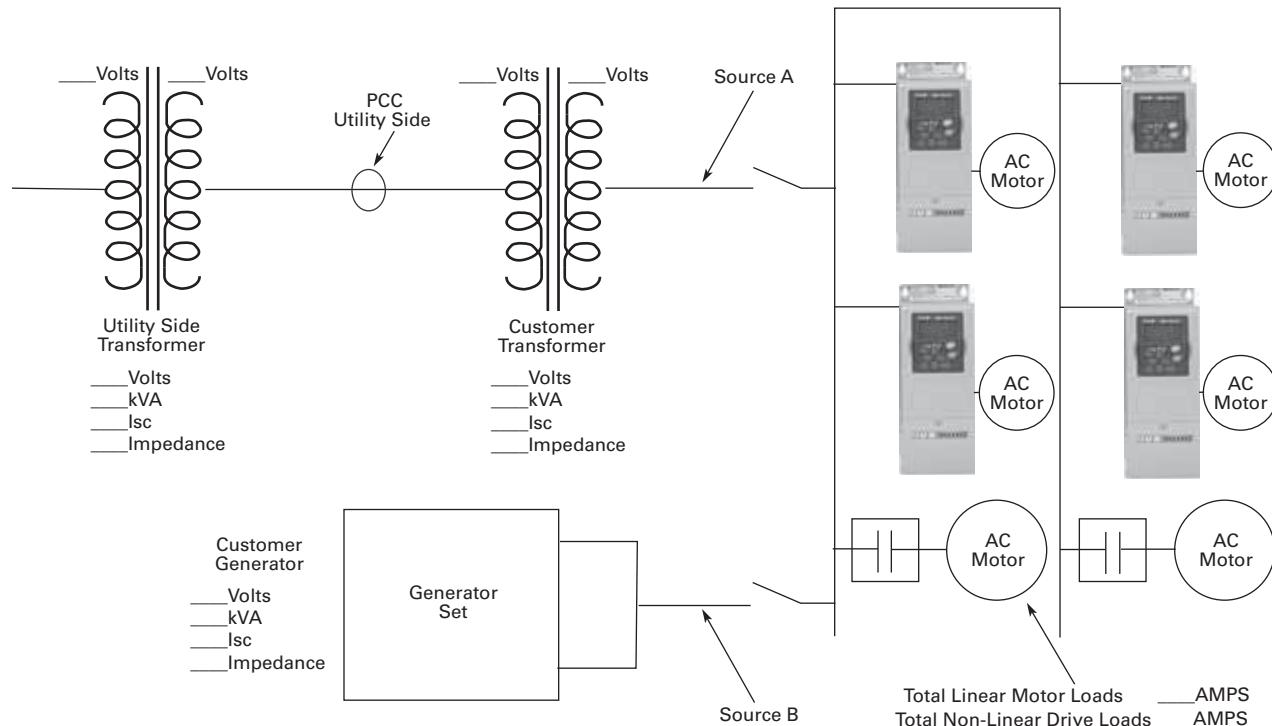
Notes

TDD = Total demand distortion is the harmonic current distortion in percent of the maximum demand load current (15 or 30 minute demand).

I_{SC} = Maximum short-circuit current at the PCC not counting motor contribution.

I_L = Maximum demand load current for all of the connected loads (fundamental frequency component) at the PCC. All of the limits are measured at a point of common coupling.

One-Line Diagram for Harmonic Analysis



The best way to estimate AFD harmonic contribution to an electrical system is to perform a harmonic analysis based on known system characteristics. The one line in this figure would provide the data to complete the calculations.

Terms

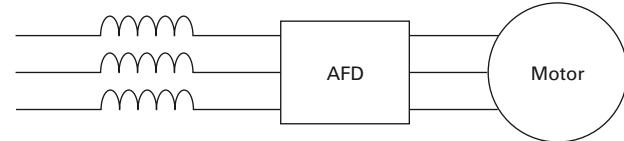
- PCC (Point of Common Coupling) is defined as the electrical connecting point between the utility and multiple customers per the specifications in IEEE 519
- POA (Point of Analysis) is defined as where the harmonic calculations are taken

An oscilloscope can make all measurements at the PCC or POA to do an on-site harmonic evaluation.

Harmonic Reduction Methods to Meet IEEE 519**1. Line Reactor**

A line reactor is a three-phase series inductance on the line side of an AFD. If a line reactor is applied on all AFDs, it is possible to meet IEEE guidelines where 10–25% of system loads are AFDs, depending on the stiffness of the line and the value of line reactance. Line reactors are available in various values of percent impedance, most typically 1–1.5%, 3% and 5%.

Note: The 9000X drives come standard with a nominal 3% input impedance.

Line Reactor**Advantages**

- Low cost
- Can provide moderate reduction in voltage and current harmonics
- Available in various values of percent impedance
- Provides increased input protection for AFD and its semiconductors from line transients

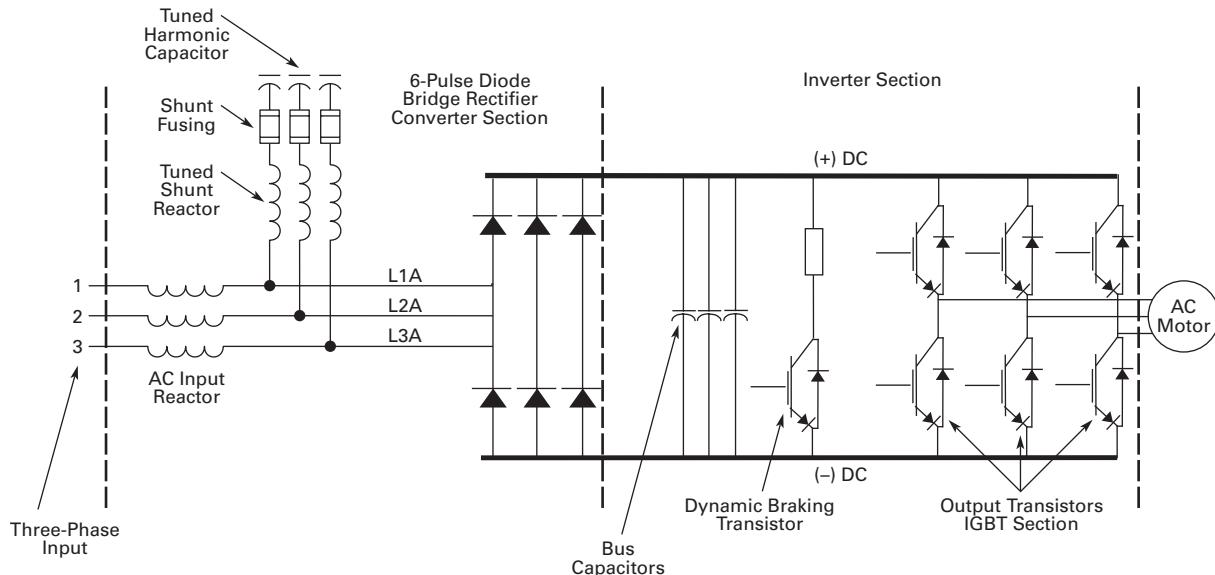
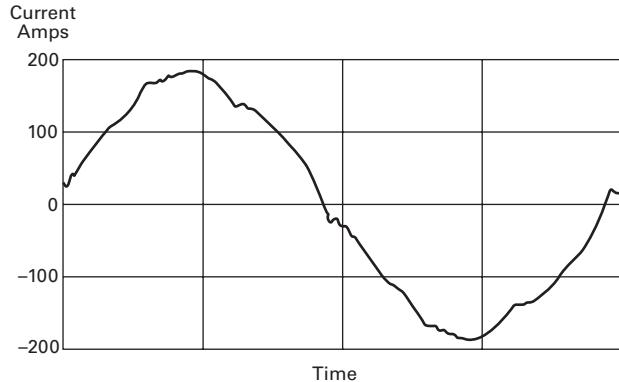
Disadvantages

- May not reduce harmonic levels to below IEEE 519-1992 guidelines
- Voltage drop due to IR loss

2. Passive Filters

Tuned harmonic filters involve the series connection of an inductor with the shunt connection of an inductor and capacitor to form a low impedance path to ground for

a specific range of frequencies. This path presents an alternative to the flow of harmonic currents back into the utility source.

Enclosed Drive with Integrated Passive Filter**100 hp Enclosed 480V Drive with Integrated Passive Filter****100 hp Enclosed 480V Drive with Integrated Passive Filter****Passive Filter****Current harmonics**

$I_1 = 100\%$	$I_{11} = 0.24\%$	$I_{19} = 0.50\%$
$I_5 = 3.76\%$	$I_{13} = 1.1\%$	$I_{23} = 0.55\%$
$I_7 = 1.65\%$	$I_{17} = 0.80\%$	$I_{25} = 0.80\%$

Power = 100 hp

 $H_c = 8.6$ Amps**Advantages**

- Low cost for smaller horsepower applications
- More effective harmonic attenuation than 12-pulse drives
- Provides increased input protection for AFD from line transients

Disadvantages

- Capacitors age over time, unlike magnetics
- Not as effective as 18-pulse drives
- Challenging to retrofit with bypass applications

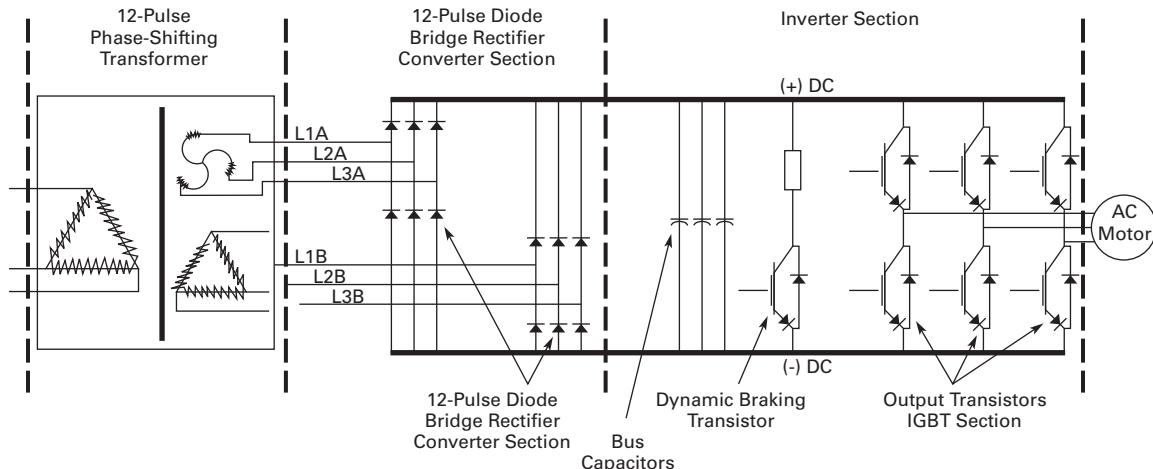
3. 12-Pulse Converters

A 12-pulse converter incorporates two separate AFD input semiconductor bridges, which are fed from 30° phase shifted power sources with identical impedance. The sources may be two isolation transformers, where one is a delta/wye design (which provides the phase shift) and

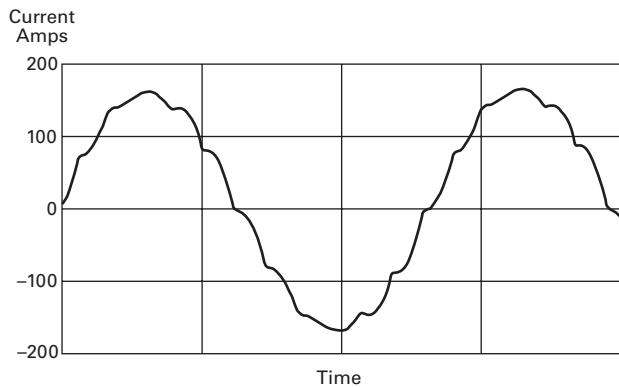
the second a delta/delta design (which does not phase shift). The 12-pulse arrangement allows the harmonics from the first converter to cancel the harmonics of the second. Up to approximately 85% reduction of harmonic current and voltage distortion may be achieved (over standard

six-pulse converter). This permits a facility to use a larger percentage of AFD loads under IEEE 519-1992 guidelines than allowable using line reactors or DC chokes. A harmonic analysis is required to guarantee compliance with guidelines.

Basic 12-Pulse Rectifier with "Phase Shifting" Transformer



100 hp 480V Drive with 12-Pulse Rectifier



100 hp 480V Drive with 12-Pulse Rectifier

12-Pulse Circuit

Current harmonics

$$I_1 = 100\% \quad I_{11} = 4.19\% \quad I_{19} = 0.06\%$$

$$I_5 = 1.25\% \quad I_{13} = 2.95\% \quad I_{23} = 0.87\%$$

$$I_7 = 0.48\% \quad I_{17} = 0.21\% \quad I_{25} = 0.73\%$$

Power = 100 hp

$H_c = 20$ Amps

Advantages

- Reasonable cost, although significantly more than reactors or chokes
- Substantial reduction (up to approx. 85%) in voltage and current harmonics
- Provides increased input protection for AFD and its semiconductors from line transients

Disadvantages

- Impedance matching of phase shifted sources is critical to performance
- Transformers often require separate mounting or larger AFD enclosures
- May not reduce distribution harmonic levels to below IEEE 519-1992 guidelines
- Cannot retrofit for most AFDs

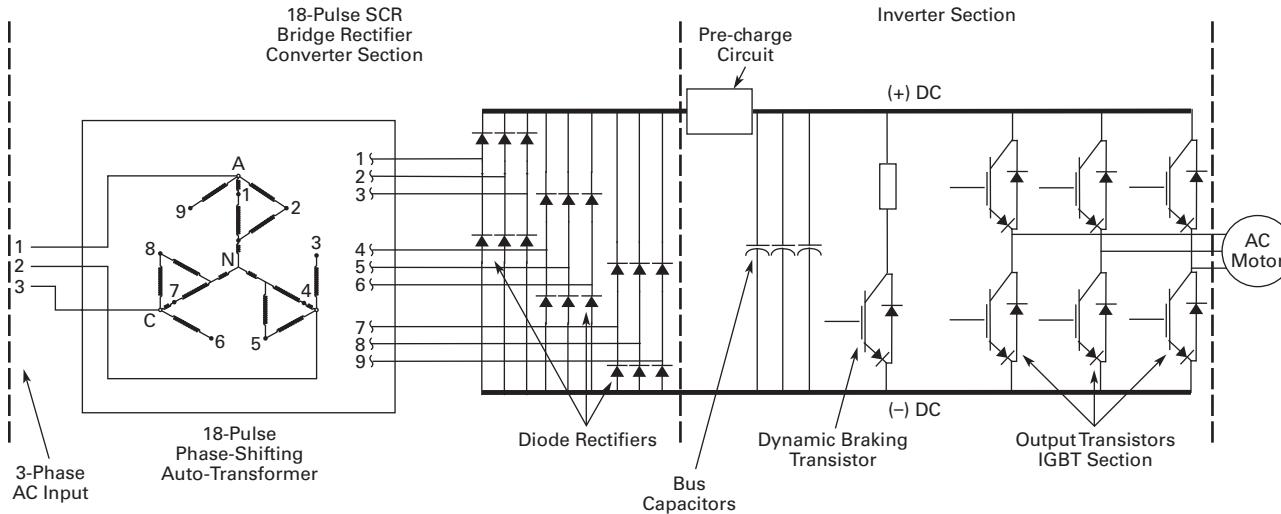
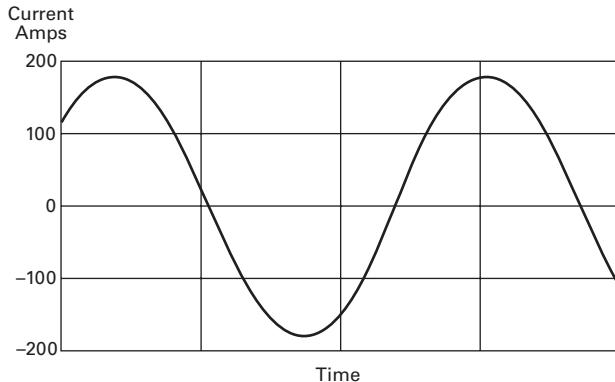
4. Clean Power Drives

When the total load is comprised of non-linear load such as drives, and the ratio is I_{SC}/I_L , the greatest harmonic mitigation is required. Under these conditions, the currents drawn from the supply need to be sinusoidal and "clean" such that system interference and additional

losses are negligible. Eaton's Enclosed 18-Pulse clean power drive uses a phase-shifting auto-transformer with delta-connected winding that carries only the ampere-turns caused by the difference in load currents. This results in nine separate phases. In this type of configuration, the

total kVA rating of the transformer magnetic system was only 48% that of the motor load. A traditional isolated transformer system, with multipulse windings, would require the full kVA rating to be supported, which is more common in an MV step-down transformer.

The integrated 18-pulse clean power drive, with near sine wave input current and low harmonics will meet the requirements of IEEE 519-1992 under all practical operating conditions. The comparisons with six-pulse passive filter and 12-pulse systems are shown on **Pages V6-T2-202, V6-T2-204** and below.

Basic 18-Pulse Rectifier with Phase-Shifting Auto-Transformer**100 hp 480V Drive with 18-Pulse Rectifiers****100 hp 480V Drive with 18-Pulse Rectifiers****18-Pulse Clean Power****Current harmonics**

$I_1 = 100\%$	$I_{11} = 0.24\%$	$I_{19} = 1.00\%$
$I_5 = 0.16\%$	$I_{13} = 0.10\%$	$I_{23} = 0.01\%$
$I_7 = 0.03\%$	$I_{17} = 0.86\%$	$I_{25} = 0.01\%$

Power = 100 hp

 $H_c = 5.9$ Amps**Advantages**

- Effectively guarantees compliance with IEEE 519-1992
- Provides increased input protection for AFD and its semiconductors from line transients
- Up to 4 times the harmonic reduction of 12-pulse methods
- Smaller transformer than isolation transformer used in 12-pulse converter
- Minimizes ripple current in capacitors, doubling expected capacitor life

Disadvantages

- Not as cost effective as some other methods at small (<50) horsepower

Features and Benefits

New enclosed passive filtered clean power drive features include (at 480V):

- UL Type 1, UL Type 12, UL Type 3R and NEMA 12 with gaskets and filters
- Input voltage: 480V, 230V, 575V
- Complete range of control, network and power options

- Horsepower range:
 - 480V, 7-1/2–400 hp I_L
 - 230V, 7-1/2–100 hp I_L ; consult factory for details
 - 575V, 15–400 hp I_L ; consult factory for details
- Single enclosure for both drive and filter reduces field wiring and enables convenient bypass installation
- Packaged solution ensures optimal coordination of drive and filter

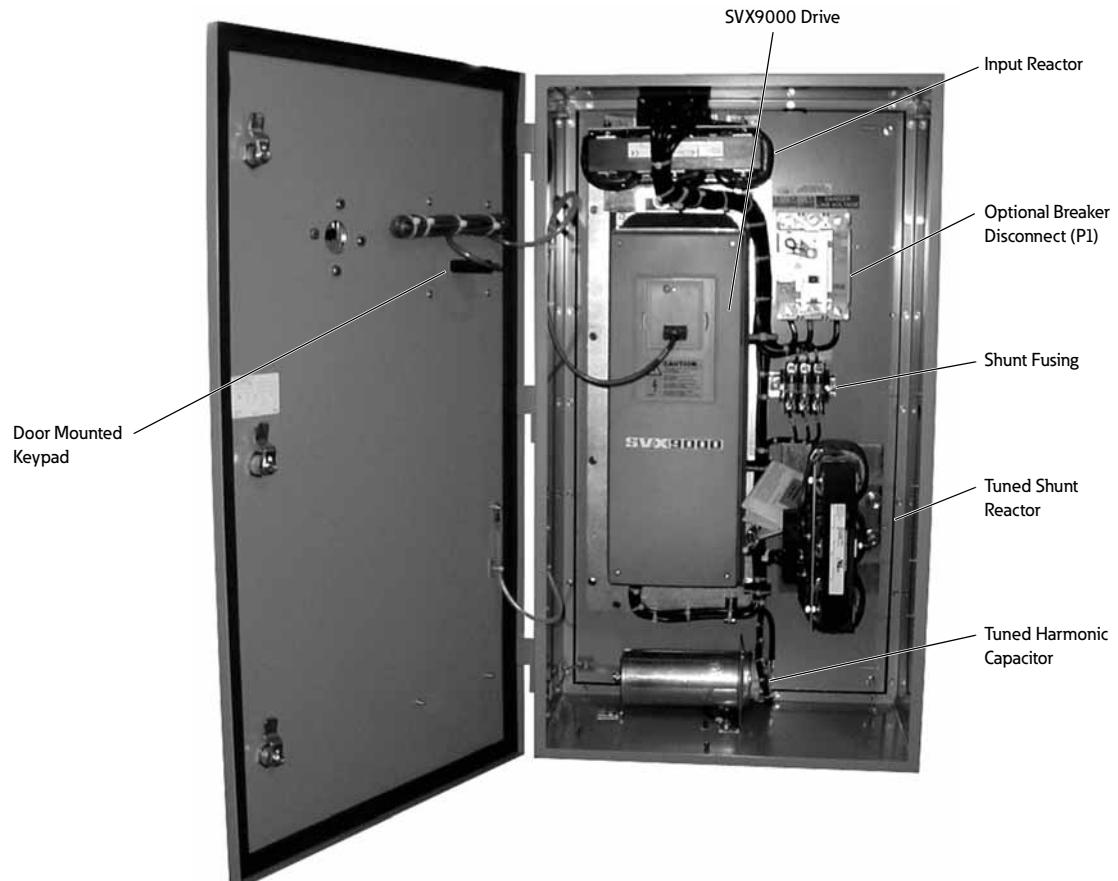
Standards and Certifications

- UL
- cUL
- 508C



Product Identification

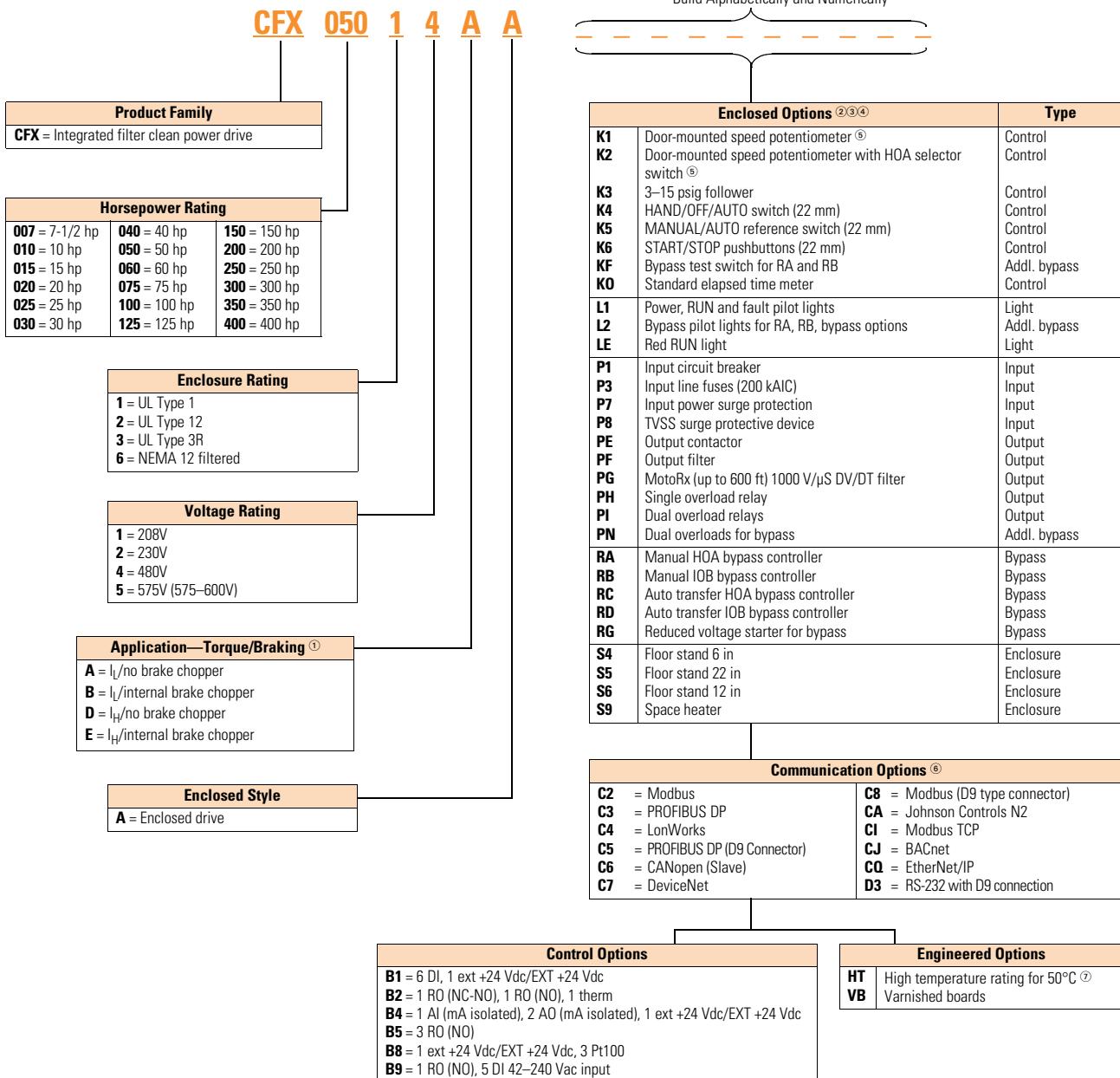
Enclosed Passive Filtered Drive—UL Type 12, 40 hp



Catalog Number Selection

Enclosed Passive Filtered Drives

2



Notes

- ① Brake chopper is standard in 208V, 230V and 480V drives up to FR6; optional in all other drives.
- ② Local/remote keypad is included as the standard control panel.
- ③ Some options are voltage and/or horsepower specific. Consult your Eaton representative for details.
- ④ See **Pages V6-T2-218** and **V6-T2-219** for complete descriptions.
- ⑤ Includes local/remote speed reference switch.
- ⑥ See **Pages V6-T2-216** and **V6-T2-217** for complete descriptions.
- ⑦ Consult Eaton for availability.

Product Selection

When Ordering

- Select a base catalog number that meets the application requirements—nominal horsepower, voltage and enclosure rating. (The enclosed drive's continuous output amp rating should be equal to or greater than the motor's full load amp rating.) The base enclosed package includes a standard drive, door-mounted alphanumeric panel and enclosure.

- The enclosed passive filtered drive product uses the term High Overload (I_H) in place of the term Constant Torque (CT). Likewise, Low Overload (I_L) is used in place of the term Variable Torque (VT). The new terms are a more precise description of the rating. The older terms included ambient temperature ratings in addition to overload ratings. In order to minimize enclosure size and offer the highest ambient temperature rating, overload and temperature ratings are now treated separately. Ambient temperature ratings are shown in the following table.

Ambient Temperature Ratings

Enclosure Size	I_H	I_L
B, C, 9 ①	40°C	40°C
7, 8	50°C	50°C

- If dynamic brake chopper or control/communication option is desired, change the appropriate code in the base catalog number.
- All of the programming is exactly the same as the standard SVX9000 drive.
- Select enclosed options. Add the codes as suffixes to the base catalog number in alphabetical and numeric order.

Note

- ① For high temperature rating, select HT option code and contact factory.

208V Drives

2

Enclosed Passive Filtered Drive



UL Type 1, UL Type 12, UL Type 3R and NEMA 12 Filtered

hp	NEC Current (A)	Chassis Frame	UL Type 1 Base Catalog Number	UL Type 12 and NEMA 12 Filtered Base Catalog Number	UL Type 3R Base Catalog Number
Low Overload Drive					
7-1/2	24.2	FR5	①	CFX00721BA	CFX00731BA
10	30.8	FR5	①	CFX01021BA	CFX01031BA
15	46.2	FR6	①	CFX01521BA	CFX01531BA
20	59.4	FR6	①	CFX02021BA	CFX02031BA
25	74.8	FR7	①	CFX02521AA	CFX02531AA
30	88	FR7	①	CFX03021AA	CFX03031AA
40	114	FR7	①	CFX04021AA	CFX04031AA
50	143	FR8	CFX05011AA	CFX05061AA	CFX05031AA
60	169	FR8	CFX06011AA	CFX06061AA	CFX06031AA
75	211	FR8	CFX07511AA	CFX07561AA	CFX07531AA
100	273	FR9	CFX10011AA	CFX10061AA	CFX10031AA
High Overload Drive					
7-1/2	24.2	FR5	①	CFX00721EA	CFX00731EA
10	30.8	FR6	①	CFX01021EA	CFX01031EA
15	46.2	FR6	①	CFX01521EA	CFX01531EA
20	59.4	FR7	①	CFX02021DA	CFX02031DA
25	74.8	FR7	①	CFX02521DA	CFX02531DA
30	88	FR7	①	CFX03021DA	CFX03031DA
40	114	FR8	CFX04011DA	CFX04061DA	CFX04031DA
50	143	FR8	CFX05011DA	CFX05061DA	CFX05031DA
60	169	FR8	CFX06011DA	CFX06061DA	CFX06031DA
75	211	FR9	CFX07511DA	CFX07561DA	CFX07531DA
100	273	FR9	CFX10011DA	CFX10061DA	CFX10031DA

Enclosed Passive Filtered Drive Enclosure

Chassis Frame	UL Type 1 Disconnect Only	With Power Options	UL Type 12 Disconnect Only	With Power Options	UL Type 3R Disconnect Only	With Power Options
FR4	N/A	N/A	B	C	B	C
FR5	N/A	N/A	B	C	B	C
FR6	N/A	N/A	B	C	B	C
FR7	N/A	7	C	7	C	D
FR8	7	7	7	7	F	F
FR9	8	8	8	8	F	F

Enclosure Dimension Drawings

Enclosure Size	UL Type 1 and UL Type 12	UL Type 3R
B	See Page V6-T2-224	See Page V6-T2-226
C	See Page V6-T2-225	See Page V6-T2-227
D	N/A	See Page V6-T2-228
F	N/A	See Page V6-T2-229
7 ②	See Page V6-T2-230	③
8 ②	See Page V6-T2-231	③
9	See Page V6-T2-232	③

Notes

① FR5–FR7 drives not available in UL Type 1.

② Enclosures 7 and 8 are NEMA 12 filtered.

③ Not available for UL Type 3R.

230V Drives

Enclosed Passive Filtered Drive



UL Type 1, UL Type 12, UL Type 3R and NEMA 12 Filtered

hp	NEC Current (A)	Chassis Frame	UL Type 1 Base Catalog Number	UL Type 12 and NEMA 12 Filtered Base Catalog Number	UL Type 3R Base Catalog Number
Low Overload Drive					
7-1/2	22	FR5	①	CFX00722BA	CFX00732BA
10	28	FR5	①	CFX01022BA	CFX01032BA
15	42	FR6	①	CFX01522BA	CFX01532BA
20	54	FR6	①	CFX02022BA	CFX02032BA
25	68	FR7	①	CFX02522AA	CFX02532AA
30	80	FR7	①	CFX03022AA	CFX03032AA
40	104	FR7	①	CFX04022AA	CFX04032AA
50	130	FR8	CFX05012AA	CFX05062AA	CFX05032AA
60	154	FR8	CFX06012AA	CFX06062AA	CFX06032AA
75	192	FR8	CFX07512AA	CFX07562AA	CFX07532AA
100	248	FR9	CFX10012AA	CFX10062AA	CFX10032AA
High Overload Drive					
7-1/2	22	FR5	①	CFX00722EA	CFX00732EA
10	28	FR6	①	CFX01022EA	CFX01032EA
15	42	FR6	①	CFX01522EA	CFX01532EA
20	54	FR7	①	CFX02022DA	CFX02032DA
25	68	FR7	①	CFX02522DA	CFX02532DA
30	80	FR7	①	CFX03022DA	CFX03032DA
40	104	FR8	CFX04012DA	CFX04062DA	CFX04032DA
50	130	FR8	CFX05012DA	CFX05062DA	CFX05032DA
60	154	FR8	CFX06012DA	CFX06062DA	CFX06032DA
75	192	FR9	CFX07512DA	CFX07562DA	CFX07532DA
100	248	FR9	CFX10012DA	CFX10062DA	CFX10032DA

Enclosed Passive Filtered Drive Enclosure

Chassis Frame	UL Type 1 Disconnect Only	With Power Options	UL Type 12 Disconnect Only	With Power Options	UL Type 3R Disconnect Only	With Power Options
FR4	N/A	N/A	B	C	B	C
FR5	N/A	N/A	B	C	B	C
FR6	N/A	N/A	B	C	B	C
FR7	N/A	7	C	7	C	D
FR8	7	7	7	7	F	F
FR9	8	8	8	8	F	F

Enclosure Dimension Drawings

Enclosure

Size UL Type 1 and UL Type 12 UL Type 3R

B	See Page V6-T2-224	See Page V6-T2-226
C	See Page V6-T2-225	See Page V6-T2-227
D	N/A	See Page V6-T2-228
F	N/A	See Page V6-T2-229
7 ②	See Page V6-T2-230	③
8 ②	See Page V6-T2-231	③
9	See Page V6-T2-232	③

Notes

- ① FR5–FR7 drives not available in UL Type 1.
- ② Enclosures 7 and 8 are NEMA 12 filtered.
- ③ Not available for UL Type 3R.

480V Drives

2

Enclosed Passive Filtered Drive



Enclosed Passive Filtered Base Drive

hp	NEC Current (A)	Chassis Frame	UL Type 1 Base Catalog Number ①
Low Overload Drive			
7-1/2	11	FR4	②
10	14	FR5	②
15	21	FR5	②
20	27	FR5	②
25	34	FR6	②
30	40	FR6	②
40	52	FR6	②
50	65	FR7	CFX05014AA ③
60	77	FR7	CFX06014AA ③
75	96	FR7	CFX07514AA ③
100	124	FR8	CFX10014AA
125	156	FR8	CFX12514AA
150	180	FR8	CFX15014AA
200	240	FR9	CFX20014AA
250	302	FR9	CFX25014AA
300	361	FR10	CFX30014AA
350	414	FR10	CFX35014AA
400	477	FR10	CFX40014AA
High Overload Drive			
7-1/2	11	FR5	②
10	14	FR5	②
15	21	FR5	②
20	27	FR6	②
25	34	FR6	②
30	40	FR6	②
40	52	FR7	CFX04014DA ③
50	65	FR7	CFX05014DA ③
60	77	FR7	CFX06014DA ③
75	96	FR8	CFX07514DA
100	124	FR8	CFX10014DA
125	156	FR8	CFX12514DA
150	180	FR9	CFX15014DA
200	240	FR9	CFX20014DA
250	302	FR10	CFX25014DA
300	361	FR10	CFX30014DA
350	414	FR10	CFX35014DA

Notes

- ① The integrated filter clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.
 ② FR4–FR6 drives not available in UL Type 1.
 ③ This catalog number is used only with power options.
 ④ Consult factory.

UL Type 12 and NEMA 12 Filtered Base Catalog Number ①

CFX00724BA

CFX01024BA

CFX01524BA

CFX02024BA

CFX02524BA

CFX03024BA

CFX04024BA

CFX05024AA

CFX06024AA

CFX07524AA

CFX10064AA

CFX12564AA

CFX15064AA

CFX20064AA

CFX25064AA

CFX30064AA

CFX35064AA

CFX40064AA

④

④

④

UL Type 3R

Base Catalog Number ①

CFX00734BA

CFX01034BA

CFX01534BA

CFX02034BA

CFX02534BA

CFX03034BA

CFX04034BA

CFX05034AA

CFX06034AA

CFX07534AA

CFX10034AA

CFX12534AA

CFX15034AA

CFX20034AA

CFX25034AA

CFX00734EA

CFX01034EA

CFX01534EA

CFX02034EA

CFX02534EA

CFX03034EA

CFX04034DA

CFX05034DA

CFX06034DA

CFX07534DA

CFX10034DA

CFX12534DA

CFX15034DA

CFX20034DA

④

④

④

Enclosed Passive Filtered Drive Enclosure

Chassis Frame	UL Type 1 Disconnect Only	With Power Options	UL Type 12 Disconnect Only	With Power Options	UL Type 3R Disconnect Only	With Power Options
FR4	N/A	N/A	B	C	B	C
FR5	N/A	N/A	B	C	B	C
FR6	N/A	N/A	B	C	B	C
FR7	N/A	7	C	7	C	D
FR8	7	7	7	7	F	F
FR9	8	8	8	8	F	F
FR10	9	9	9	9	①	①

Enclosure Dimension Drawings

Enclosure Size	UL Type 1 and UL Type 12	UL Type 3R
B	See Page V6-T2-224	See Page V6-T2-226
C	See Page V6-T2-225	See Page V6-T2-227
D	N/A	See Page V6-T2-228
F	N/A	See Page V6-T2-229
7 ②	See Page V6-T2-230	③
8 ②	See Page V6-T2-231	③
9	See Page V6-T2-232	③

Notes

- ① Consult factory.
- ② Enclosures 7 and 8 are NEMA 12 filtered.
- ③ Not available for UL Type 3R.

575V Drives

2

Enclosed Passive Filtered Drive



UL Type 1, UL Type 12, UL Type 3R and NEMA 12 Filtered

hp	NEC Current (A)	Chassis Frame	UL Type 1 Base Catalog Number	UL Type 12 and NEMA 12 Filtered Base Catalog Number	UL Type 3R Base Catalog Number
Low Overload Drive					
15	17	FR6	①	CFX01525AA	CFX01535AA
20	22	FR6	①	CFX02025AA	CFX02035AA
25	27	FR6	①	CFX02525AA	CFX02535AA
30	32	FR6	①	CFX03025AA	CFX03035AA
40	41	FR7	①	CFX04025AA	CFX04035AA
50	52	FR7	①	CFX05025AA	CFX05035AA
60	62	FR8	CFX06015AA	CFX06065AA	CFX06035AA
75	77	FR8	CFX07515AA	CFX07565AA	CFX07535AA
100	99	FR8	CFX10015AA	CFX10065AA	CFX10035AA
125	125	FR9	CFX12515AA	CFX12565AA	CFX12535AA
150	144	FR9	CFX15015AA	CFX15065AA	CFX15035AA
200	192	FR9	CFX20015AA	CFX20065AA	CFX20035AA
250	242	FR10	CFX25015AA	CFX25065AA	②
300	289	FR10	CFX30015AA	CFX30065AA	②
400	382	FR10	CFX40015AA	CFX40065AA	②
High Overload Drive					
10	14	FR6	①	CFX01025DA	CFX01035DA
15	17	FR6	①	CFX01525DA	CFX01535DA
20	22	FR6	①	CFX02025DA	CFX02035DA
25	27	FR6	①	CFX02525DA	CFX02535DA
30	32	FR7	①	CFX03025DA	CFX03035DA
40	41	FR7	①	CFX04025DA	CFX04035DA
50	52	FR8	CFX05015DA	CFX05065DA	CFX05035DA
60	62	FR8	CFX06015DA	CFX06065DA	CFX06035DA
75	77	FR8	CFX07515DA	CFX07565DA	CFX07535DA
100	99	FR9	CFX10015DA	CFX10065DA	CFX10035DA
125	125	FR9	CFX12515DA	CFX12565DA	CFX12535DA
150	144	FR9	CFX15015DA	CFX15065DA	CFX15035DA
200	192	FR10	CFX20015DA	CFX20065DA	②
250	242	FR10	CFX25015DA	CFX25065DA	②
300	289	FR10	CFX30015DA	CFX30065DA	②

Notes

① FR6–FR7 drives not available in UL Type 1.

② Consult factory.

Enclosed Passive Filtered Drive Enclosure

Chassis Frame	UL Type 1 Disconnect Only	With Power Options	UL Type 12 Disconnect Only	With Power Options	UL Type 3R Disconnect Only	With Power Options
FR6	N/A	N/A	B	C	B	C
FR7	N/A	7	C	7	C	D
FR8	7	7	7	7	F	F
FR9	8	8	8	8	F	F
FR10	9	9	9	9	①	①

Enclosure Dimension Drawings

Enclosure Size	UL Type 1 and UL Type 12	UL Type 3R
B	See Page V6-T2-224	See Page V6-T2-226
C	See Page V6-T2-225	See Page V6-T2-227
D	N/A	See Page V6-T2-228
F	N/A	See Page V6-T2-229
7 ②	See Page V6-T2-230	③
8 ②	See Page V6-T2-231	③
9	See Page V6-T2-232	③

Notes

- ① Consult factory.
- ② Enclosures 7 and 8 are NEMA 12 filtered.
- ③ Not available for UL Type 3R.

Options

Enclosed Passive Filtered Drive Option Board Kits

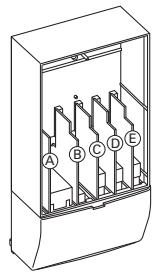
2

The enclosed passive filtered drive series can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of five option boards.

The enclosed passive filtered drive series factory-installed standard board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B.

Option Boards

Option Board Kits



Option Kit Description ^①	Allowed Slot Locations ^②	Field Installed Catalog Number	Factory Installed Option Designator	SVX Ready Programs					
				Basic	Local/ Remote	Standard	MSS	PID	Multi-P.
Standard I/O Cards									
2 RO (NC/NO)	B	OPTA2	—	■	■	■	■	■	■
6 DI, 1 DO, 2 AI, 1AO, 1 +10 Vdc ref, 2 ext +24 Vdc/ext +24 Vdc	A	OPTA9	—	■	■	■	■	■	■
Extended I/O Cards									
6 DI	B, C, D, E	OPTB1	B1	—	—	—	—	—	■
1 RO (NC/NO), 1 RO (NO), 1 therm	B, C, D, E	OPTB2	B2	—	—	—	—	—	■
1 AI (mA isolated), 2 AO (mA isolated)	B, C, D, E	OPTB4	B4	■	■	■	■	■	■
3 RO (NO)	B, C, D, E	OPTB5	B5	—	—	—	—	—	■
3 Pt100 RTD board	B, C, D, E	OPTB8	B8	—	—	—	—	■	—
1 RO (NO), 5 DI 42–240 Vac input	B, C, D, E	OPTB9	B9	—	—	—	—	■	■
Communication Cards ^③									
Modbus	D, E	OPTC2	C2	■	■	■	■	■	■
Modbus TCP	D, E	OPTC1	CI	■	■	■	■	■	■
BACnet	D, E	OPTCJ	CJ	■	■	■	■	■	■
EtherNet/IP	D, E	OPTCQ	CQ	■	■	■	■	■	■
Johnson Controls N2	D, E	OPTC2	CA	■	■	■	■	■	■
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■	■
LonWorks	D, E	OPTC4	C4	■	■	■	■	■	■
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■	■
CANopen (slave)	D, E	OPTC6	C6	■	■	■	■	■	■
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■	■
Modbus (D9 type connector)	D, E	OPTC8	C8	■	■	■	■	■	■
RS-232 with D9 connection	D, E	OPTD3	D3	■	■	■	■	■	■

Notes

^① AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

^② Option card must be installed in one of the slots listed for that card. Slot indicated in bold is the preferred location.

^③ OPTC2 is a multi-protocol option card.

Modbus RTU Network Communications

The Modbus Network Card OPTC2 is used for connecting the 9000X Drive as a slave on a Modbus network. The interface is connected by a 9-pin DSUB connector (female) and the baud rate ranges from 300 to 19,200 baud. Other communication parameters include an address range from 1 to 247; a parity of None, Odd or Even; and the stop bit is 1.

PROFIBUS Network Communications

The PROFIBUS Network Card OPTC3 is used for connecting the 9000X Drive as a slave on a PROFIBUS-DP network. The interface is connected by a 9-pin DSUB connector (female). The baud rates range from 9.6K baud to 12M baud, and the addresses range from 1 to 127.

LonWorks Network Communications

The LonWorks Network Card OPTC4 is used for connecting the 9000X Drive on a LonWorks network. This interface uses Standard Network Variable Types (SNVT) as data types. The channel connection is achieved using a FTT-10A Free Topology transceiver via a single twisted transfer cable. The communication speed with LonWorks is 78 kBits/s.

CANopen (Slave) Communications

The CANopen (Slave) Network Card OPTC6 is used for connecting the 9000X Drive to a host system. According to ISO® 11898 standard cables to be chosen for CAN bus should have a nominal impedance of 120 ohms, and specific line delay of nominal 5 as/m. 120 ohm line termination resistors required for installation.

DeviceNet Network Communications

The DeviceNet Network Card OPTC7 is used for connecting the 9000X Drive on a DeviceNet Network. It includes a 5.08 mm pluggable connector. Transfer method is via CAN using a two-wire twisted shielded cable with two-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud.

Johnson Controls Metasys N2 Network Communications

The OPTC2 fieldbus board provides communication between the 9000X Drive and a Johnson Controls Metasys™ N2 network. With this connection, the drive can be controlled, monitored and programmed from the Metasys system. The N2 fieldbus is available as a factory-installed option and as a field-installable kit.

Modbus/TCP Network Communications

The Modbus/TCP Network Card OPTC1 is used for connecting the 9000X Drive to Ethernet networks using Modbus protocol. It includes an RJ-45 pluggable connector. This interface provides a selection of standard and custom register values to communicate drive parameters. The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable over Ethernet using a supplied software tool.

BACnet Network Communications

The BACnet Network Card OPTCJ is used for connecting the 9000X Drive to BACnet networks. It includes a 5.08 mm pluggable connector. Data transfer is Master-Slave/Token Passing (MS/TP) RS-485. This interface uses a collection of 30 Binary Value Objects (BVOs) and 35 Analog Value Objects (AVOs) to communicate drive parameters. The card supports 9.6, 19.2 and 38.4 Kbaud communication speeds and supports network addresses 1 to 127.

Ethernet/IP Network Communications

The Ethernet/IP Network Card OPTCK is used for connecting the 9000X Drive to Ethernet/Industrial Protocol networks. It includes an RJ-45 pluggable connector. The interface uses CIP objects to communicate drive parameters (CIP is "Common Industrial Protocol," the same protocol used by DeviceNet). The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable by Static, BOOTP and DHCP methods.

Control/Communication Option Descriptions**Available Control/Communications Options**

Option	Description	Option Type
K1	Door-Mounted Speed Potentiometer —Provides the drive with the ability to adjust the frequency reference using a door-mounted potentiometer. This option uses the 10 Vdc reference to generate a 0–10V signal at the analog voltage input signal terminal. When the HOA bypass option is added, the speed is controlled when the HOA switch is in the HAND position. Without the HOA bypass option, a two-position switch (labeled local/remote) is provided on the keypad to select speed reference from the speed potentiometer or a remote speed signal.	Control
K2	Door-Mounted Speed Potentiometer with HOA Selector Switch —Provides the drive with the ability to start/stop and adjust the speed reference from door-mounted control devices or remotely from customer supplied inputs. In HAND position, the drive will start and the speed is controlled by the door-mounted speed potentiometer. The drive will be disabled in the OFF position. When AUTO is selected, the drive run and speed control commands are via user-supplied dry contact and 4–20 mA signal.	Control
K3	3–15 psig Follower —Provides a pneumatic transducer which converts a 3–15 psig pneumatic signal to either 0–8 Vdc or a 1–9 Vdc signal interface with the drive. The circuit board is mounted on the inside of the front enclosure panel and connects to the user's pneumatic control system via 6 ft (1.8m) of flexible tubing and a 1/4 in (6.4 mm) brass tube union.	Control
K4	HAND/OFF/AUTO Switch for Non-Bypass Configurations —Provides a three-position selector switch that allows the user to select either a HAND or AUTO mode of operation. HAND mode is defaulted to keypad operation, and AUTO mode is defaulted to control from an external terminal source. These modes of operation can be configured via drive programming to allow for alternate combinations of start and speed sources. Start and speed sources include keypad, I/O and fieldbus.	Control
K5	MANUAL/AUTO Speed Reference Switch —Provides door-mounted selector switch for MANUAL/AUTO speed reference.	Control
K6	START/STOP Pushbuttons —Provide door-mounted START and STOP pushbuttons for either bypass or non-bypass configurations.	Control
KF	Bypass Test Switch for RB and RA —Allows the user to energize the AF drive for testing while operating the motor on the bypass controller. The Test Switch is mounted on the inside of the enclosure door.	Addl. bypass
KO	Standard Elapsed Time Meter —Provides a door-mounted elapsed run time meter.	Control
L1	Power On, Run and Fault Lights —Provide a white power on light that indicates power to the enclosed cabinets, a green run light and a red fault light that indicates a drive fault has occurred.	Light
L2	Bypass Pilot Lights for RB, RA Bypass Options —A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode. The lights are mounted on the enclosure door, above the switches.	Addl. bypass
LE	Red Run Pilot Light (22 mm) —Provides a red run pilot light that indicates the drive is running.	Light
P1	Input Circuit Breaker —High interrupting circuit breaker that provides a means of short-circuit protection for the power cables between it and the enclosed 18-pulse drive, and protection from high-level ground faults on the power cable. Allows a convenient means of disconnecting the enclosed 18-pulse drive from the line and the operating mechanism can be padlocked in the OFF position. This is factory mounted in the enclosure. Standard rating is 65 kAIC at 208/480V. 100 kAIC is available as an option.	Input
P3	Input Line Fuses Rated to 200 kAIC —Provide high-level fault protection of the drive input power circuit from the load side of the fuses to the input side of the power transistors. This option consists of three 200 kA fuses, which are factory mounted in the enclosure.	Input
P7	MOV Surge Suppressor —Provides a Metal Oxide Varistor (MOV) connected to the line side terminals and is designed to clip line side transients.	Input
P8	TVSS Surge Protective Device with 50 kA Rating —Provides transient voltage protection eliminating surges and spikes which can damage the diode bridge of the drive.	Input
PC	Capacitor Contactor —This option provides a contactor between the tuned reactor and capacitor to disconnect the capacitor from the circuit when desired, typically at light or no load conditions. This contactor is wired to a programmable relay output.	Input
PE	Output Contactor —Provides a means for positive disconnection of the drive output from the motor terminals. The contactor coil is controlled by the drive's run or permissive logic. NO auxiliary contacts rated at 10A, 600 Vac are provided for customer use. Bypass options RB and RA include an output contactor as standard. This option includes a low VA 115 Vac fused control power transformer and is factory mounted in the enclosure.	Output
PF	Output Filter —Used to reduce the transient voltage (DV/DT) at the motor terminals. The output filter is recommended for cable lengths exceeding 100 ft (30m) or for a drive rated at 525–690V. This option is mounted in the enclosure, and may be used in conjunction with a brake chopper circuit.	Output
PG	MotoRx (300–600 ft) 1000 V/μs DV/DT Filter —Used to reduce transient voltage (DV/DT) and peak voltages at the motor terminals. This option is comprised of a 0.5% line reactor, followed by capacitive filtering and an energy recovery/clamping circuit. Unlike the output filter (see option PF), the MotoRx recovers most of the energy from the voltage peaks, resulting in a lower voltage drop to the motor, and therefore conserving power. This option is used when the distance between a single motor and the drive is 300–600 ft (91–183m). <i>This option cannot be used with the brake chopper circuit. The output filter (option PF) should be investigated as an alternative.</i>	Output
PH	Single Overload Relay —Uses a bimetallic overload relay to provide additional overload current protection to the motor on configurations without bypass options. It is included with the bypass configurations for overload current protection in the bypass mode. The overload relay is mounted within the enclosure, and is manually resettable. Heater pack included.	Output
PI	Dual Overload Relays —This option is recommended when a single drive is operating two motors and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable. Heater packs not included.	Output
PN	Dual Overloads for Bypass —This option is recommended when a single drive is operating two motors in the bypass mode and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable.	Addl. bypass

Available Control/Communications Options, continued

Option	Description	Option Type
RA	Manual HOA Bypass Controller —The manual HAND/OFF/AUTO (HOA)—three-contactor—bypass option provides a means of bypassing the enclosed passive filtered drive, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input HMCP, a fused control power transformer, and a full voltage bypass starter with a door-mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in the inverter mode. IEC type input, bypass and input contactors are provided. The contactors are mechanically and electrically interlocked (see wiring diagram on Page V6-T2-223).	Bypass
RB	Manual IOB Bypass Controller —The manual INVERTER/OFF/BYPASS (IOB)—three-contactor—bypass option provides a means of bypassing the enclosed passive filtered drive, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input HMCP, a fused control power transformer, and a full voltage bypass starter with a door-mounted IOB selector switch. IEC type input, bypass and input contactors are provided. The contactors are mechanically and electrically interlocked (see wiring diagram on Page V6-T2-223).	Bypass
RC	Auto Transfer HOA Bypass Controller —The manual HAND/OFF/AUTO (HOA)—three-contactor—bypass option provides a means of bypassing the enclosed passive filtered drive, allowing the AC motor to be operated at full speed directly from the AC supply line. The circuitry provides an automatic transfer of the load to “across the line” operation after a drive trip. This option consists of an input HMCP, a fused control power transformer, and a full voltage bypass starter with a door-mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in either mode. IEC type input, bypass and input contactors are provided. The contactors are mechanically and electrically interlocked (see wiring diagram on Page V6-T2-223). Door-mounted pilot lights are provided that indicate bypass or inverter operation. A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode.	Bypass
	WARNING: The motor may restart when the overcurrent relay is reset when operating in bypass, unless the IOB selector switch is turned to the OFF position.	
RD	Auto Transfer IOB Bypass Controller —The auto INVERTER/OFF/BYPASS (IOB)—three-contactor—bypass option provides a means of bypassing the enclosed passive filtered drive, allowing the AC motor to be operated at full speed directly from the AC supply line. The circuitry provides an automatic transfer of the load to “across the line” operation after a drive trip. This option consists of an input HMCP, a fused control power transformer, and a full voltage bypass starter with a door-mounted IOB selector switch. IEC type input, bypass and input contactors are provided. The contactors are mechanically and electrically interlocked (see wiring diagram on Page V6-T2-223). Door-mounted pilot lights are provided that indicate bypass or inverter operation. A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode.	Bypass
	WARNING: The motor may restart when the overcurrent relay is reset when operating in bypass, unless the IOB selector switch is turned to the OFF position.	
RG	Reduced Voltage Starter for Bypass —Used in conjunction with bypass option RA, RB, RC or RD. This option adds IT . Series reduced voltage soft starter to bypass assembly for soft starting in bypass mode.	Bypass
S4	Floor Stand 6 in —Raises “F” box off the ground 6 in (152.4 mm). Recommended when box is not installed on an appropriate concrete pad.	Enclosure
S5	Floor Stand 22 in —Converts a Size B or C, normally wall mounted enclosure to a floor standing enclosure with a height of 22 in (558.8 mm).	Enclosure
S6	Floor Stand 12 in —Converts a Size C or D, normally wall mounted enclosure to a floor standing enclosure with a height of 12 in (304.8 mm).	Enclosure
S9	Space Heater —Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. Heater requires a customer supplied 115V remote supply source.	Enclosure

Enclosed Drive Options

Conformal (Varnished) Coating ^①

Chassis Frame	Delivery Code
FR6	FP
FR7	FP
FR8	FP
—	—

Chassis Frame	Delivery Code
FR9	FP
FR10	FP
FR11	FP
FR12	FP

Control Options

Description	Catalog Number Suffix
Door-mounted speed potentiometer	K1
Door-mounted speed potentiometer with HOA selector switch	K2
3-15 psig follower	K3
HOA selector switch	K4
MANUAL/AUTO reference switch	K5
START-STOP pushbuttons	K6
Type D2 control relay	SD
On-delay relay	SE
Off-delay relay	SF
Additional terminal blocks per 4 points	SD

Note^① See catalog number description to order.

Light Options

Description	Catalog Number Suffix
Power on, run, fault LED lights (22 mm)	L1
Power on, fault LED lights (22 mm)	L3
Green LED run light (22 mm)	LA
Green LED stop light (22 mm)	LD
Red LED run light (22 mm)	LE
Red LED stop light (22 mm)	LF
Red LED fault light (22 mm)	LG
Power on white LED light (22 mm)	LJ
Miscellaneous LED light (22 mm)	LU

Bypass Control Options

Description	Catalog Number Suffix
Bypass test switch used with RA and RB	KF
Inverter/bypass pilot lights	L2

Meter Options

Description	Catalog Number Suffix
Standard elapsed time meter	KO
Frequency meter	KS
MP-3000 relay with URTD	KV
MP-3000 relay with URTD and CTs	KU

Enclosure Options

Enclosure Size	Catalog Number Suffix
Space Heater ①	
7	S9
8	S9
9	S9
B	S9
C	S9
D	S9
F	S9
Plastic Nameplate	
All	SN
Floor Stand/Enclosure Size	
6 in floor stand, size F	S4
22 in floor stand, size B and C	S5
12 in floor stand, size C and D	S6

208V Power Options, 7-1/2-100 hp

Description	Catalog Number Suffix
Input breaker	P1
Input line fusing	P2
Input line fuses 200 kAIC	P3
Output contactor	PE
Single overload relay	PH
Dual overload relays	PI
MOV	P7
50 kA surge protective device	P8
100 kA surge protective device	P9

230V Power Options, 7-1/2-125 hp

Description	Catalog Number Suffix
Input breaker	P1
Input line fusing	P2
Input line fuses 200 kAIC	P3
Output contactor	PE
Single overload relay	PH
Dual overload relays	PI
MOV	P7
50 kA surge protective device	P8
100 kA surge protective device	P9

480 and 575V Power Options, 7-1/2-400 hp

Description	Catalog Number Suffix
Input breaker	P1
Input line fusing	P2
Input line fuses 200 kAIC	P3
Output contactor	PE
Output filter	PF
MotoRx (300–600 ft) DV/DT filter	PG
Single overload relay	PH
Dual overload relays	PI
Input MOV	P7
50 kA surge protective device	P8
100 kA surge protective device	P9

208V Bypass Options, 7-1/2-100 hp

Description	Catalog Number Suffix
Manual HOA bypass controller	RA
IOB bypass controller	RB
Auto transfer HOA bypass controller	RC
Auto transfer IOB bypass controller	RD
Reduced voltage starter for bypass	RG
Dual overloads for bypass	PN

230V Bypass Options, 7-1/2-125 hp

Description	Catalog Number Suffix
Manual HOA bypass controller	RA
IOB bypass controller	RB
Auto transfer HOA bypass controller	RC
Auto transfer IOB bypass controller	RD
Reduced voltage starter for bypass	RG
Dual overloads for bypass	PN

480 and 575V Bypass Options, 7-1/2-400 hp

Description	Catalog Number Suffix
Manual HOA bypass controller	RA
IOB bypass controller	RB
Auto transfer HOA bypass controller	RC
Auto transfer IOB bypass controller	RD
Reduced voltage starter for bypass	RG
Dual overloads for bypass	PN

Note

① Requires customer-supplied 115 Vac supply.

Technical Data and Specifications

Enclosed Passive Filtered Drives

Description	Specification
Primary Design Features	
45–66 Hz input frequency	Standard
Output: AC volts maximum	Input Voltage Base
Output frequency range	0–320 Hz
Initial output current (I_H)	250% for 2 seconds
Overload (1 minute [I_H/I_L])	150%/110%
Enclosure space heater	Optional
Oversize enclosure	Standard
Output contactor	Optional
Bypass motor starter	Optional
Listings	UL, cUL, 508C
Protection Features	
Incoming line fuses	Optional
AC input circuit disconnect	Optional
Phase rotation insensitive	Standard
EMI filter	Standard—FR6 thru FR9 ^①
Input phase loss protection	Standard
Input overvoltage protection	Standard
Line surge protection	Standard
Output short-circuit protection	Standard
Output ground fault protection	Standard
Output phase protection	Standard
Overtemperature protection	Standard
DC overvoltage protection	Standard
Drive overload protection	Standard
Motor overload protection	Standard
Programmer software	Optional
Local/remote keypad	Standard
Keypad lockout	Standard
Fault alarm output	Standard
Built-in diagnostics	Standard
Surge protective device	Optional
Input/Output Interface Features	
Setup adjustment provisions	
Remote keypad/display	Standard
Personal computer	Standard
Operator control provisions	
Drive mounted keypad/display	Standard
Remote keypad/display	Standard
Conventional control elements	Standard
Serial communications	Optional
115 Vac control circuit	Optional
Speed setting inputs	
Keypad	Standard
0–10 Vdc potentiometer/voltage signal	Standard
4–20 mA isolated	Configurable
4–20 mA differential	Configurable
3–15 psig	Optional
Analog outputs	
Speed/frequency	Standard
Torque/load/current	Programmable
Motor voltage	Programmable
Kilowatts	Programmable
0–10 Vdc signals	Configurable w/jumpers
4–20 mA DC signals	Standard
Isolated signals	Optional
Discrete outputs	
Fault alarm	Standard
Drive running	Standard
Drive at set speed	Programmable
Optional parameters	14
Dry contacts	2 relays Form C
Open collector outputs	1
Additional discrete outputs	Optional
Communications	
RS-232	Standard
RS-422/485	Optional
DeviceNet™	Optional
Modbus RTU	Optional
CANopen (slave)	Optional
PROFIBUS-DP	Optional
Lonworks®	Optional
Johnson Controls Metasys™ N2	Optional
EtherNet/IP/Modbus TCP	Optional
BACnet	Optional

Note

^① The EMI filter is optional in FR10.

Enclosed Passive Filtered Drives, continued

Description	Specification
Performance Features	
Sensorless vector control	Standard
Volts/hertz control	Standard
IR and slip compensation	Standard
Electronic reversing	Standard
Dynamic braking	Optional
DC braking	Standard
PID setpoint controller	Programmable
Critical speed lockout	Standard
Current (torque) limit	Standard
Adjustable acceleration/deceleration	Standard
Linear or S curve accel/decel	Standard
Jog at preset speed	Standard
Thread/preset speeds	7
Automatic restart	Selectable
Coasting motor start	Standard
Coast or ramp stop selection	Standard
Elapsed time meter	Optional
Standard Conditions for Application and Service	
Maximum operating ambient temperature	0 to 40°C, contact factory for 50°C ^①
Storage temperature	-40 to 60°C
Humidity (maximum), non-condensing	95%
Altitude	100% load capacity (no derating) up to 3280 ft (1000m); 1% derating for each 328 ft (100m) above 3280 ft (1000m); max. 9842 ft (3000m)
Line voltage variation	+10/-15%
Line frequency variation	45–66 Hz
Efficiency	>96%
Power factor (displacement)	0.99

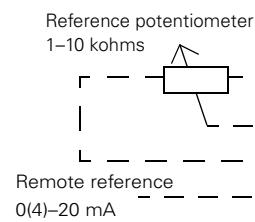
Standard I/O Specifications

Description	Specification
Six-digital input programmable	24V: "0" ≤10V, "1" ≥18V, $R_i > 5\text{ kohms}$
Two-analog input configurable w/jumpers	Voltage: 0–10V, $R_i > 200\text{ kohms}$ Current: 0 (4)–20 mA, $R_i = 250\text{ kohms}$
Two-digital output programmable	Form C relays 250 Vac or 30 Vdc 2 Amp resistive
One-digital output programmable	Open collector 48 Vdc 50 mA
One-analog output programmable	0–20 mA, R_L max. 500 ohms 10 bits ±2% configurable w/jumper

I/O Specifications for Control/Communication Options

Description	Specification
Analog voltage, input	0–10V, $R_i \geq 200\text{ kilohms}$
Analog current, input	0 (4)–20 mA, $R_i = 250\text{ ohms}$
Digital input	24V: "0" ≤10V, "1" ≥18V, $R_i > 5\text{ kilohms}$
Auxiliary voltage	24V (±20%), max. 50 mA
Reference voltage	10V ±3%, max. 10 mA
Analog current, output	0 (4)–20 mA, $R_L = 500\text{ kilohms}$, resolution 10 bit, accuracy ≤2%
Analog voltage, output	0 (2)–10V, $R_L \geq 1\text{ kohm}$, resolution 10 bit, accuracy ≤2%
Relay output max. switching voltage	300 Vdc, 250 Vac
Relay output max. switching load	3A/24 Vdc, 300 Vdc, 250 Vac ^②
Relay output max. continuous load	2A rms
Thermistor input	$R_{trip} = 4.7\text{ kohms}$

Notes^① Units FR10 rated 40°C.^② For applications above 3A consult instruction manual.

Wiring Diagram**Control Input/Output****Basic Application Default I/O Configuration**

Terminal	Signal	Description		
OPTA9				
1	+10V _{ref}	Reference output	Voltage for potentiometer, etc.	
2	AI1+	Analog input, voltage range 0–10 Vdc	Voltage input frequency reference	
3	AI1–	I/O Ground	Ground for reference and controls	
4	AI2+	Analog input, current range 0–20 mA	Current input frequency reference	
5	AI2–			
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A	
7	GND	I/O ground	Ground for reference and controls	
8	DIN1	Start forward	Contact closed = start forward	
9	DIN2	Start reverse	Contact closed = start reverse	
10	DIN3	External fault input (programmable)	Contact open = no fault Contact closed = fault	
11	CMA	Common for DIN 1–DIN 3	Connect to GND or +24V	
12	+24V	Control voltage output	Voltage for switches (see terminal 6)	
13	GND	I/O ground	Ground for reference and controls	
14	DIN4	Multi-step speed select 1	DIN4	DIN5
15	DIN5	Multi-step speed select 2	Open Closed Open Closed Closed	Open Open Closed Closed Ref _{Max}
16	DIN6	Fault reset	Contact open = no action Contact closed = fault reset	
17	CMB	Common for DIN4–DIN6	Connect to GND or +24V	
18	A01+	Output frequency	Programmable	
19	A01–	Analog output	Range 0–20 mA, R _L max. 500 ohms	
20	D01	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48 Vdc	
OPTA2				
21	RO1		Relay output 1 RUN	
22	RO1			
23	RO1			
24	RO2		Relay output 2 FAULT	
25	RO2			
26	RO2			

2.8

Adjustable Frequency Drives

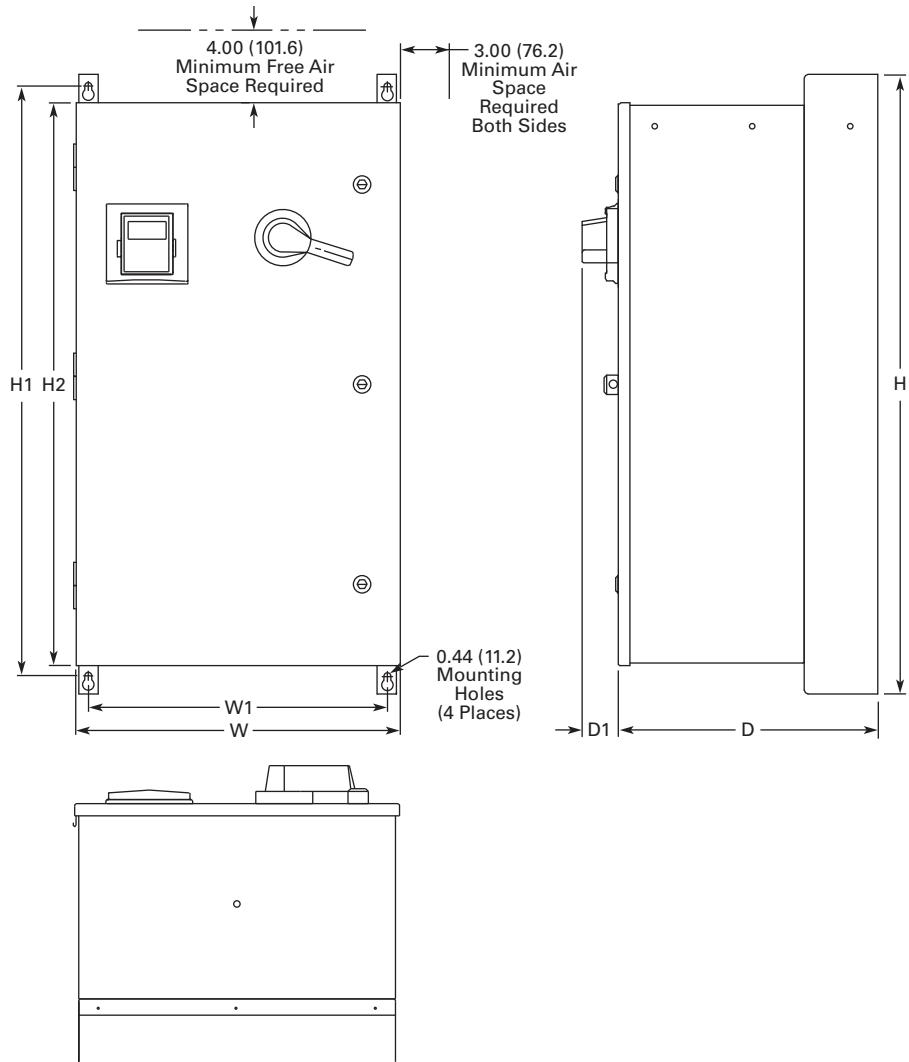
Low Harmonic Drives

Dimensions

Approximate Dimensions in Inches (mm)

2

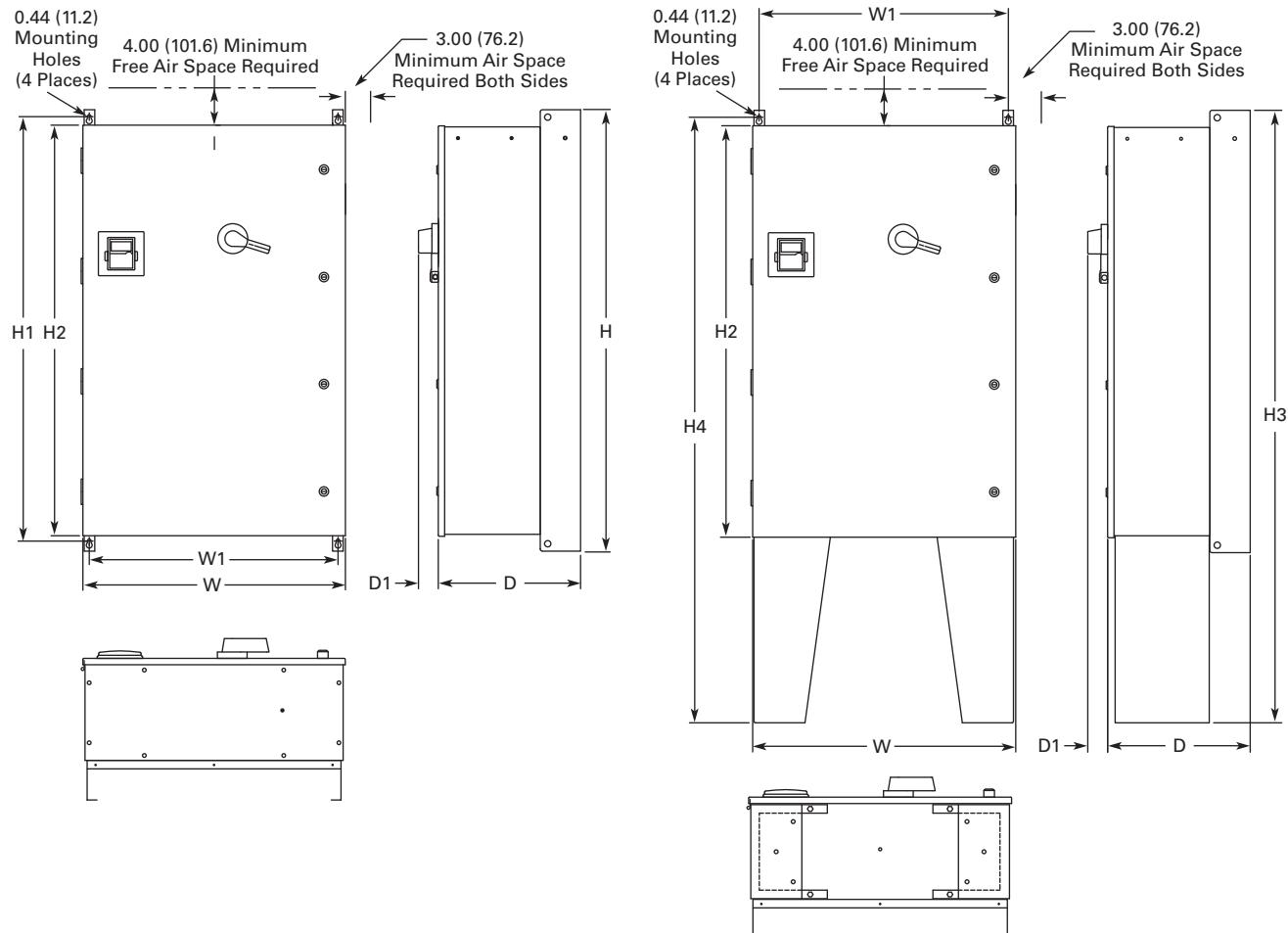
Enclosure Size B—UL Type 12



H	H1	H2	W	W1	D	D1	Approximate Weight Lbs (kg)	Approximate Shipping Weight Lbs (kg)
40.00 (1016.0)	38.00 (965.2)	36.35 (923.3)	20.92 (531.4)	19.30 (490.2)	16.76 (425.7)	2.34 (59.4)	185 (84)	229 (104)

Approximate Dimensions in Inches (mm)

Enclosure Size C—UL Type 12



H	H1	H2	H3	H4	W	W1	D	D1	Approximate Weight Lbs (kg)	Approximate Shipping Weight Lbs (kg)
52.00 (1320.8)	50.00 (1270.0)	48.35 (1228.1)	72.00 (1828.8)	71.19 (1808.2)	30.92 (785.4)	29.30 (744.2)	16.78 (426.2)	2.34 (59.4)	320 (145)	435 (197)

2.8

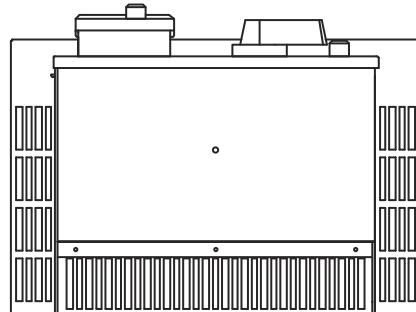
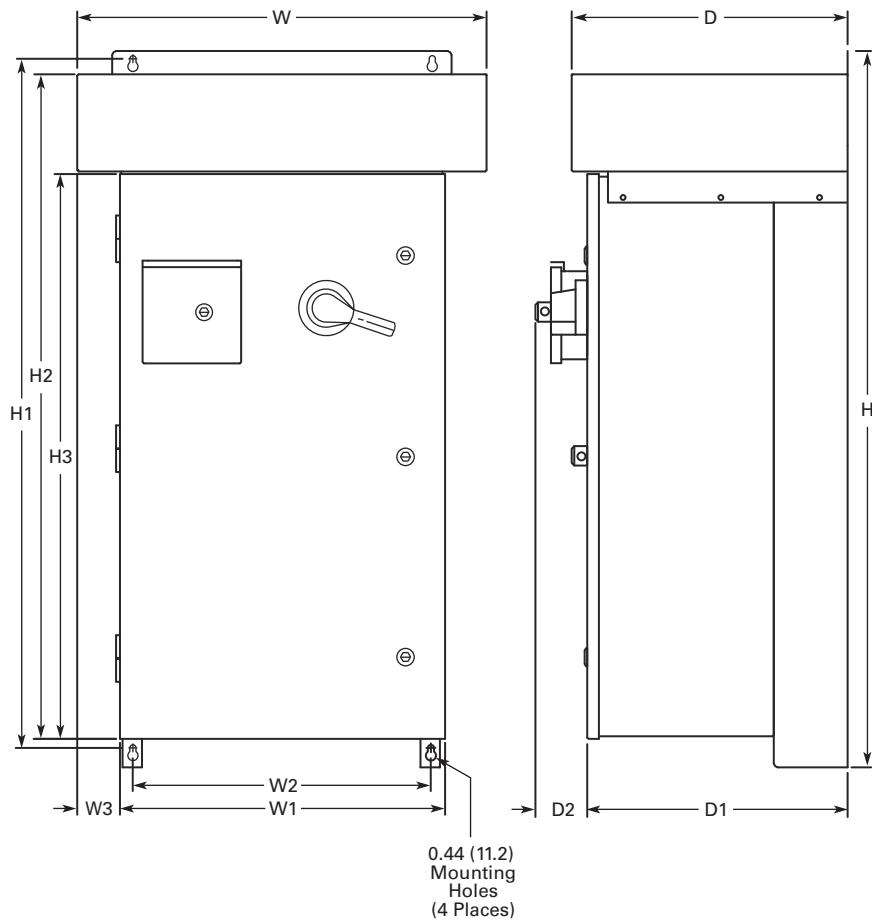
Adjustable Frequency Drives

Low Harmonic Drives

Approximate Dimensions in Inches (mm)

Enclosure Size B—UL Type 3R

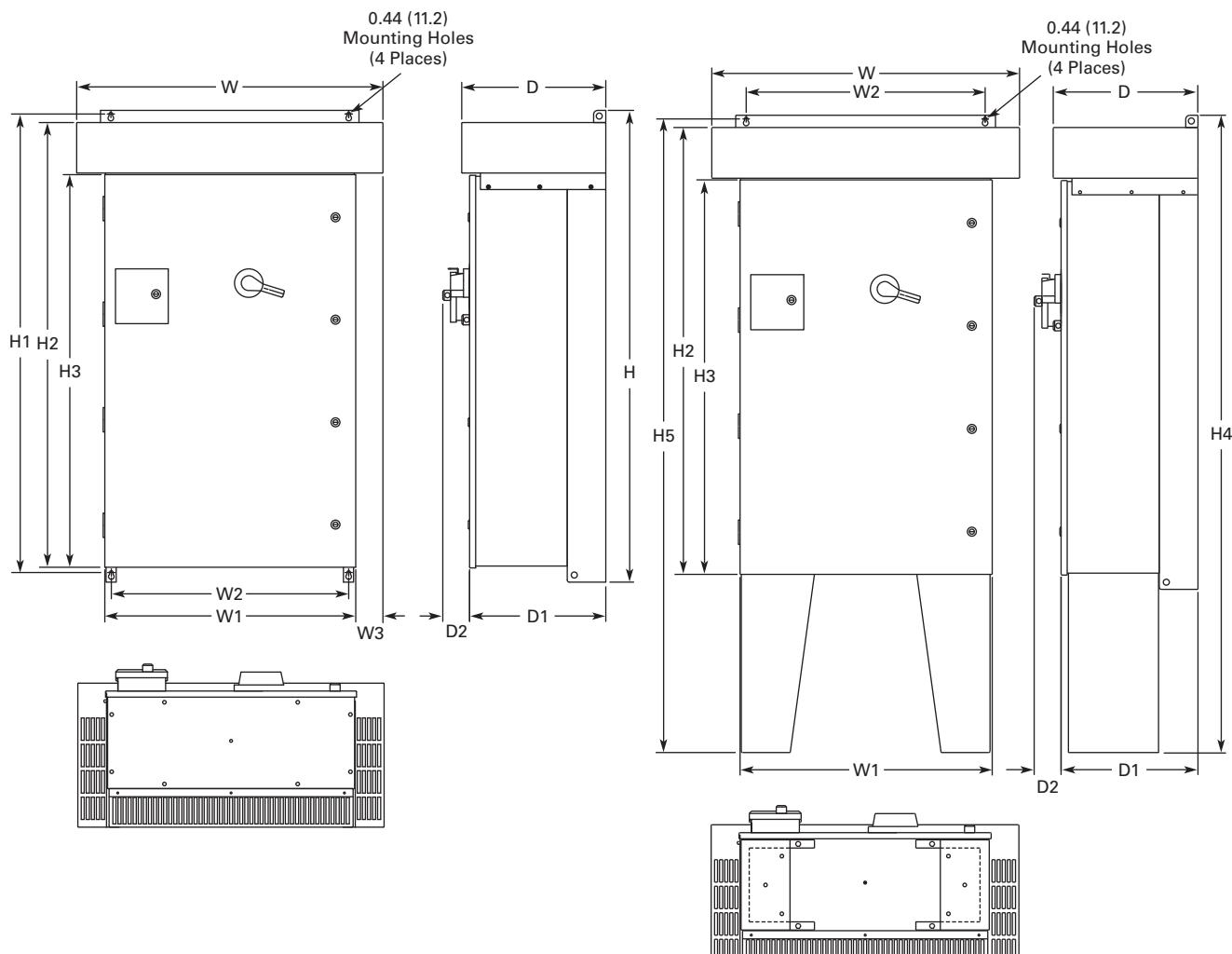
2



H	H1	H2	H3	W	W1	W2	W3	D	D1	D2	Approximate Weight Lbs (kg)	Approximate Shipping Weight Lbs (kg)
46.09 (1170.7)	44.45 (1129.0)	42.77 (1086.4)	36.35 (923.3)	26.31 (668.3)	20.92 (531.4)	19.30 (490.2)	2.69 (68.3)	17.74 (450.6)	16.76 (425.7)	3.31 (84.1)	235 (107)	290 (132)

Approximate Dimensions in Inches (mm)

Enclosure Size C—UL Type 3R



H	H1	H2	H3	H4	H5	W	W1	W2	W3	D	D1	D2	Approximate Weight Lbs (kg)	Approximate Shipping Weight Lbs (kg)
58.09 (1475.5)	56.45 (1433.8)	54.77 (1391.2)	48.35 (1228.1)	78.09 (1983.5)	77.64 (1972.1)	37.73 (958.3)	30.92 (785.4)	29.30 (744.2)	3.34 (84.8)	17.74 (450.6)	16.77 (426.0)	3.31 (84.1)	370 (168)	485 (220)

2.8

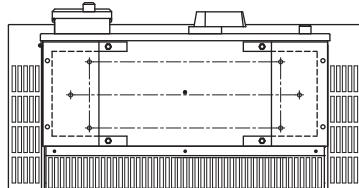
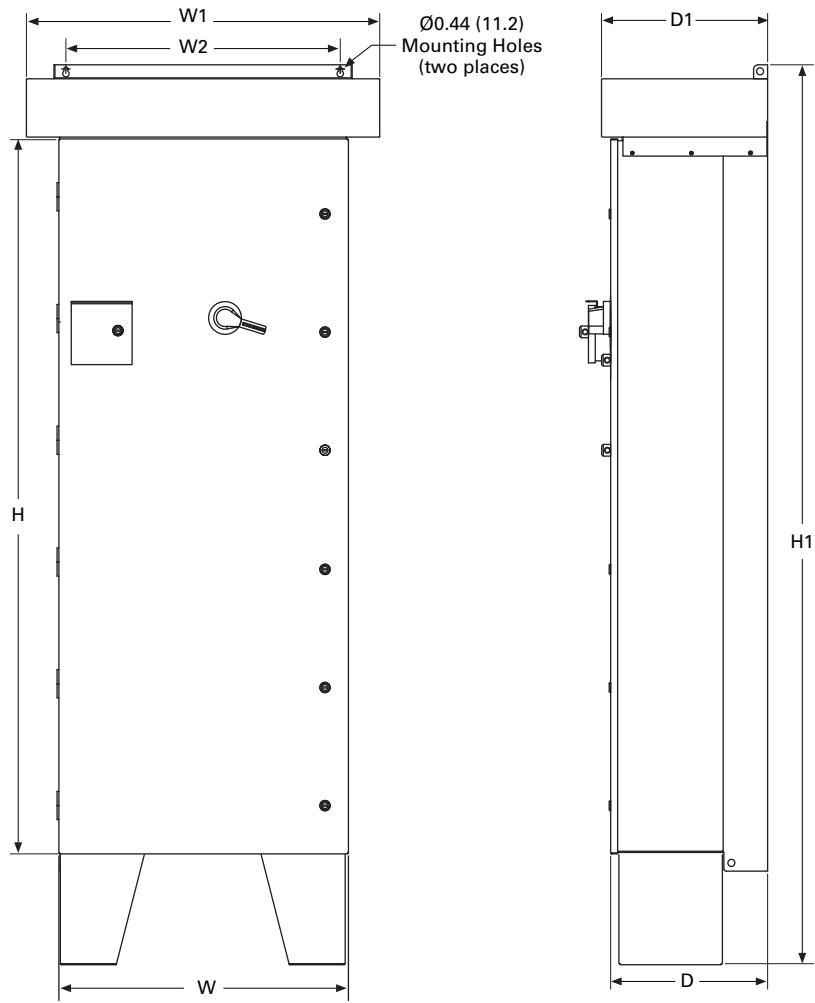
Adjustable Frequency Drives

Low Harmonic Drives

Approximate Dimensions in Inches (mm)

Enclosure Size D—UL Type 3R

2

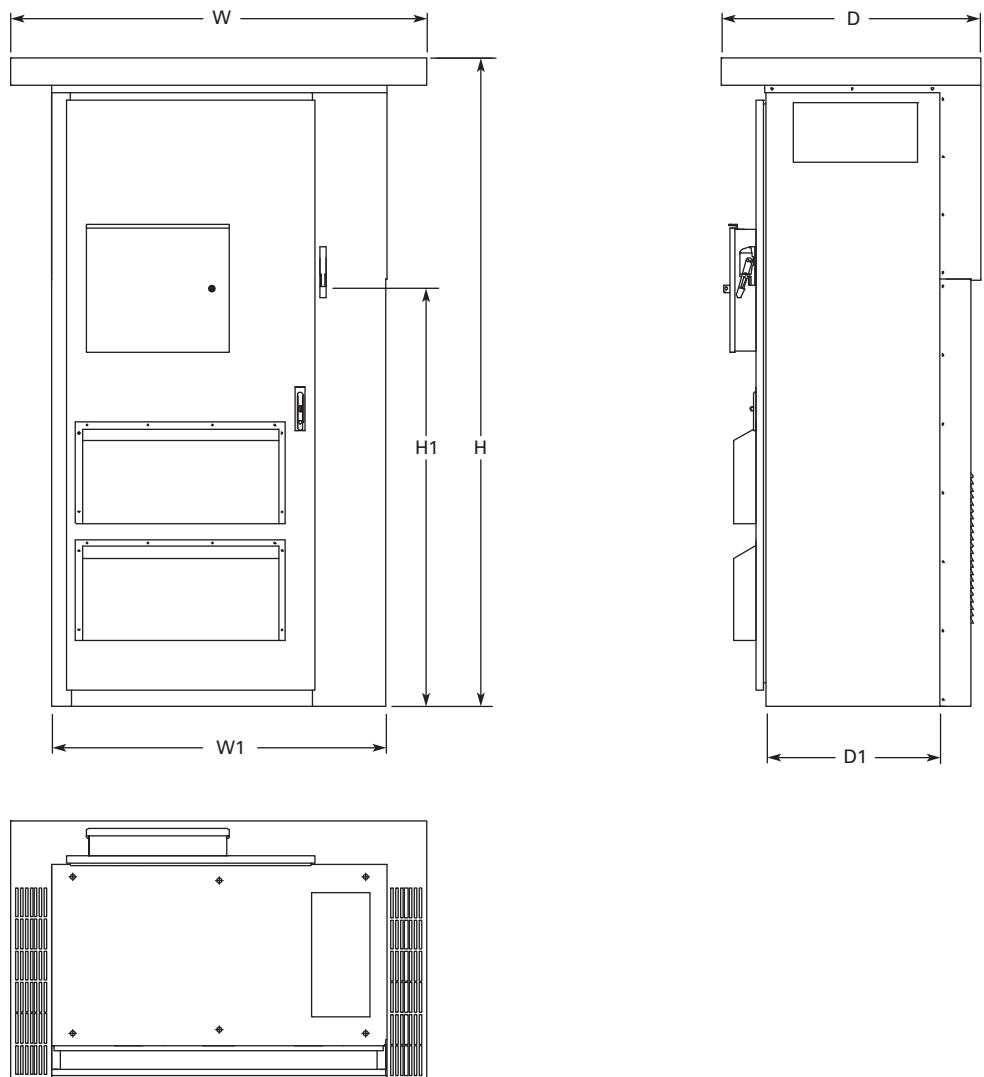


H	H1	W	W1	W2	D	D1	Approximate Shipping Weight Lbs (kg)
76.27 (1937.3)	96.00 (2438.4)	30.92 (784.4)	37.73 (958.3)	29.30 (744.2)	16.76 (424.7)	17.74 (450.6)	1000 (454)

Note

Shown with optional floor stands.

Approximate Dimensions in Inches (mm)

Enclosure Size F

H	H1	W	W1	D	D1	Approximate Weight Lbs (kg)	Approximate Shipping Weight Lbs (kg)
93.58 (2376.9)	69.51 (1765.60)	60.00 (1524.0)	48.00 (1219.2)	37.50 (952.5)	26.00 (660.4)	1700 (771)	1850 (839)

2.8

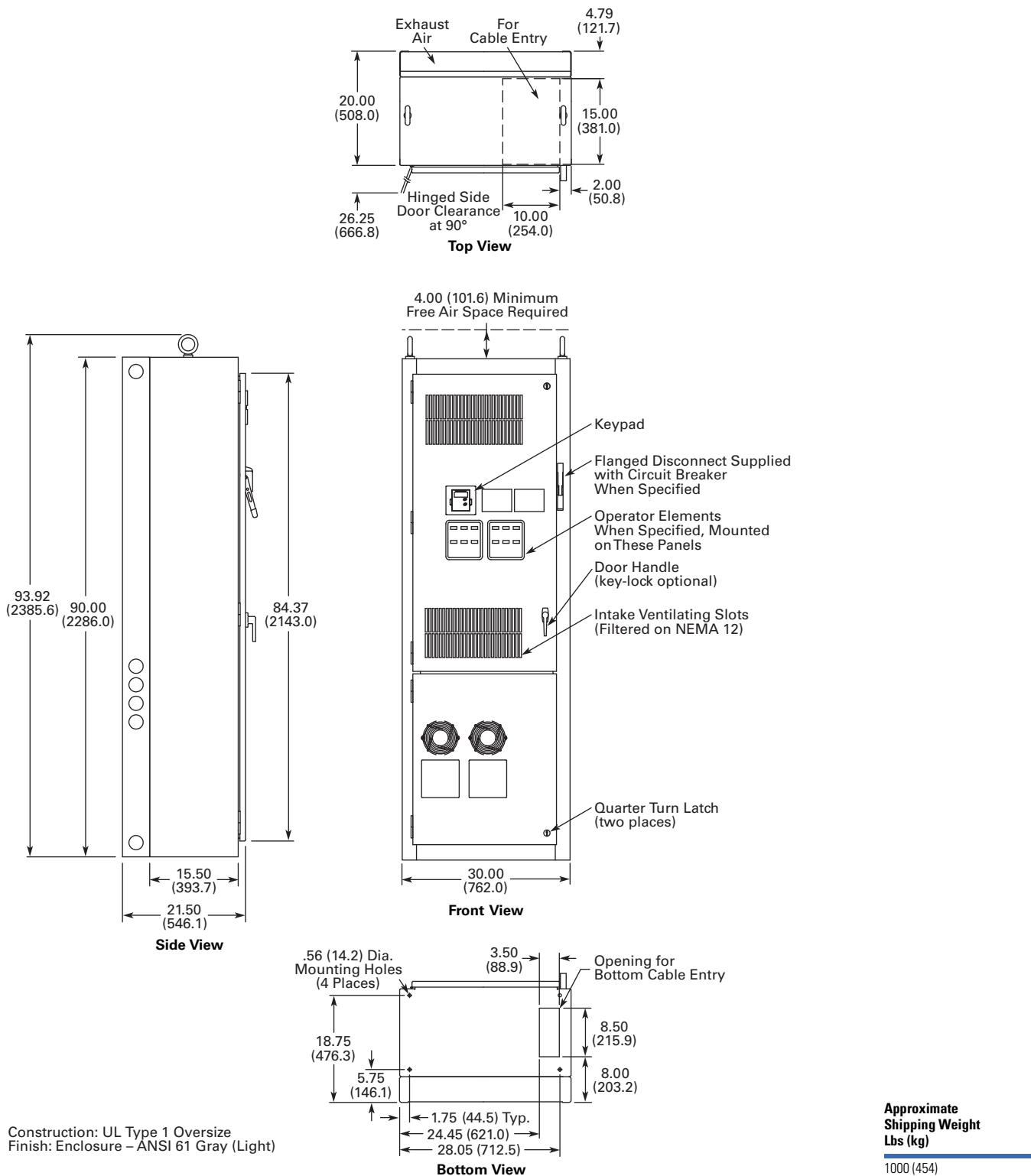
Adjustable Frequency Drives

Low Harmonic Drives

Approximate Dimensions in Inches (mm)

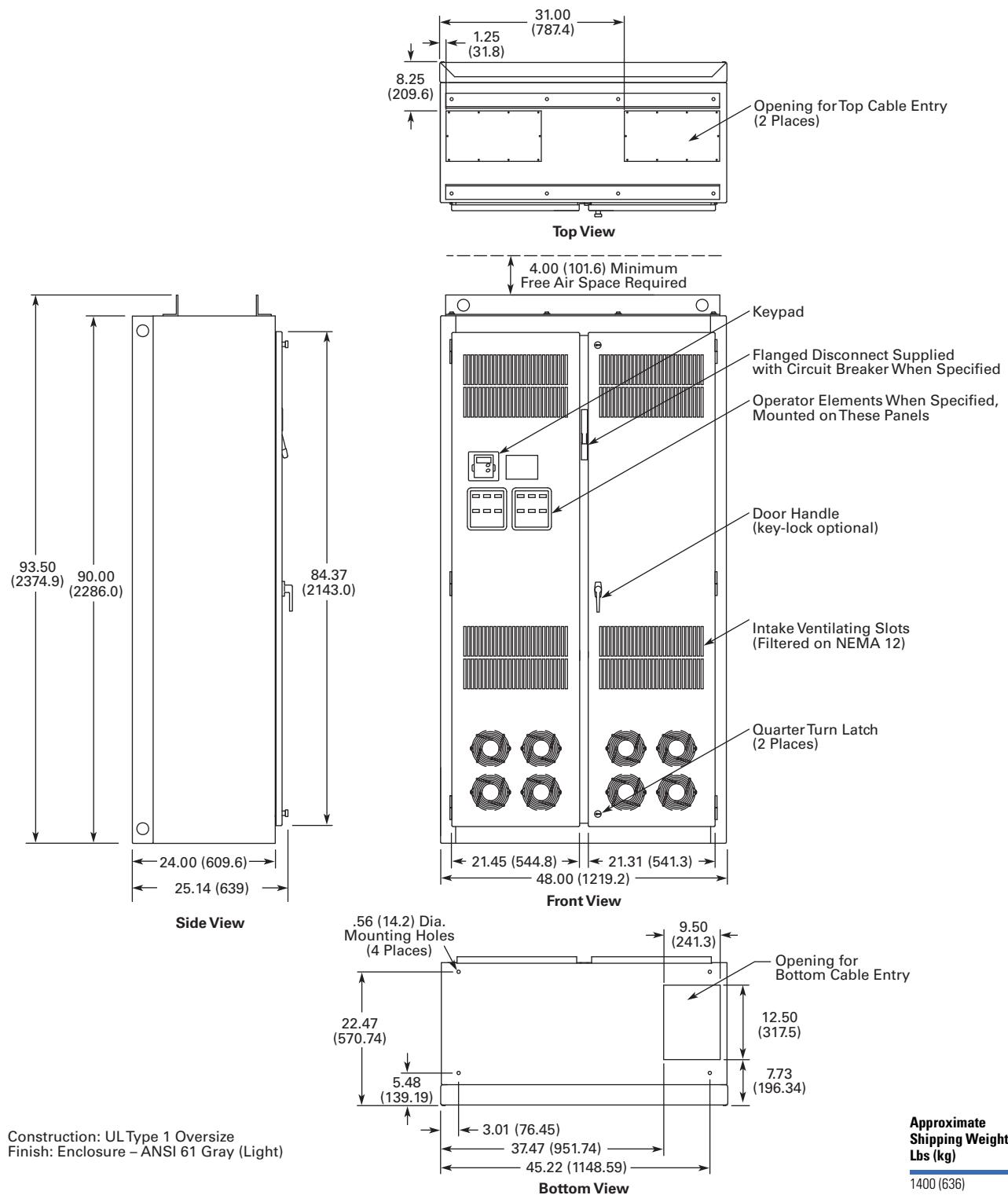
Enclosure Size 7

2



Approximate Dimensions in Inches (mm)

Enclosure Size 8



2.8

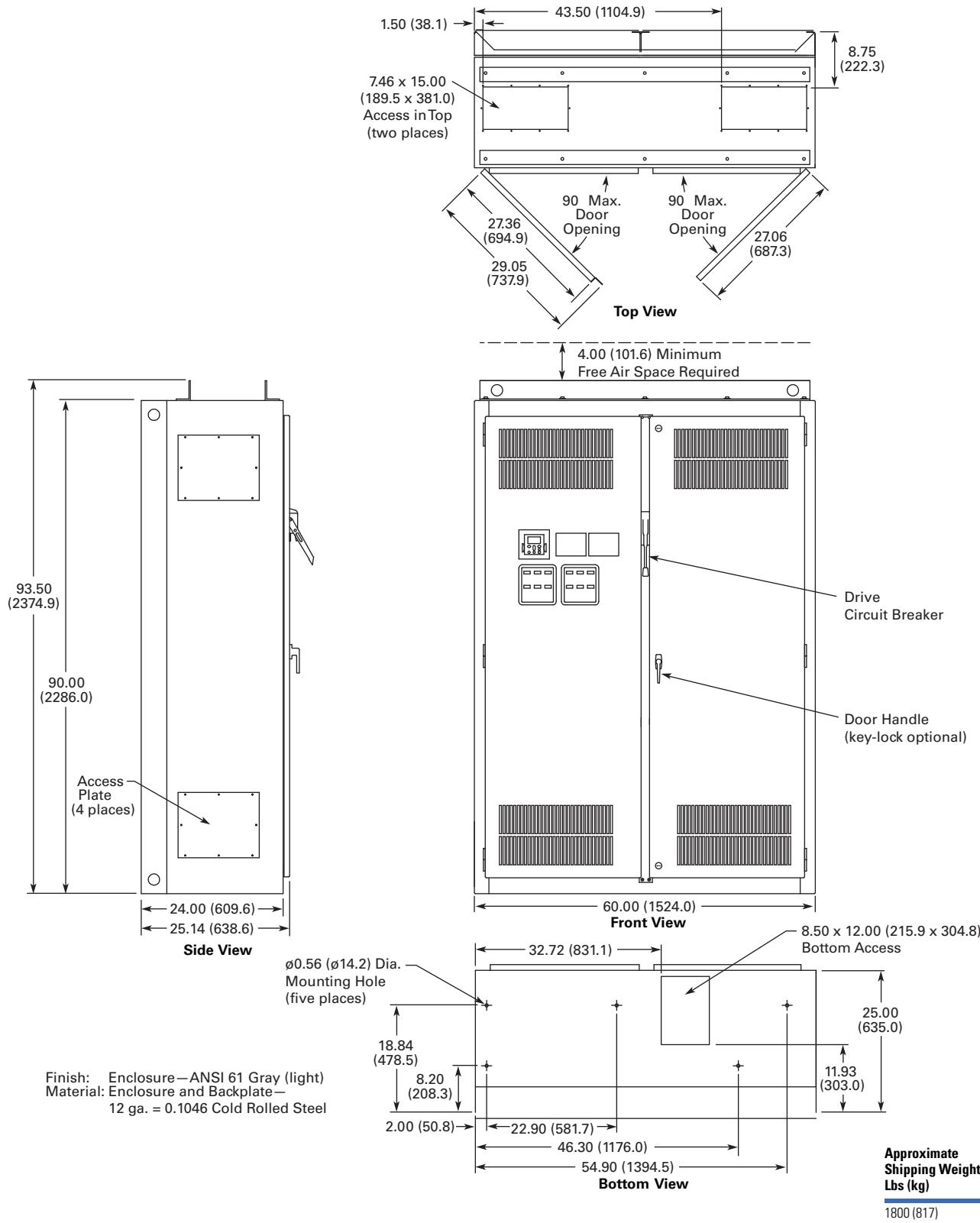
Adjustable Frequency Drives

Low Harmonic Drives

Approximate Dimensions in Inches (mm)

Enclosure Size 9

2



Enclosed 18-Pulse Drives**Contents****Description**

	Page
Enclosed Passive Filtered Drives	V6-T2-200
Enclosed 18-Pulse Drives	
Application Description	V6-T2-234
Features and Benefits	V6-T2-239
Catalog Number Selection	V6-T2-240
Product Selection	V6-T2-241
Options	V6-T2-249
Technical Data and Specifications	V6-T2-255
Wiring Diagrams	V6-T2-257
Dimensions	V6-T2-258

Enclosed 18-Pulse Drives**Product Description**

Eaton's enclosed 18-pulse clean power drives use advanced 18-pulse clean power technology that significantly reduces line harmonics at the drive input terminals, resulting in one of the purest sinusoidal waveforms available.

The enclosed 18-pulse drive also delivers True Power Factor—in addition to reducing harmonic distortion, the enclosed 18-pulse drive prevents upstream transformer overheating and overloading of breakers and feeders, enabling the application of adjustable frequency drives on generators and other high impedance power systems.

All 9000X Series drives are constant torque rated and rated for either high overload (I_H) or low overload (I_L). I_H indicates 150% overload capacity for 1 minute out of 10 minutes. I_L indicates 110% overload capacity for 1 minute out of 10 minutes.

Enclosed 18-Pulse Drive Products

- **Standard Enclosed**—covers a wide range of the most commonly ordered options. Pre-engineering eliminates the lead time normally associated with customer specific options. Available configurations are listed on **Pages V6-T2-240** and **V6-T2-249** to **V6-T2-254**.
- **Modified Standard Enclosed**—applies to specific customer requirements that vary from the Standard Enclosed offering, such as the need for an additional indicating light or minor modifications to drawings. *Contact your local sales office for assistance in pricing and lead time.*

- **Custom Engineered**—for those applications with more unique or complex requirements, these are individually engineered to the customer's needs. *Contact your local sales office for assistance in pricing and lead time.*

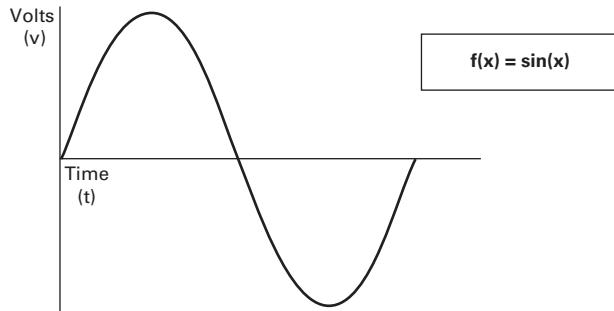
Application Description

Designed to exceed the IEEE® 519-1992 requirements for harmonic distortion, the enclosed 18-pulse drive is the clear choice for applications in

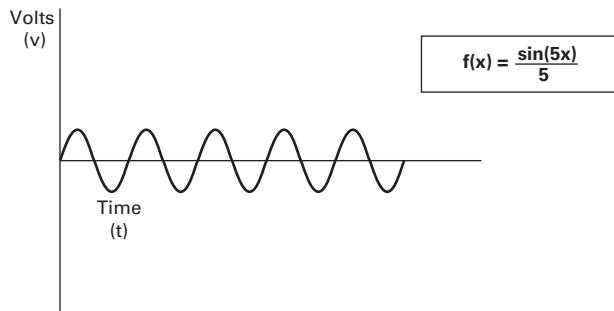
the water, wastewater, HVAC, industrial and process industries where harmonics are a concern.

What Are Harmonics?

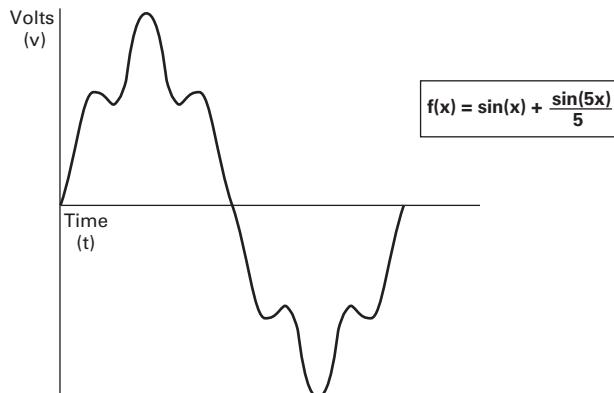
Take a perfect wave with a fundamental frequency of 60 Hz, which is close to what is supplied by the power company.

Perfect Wave

Add a second wave that is five times the fundamental frequency—300 Hz (typical of frequency added to the line by a fluorescent light).

Second Wave

Combine the two waves. The result is a 60 Hz supply rich in fifth harmonics.

Resulting Supply**What Causes Harmonics?**

Harmonics are the result of nonlinear loads that convert AC line voltage to DC. Examples of equipment that are non-linear loads are listed below:

- AC variable frequency drives
- DC drives
- Fluorescence lighting, computers, UPS systems
- Industrial washing machines, punch presses, welders, etc.

How Can Harmonics Due to VFDs Be Diminished?

By purchasing Eaton's enclosed 18-pulse drive that is guaranteed to meet IEEE Std. 519-1992 Harmonic Distortion Limits.

What Are Linear Loads?

Linear loads are primarily devices that run across the line and do not add harmonics. Motors are prime examples. The downside to having large motor linear loads is that they draw more energy than a VFD, because of their inability to control motor speed. In most applications, there is a turn down valve used with the motor that will reduce the flow of the material, without significantly reducing the load to the motor. While this provides some measure of speed control, it is extremely inefficient.

Why Be Concerned About Harmonics?**1. Installation and utility costs increase.**

Harmonics cause damage to transformers and lower efficiencies due to the IR loss. These losses can become significant and can have a dramatic effect on the HVAC systems that are controlling the temperatures of the building where the transformer and drive equipment reside.

2. Downtime and loss of productivity. Telephones and data transmissions links may not be guaranteed to work on the same power grids polluted with harmonics.**3. Downtime and nuisance trips of drives and other equipment.**

Emergency generators have up to three times the impedance that is found in a conventional utility source. Thus the harmonic voltage distortion can be up to three times as large, causing risk of operation problems.

4. Larger motors must be used.

Motors running across the line that are connected on polluted power distribution grids can overheat or operate at lower efficiency due to harmonics.

5. Higher installation costs.

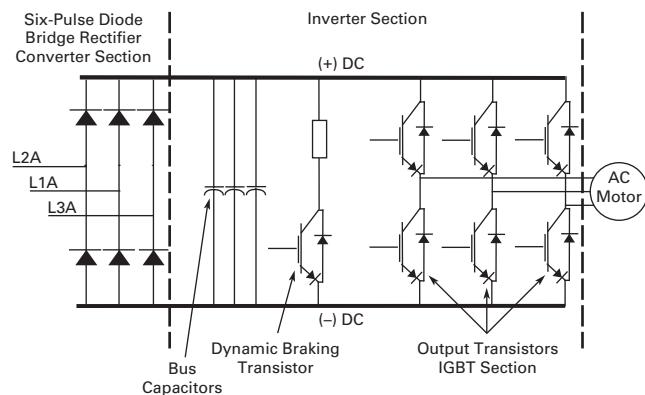
Transformers and power equipment must be oversized to accommodate the loss of efficiencies. This is due to the harmonic currents circulating through the distribution without performing useful work.

How Does a VFD Convert Three-Phase AC to a Variable Output Voltage and Frequency?

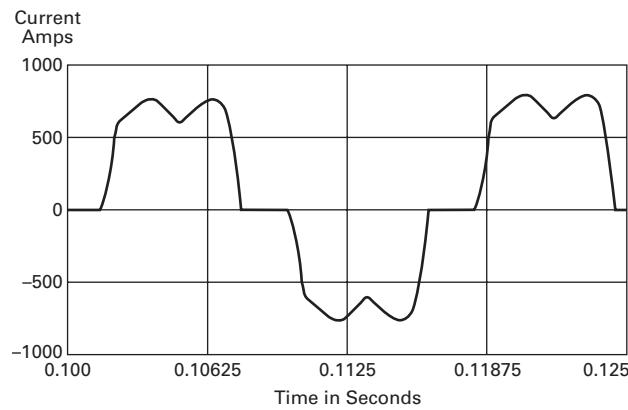
The six-pulse VFD: The majority of all conventional drives that are built consist of a six-pulse configuration. The figure below represents a six-diode rectifier design that converts three-phase utility power to DC. The inverter section uses IGBTs to convert DC power to a simulated AC sine wave that can vary in frequency from 0–320 Hz.

The six-pulse VFD drive creates harmonic current distortion. The harmonic current that is created is energy that can not be used by customers and causes external heat and losses to all components including other drives that are on the same power distribution. See the curve below showing a 500 hp drive with 167A of damaging harmonic current.

Six-Diode Rectifier Design



500 hp Six-Pulse Nonproductive Harmonic Current



500 hp Six-Pulse Nonproductive Harmonic Current

Six-Pulse Circuit

Current harmonics		
$I_1 = 100\%$	$I_{11} = 6.10\%$	$I_{19} = 1.77\%$
$I_5 = 22.5\%$	$I_{13} = 4.06\%$	$I_{23} = 1.12\%$
$I_7 = 9.38\%$	$I_{17} = 2.26\%$	$I_{25} = 0.86\%$
Power = 500 hp		
Harmonic current = 167 amps		

Guidelines of Meeting IEEE Std. 519-1992 Harmonic Distortion Limits

The IEEE 519-1992 Specification is a standard that provides guidelines for commercial and industrial

users that are implementing medium and low voltage equipment.

2

Maximum Harmonic Current Distortion in % of the Fundamental (120V through 69,000V)

I_{SC}/I_L	Harmonic Order (Odd Harmonics)					
	$h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h$	TDD
<20	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

The ratio I_{SC}/I_L is the ratio of the short-circuit current available at the point of common coupling (PCC), to the maximum fundamental load current. Consequently, as the size of the user load decreases with respect to the size of the system, the percentage of harmonic current that the user is allowed to inject into the utility system increases.

Notes

TDD = Total demand distortion is the harmonic current distortion in percent of the maximum demand load current (15 or 30 minute demand).

I_{SC} = Maximum short-circuit current at the PCC not counting motor contribution.

I_L = Maximum demand load current for all of the connected loads (fundamental frequency component) at the PCC. All of the limits are measured at a point of common coupling.

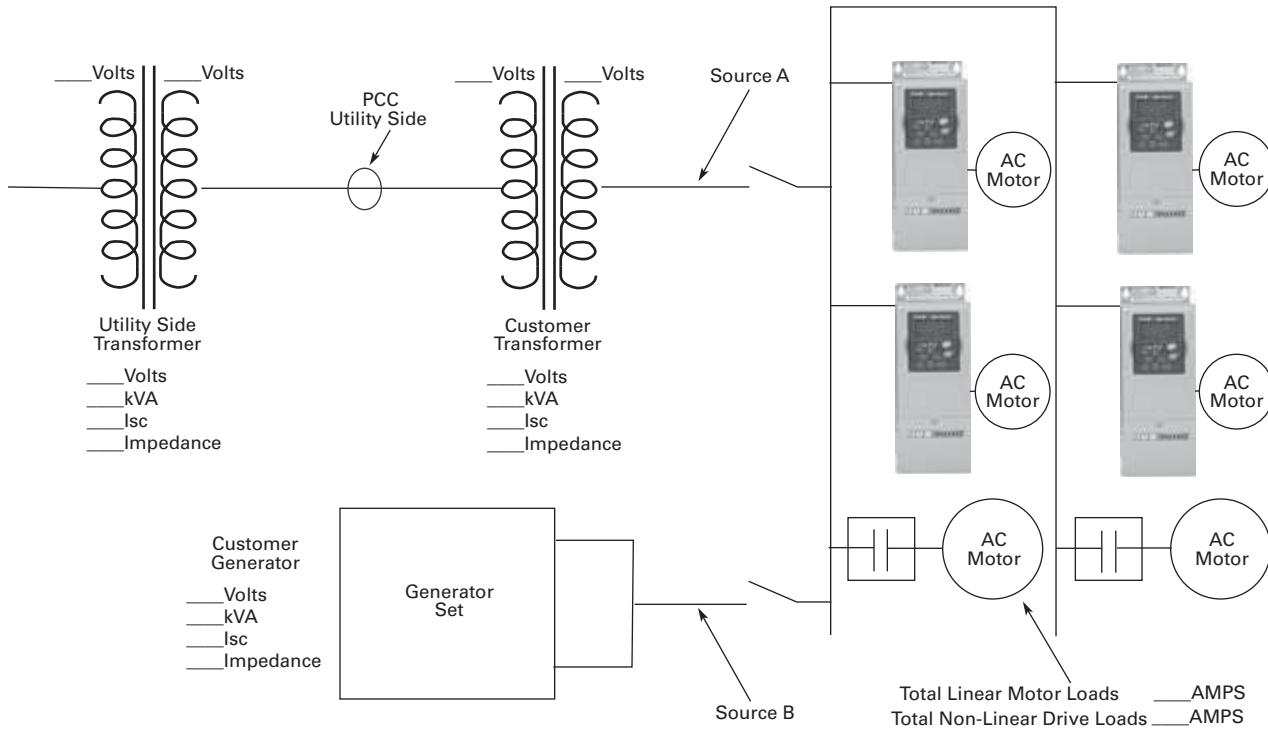
2.8

Adjustable Frequency Drives

Low Harmonic Drives

One-Line Diagram for Harmonic Analysis

2



The best way to estimate AFD harmonic contribution to an electrical system is to perform a harmonic analysis based on known system characteristics. The one-line in this figure would provide the data to complete the calculations.

Terms

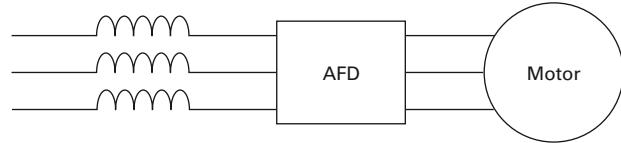
- PCC (Point of Common Coupling) is defined as the electrical connecting point between the utility and multiple customers per the specifications in IEEE 519
 - POA (Point of Analysis) is defined as where the harmonic calculations are taken
- An oscilloscope can make all measurements at the PCC or POA do an on-site harmonic evaluation.

Harmonic Reduction Methods to Meet IEEE 519

1. Line Reactor

A line reactor is a three-phase series inductance on the line side of an AFD. If a line reactor is applied on all AFDs, it is possible to meet IEEE guidelines where 10–25% of system loads are AFDs, depending on the stiffness of the line and the value of line reactance. Line reactors are available in various values of impedance, most typically 1–1.5%, 3% and 5%.

Line Reactor



Advantages

- Low cost
- Can provide moderate reduction in voltage and current harmonics
- Available in various values of impedance
- Provides increased input protection for AFD and its semiconductors from line transients

Disadvantages

- May not reduce harmonic levels to below IEEE 519-1992 guidelines
- Voltage drop due to IR loss

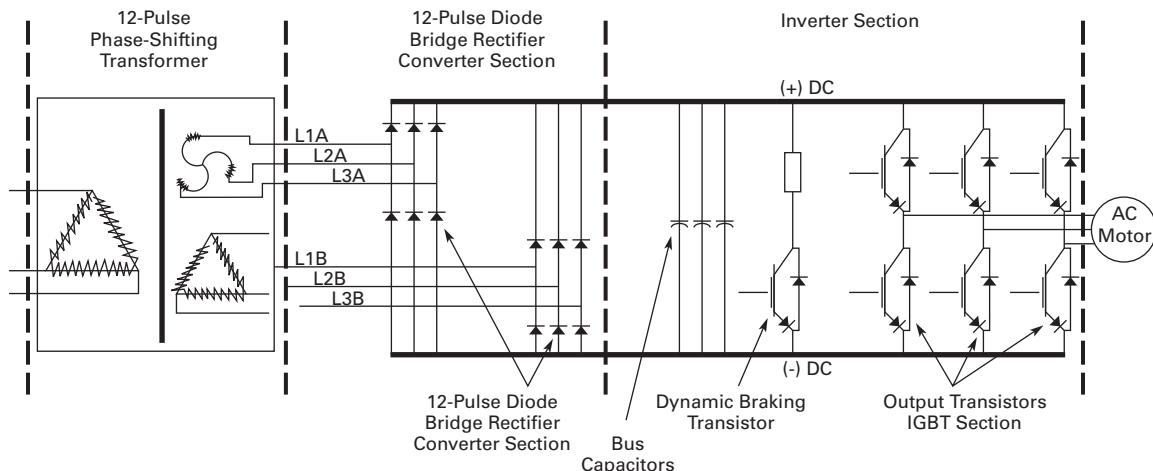
2.12-Pulse Converters

A 12-pulse converter incorporates two separate AFD input semiconductor bridges, which are fed from 30° phase shifted power sources with identical impedance. The sources may be two isolation transformers, where one is a delta/wye design (which provides the phase shift)

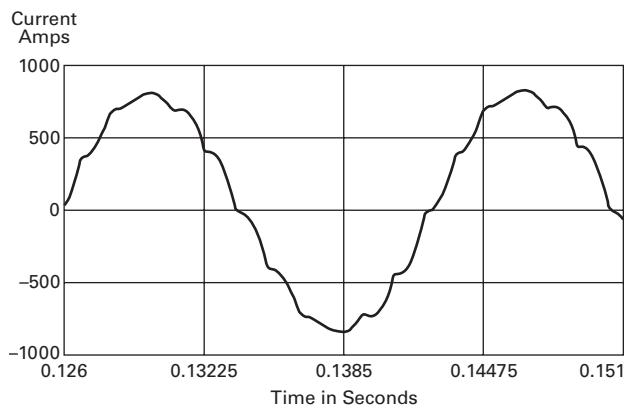
and the second a delta/delta design (which does not phase shift). The 12-pulse arrangement allows the harmonics from the first converter to cancel the harmonics of the second. Up to approximately 85% reduction of harmonic current and voltage distortion may be achieved (over standard

six-pulse converter). This permits a facility to use a larger percentage of AFD loads under IEEE 519-1992 guidelines than allowable using line reactors or DC chokes. A harmonic analysis is required to guarantee compliance with guidelines.

Basic 12-Pulse Rectifier with "Phase Shifting" Transformer



500 hp 480V Drive with 12-Pulse Rectifier



500 hp 480V Drive with 12-Pulse Rectifier

12-Pulse Circuit

Current harmonics

$I_1 = 100\%$	$I_{11} = 4.19\%$	$I_{19} = 0.06\%$
$I_5 = 1.25\%$	$I_{13} = 2.95\%$	$I_{23} = 0.87\%$
$I_7 = 0.48\%$	$I_{17} = 0.21\%$	$I_{25} = 0.73\%$

Power = 500 hp

$H_c = 66.2$ amps

Advantages

- Moderate cost, although significantly more than reactors or chokes
- Substantial reduction (up to approx. 85%) in voltage and current harmonics
- Provides increased input protection for AFD and its semiconductors from line transients

Disadvantages

- Impedance matching of phase shifted sources is critical to performance
- Transformers often require separate mounting or larger AFD enclosures
- May not reduce distribution harmonic levels to below IEEE 519-1992 guidelines
- Cannot retrofit for most AFDs

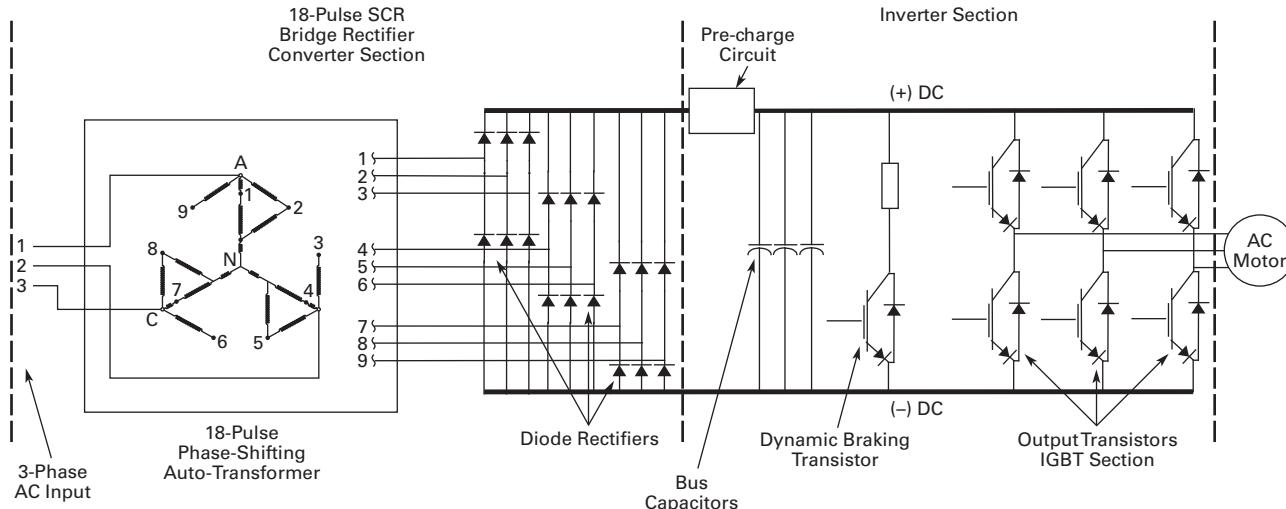
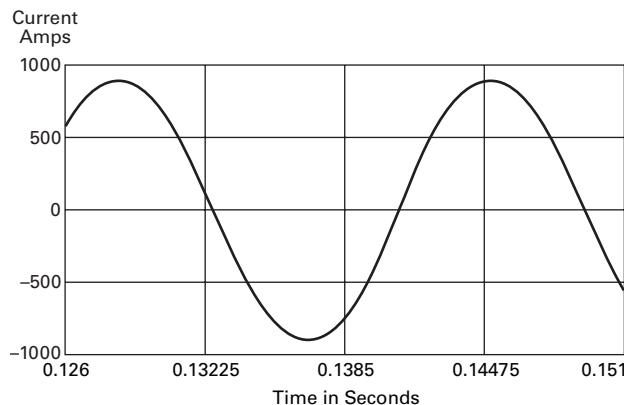
3. Clean Power Drives

When the total load is of nonlinear, the greatest harmonic mitigation is required. Under these conditions, the currents drawn from the supply need to be sinusoidal and "clean" such that system interference and additional losses are negligible. Eaton's enclosed 18-pulse clean power drive uses a phase-shifting auto-transformer with delta-connected winding. Three of the output phases

are advanced and three are retarded. The remaining three phases of this nine-phase supply are in phase with the incoming line. This results in nine separate phases. In this type of configuration, the total required kVA rating of the transformer is only 48% of a drive rate isolation transformer. A traditional isolated transformer system, with multipulse windings, would require the full kVA

rating to be supported, which is more common in an MV step-down transformer.

The integrated 18-pulse clean power drive, with near sine wave input current and low harmonics will meet the requirements of IEEE 519-1992 under all practical operating conditions. The comparisons with six-pulse and 12-pulse systems are shown, see **Pages V6-T2-235, V6-T2-237** and **V6-T2-238**.

Basic 18-Pulse Rectifier with Phase Shifting Transformer**500 hp 480V Drive with 18-Pulse Rectifiers****500 hp 480V Drive with 18-Pulse Rectifiers****18-Pulse Clean Power****Current harmonics**

$$I_1 = 100\% \quad I_{11} = 0.24\% \quad I_{19} = 1.00\%$$

$$I_5 = 0.16\% \quad I_{13} = 0.10\% \quad I_{23} = 0.01\%$$

$$I_7 = 0.03\% \quad I_{17} = 0.86\% \quad I_{25} = 0.01\%$$

Power = 500 hp

$H_c = 24$ amps

Advantages

- Virtually guarantees compliance with IEEE 519-1992
- Provides increased input protection for AFD and its semiconductors from line transients
- Up to four times the harmonic reduction of 12-pulse methods
- Smaller transformer than isolation transformer used in 12-pulse converter

Disadvantages

- Not as cost-effective as some other methods at small (<50) horsepower

Features and Benefits

Enclosed 18-pulse clean power drive features include:

- Space optimized enclosure
- Simple layout for power options
- Type 1, NEMA 12 with gaskets and filters, Type 3R
- Input voltage: 480V, 208V, 575V
- Complete range of control, network and power options

- Horsepower range:
 - 480V, 25–800 hp (consult factory for larger sizes)
 - 208/230V, 25–200 hp
 - 575V, 25–800 hp (consult factory for larger sizes)
- Over 15 years of 18-pulse clean power experience
- 65 kAIC Standard at 480V and 208V
- 100 kAIC optional

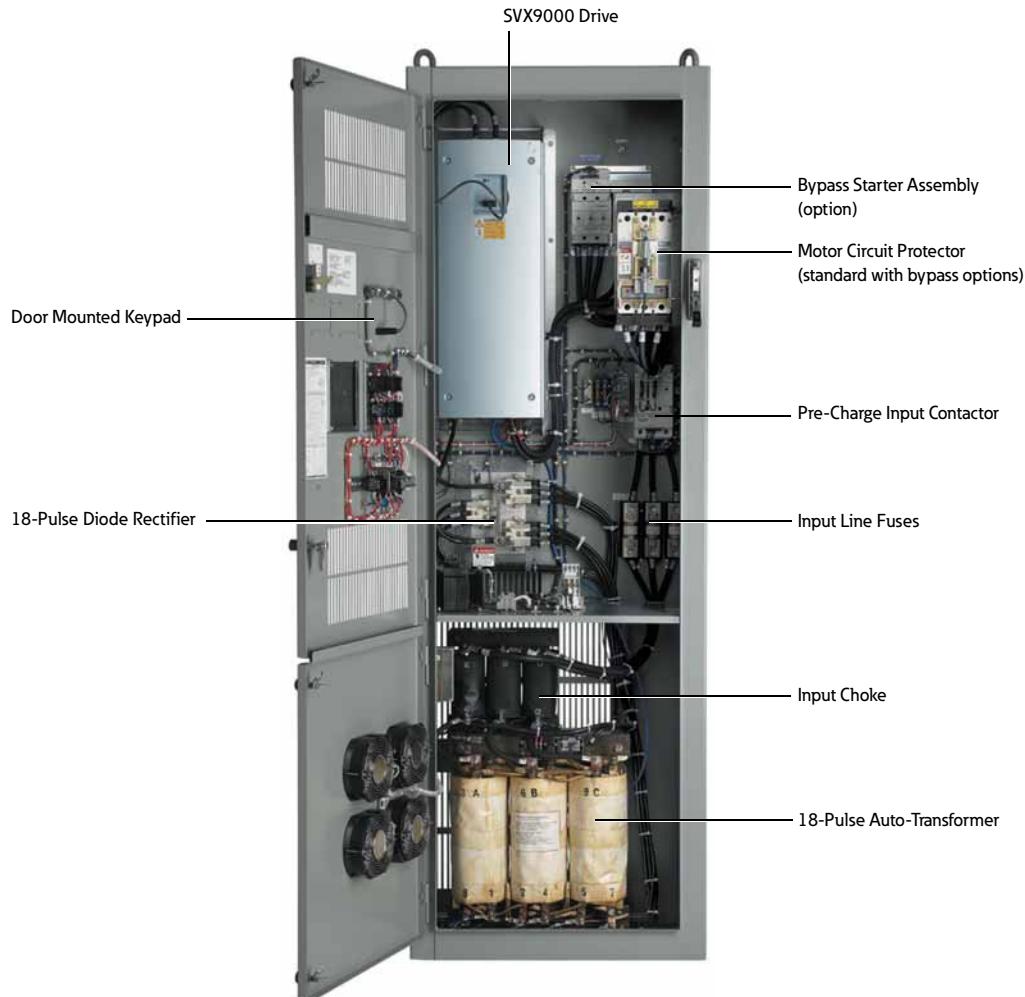
Standards and Certifications

UL 508C tested, listed and approved.



Product Identification

Type 1, 25–150 hp (30 x 90 x 21.50)



Catalog Number Selection

2

Enclosed 18-Pulse Drive

CPX 100 1 4 A A

Product Family		
CPX = Clean power 18-pulse enclosed drives		
Horsepower Rating		
025 = 25 hp	100 = 100 hp	350 = 350 hp
030 = 30 hp	125 = 125 hp	400 = 400 hp
040 = 40 hp	150 = 150 hp	500 = 500 hp
050 = 50 hp	200 = 200 hp	600 = 600 hp
060 = 60 hp	250 = 250 hp	700 = 700 hp
075 = 75 hp	300 = 300 hp	800 = 800 hp
Enclosure Rating		
1 = Type 1	3 = Type 3R	6 = Type 12 filtered
Voltage Rating		
2 = 230V (208–240V)	4 = 480V	5 = 575V (575–600V)
Application—Torque/Braking ^(①)		
A = I_L /no brake chopper	B = I_L /internal brake chopper	D = I_H /no brake chopper
E = I_H /internal brake chopper		
Enclosed Style		
A = Enclosed drive		

Build options alphabetically and numerically.

Enclosed Options ^(②③④)		Type
K1	Door-mounted speed potentiometer ^(⑤)	Control
K2	Door-mounted speed potentiometer with HOA selector switch ^(⑤)	Control
K3	3–15 psig follower	Control
K4	HAND/OFF/AUTO switch 0.87-inch (22 mm)	Control
K5	MANUAL/AUTO reference switch 0.87-inch (22 mm)	Control
K6	START/STOP pushbuttons 0.87-inch (22 mm)	Control
KF	Bypass test switch for RA and RB	Addl. bypass
KO	Standard elapsed time meter	Control
L1	Power, RUN and fault pilot lights	Light
L2	Bypass pilot lights for RA, RB, bypass options	Addl. bypass
LE	Red RUN light	Light
P1	Input disconnect	Input
P8	Surge protective device	Input
PE	Output contactor	Output
PF	Output filter	Output
PG	MotoRx (up to 600 ft [182.9m]) 1000 V/ μ s DV/DT filter	Output
PH	Single overload relay	Output
PI	Dual overload relays	Output
PN	Dual overloads for bypass	Addl. bypass
RA	Manual HOA bypass controller	Bypass
RB	Manual IOB bypass controller	Bypass
RC	Auto transfer HOA bypass controller	Bypass
RD	Auto transfer IOB bypass controller	Bypass
RG	Reduced voltage starter for bypass	Bypass
S7	10.00-inch (254.0 mm) expansion	Enclosure
S8	20.00-inch (508.0 mm) expansion	Enclosure
S9	Space heater	Enclosure

Communication Options ^(⑥)	
C2 = Modbus [®]	CA = Johnson Controls N2
C3 = PROFIBUS [®] DP	CI = Modbus TCP
C4 = LonWorks [®]	CJ = BACnet
C5 = PROFIBUS DP (D9 connector)	CQ = EtherNet/IP
C6 = CANopen (slave)	D3 = RS-232 with D9 connection
C7 = DeviceNet [™]	
C8 = Modbus (D9 Type connector)	

Control Options	
B1 = 6 DI, 1 ext +24 Vdc/ext +24 Vdc	
B2 = 1 RO (NC/NO), 1 RO (NO), 1 therm	
B4 = 1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24 Vdc/EXT +24 Vdc	
B5 = 3 RO (NO)	
B8 = 1 ext +24 Vdc/ext +24 Vdc, 3 Pt100	
B9 = 1 RO (NO), 5 DI 42–240 Vac input	

Engineered Options	
HT	High temperature rating for 50°C (FR10 and above) ^(⑦)
VB	Varnished boards

Notes

- ① Brake chopper is standard in drives up to 30 hp I_H or 40 hp I_L at 480V. It is optional in larger drives.
- ② Local/remote keypad is included as the standard control panel.
- ③ Some options are voltage and/or horsepower specific. Consult your Eaton representative for details.
- ④ See **Pages V6-T2-251** and **V6-T2-252** for complete descriptions.
- ⑤ Includes local/remote speed reference switch.
- ⑥ See **Pages V6-T2-249** and **V6-T2-250** for complete descriptions.
- ⑦ Consult Eaton for availability.

Product Selection

When Ordering

- Select a base catalog number that meets the application requirements—nominal horsepower, voltage and enclosure rating. (The enclosed drive's continuous output amp rating should be equal to or greater than the motor's full load amp rating.) The base-enclosed package includes a standard drive, door-mounted alphanumeric panel and enclosure.

The enclosed 18-pulse drive product uses the term High Overload (I_H) in place of the term Constant Torque (CT). Likewise, Low Overload (I_L) is used in place of the term Variable Torque (VT). The new terms are a more precise description of the rating. The older terms included ambient temperature ratings in addition to overload ratings. In order to minimize enclosure size and offer the highest ambient temperature

rating, overload and temperature ratings are now treated separately. Ambient temperature ratings are shown in the table below. Consult the factory for 50°C ratings of FR10 and above.

- If dynamic brake chopper or control/communication option is desired, change the appropriate code in the base catalog number.
- All of the programming is exactly the same as the standard SVX9000 drive.
- Select enclosed options. Add the codes as suffixes to the base catalog number in alphabetical and numeric order.

Ambient Temperature Ratings

Frame Size	I_H	I_L
FR4–FR9	50°C	50°C
FR10 and above	40°C	40°C

208/230V Drives

Enclosed 18-Pulse Drive



Enclosed 18-Pulse Base Drive Type 1

Enclosure Size ^①	hp ^②	Current (A)	Chassis Frame	Base Catalog Number ^③
Low Overload Drive				
7	25	75	FR7	CPX02512AA
	30	88	FR7	CPX03012AA
	40	114	FR7	CPX04012AA
	50	140	FR8	CPX05012AA
	60	170	FR8	CPX06012AA
	75	205	FR8	CPX07512AA
8	100	300	FR9	CPX10012AA
9	125	340	FR8T	CPX12512AA
	150	410	FR8T	CPX15012AA
10	200	522	FR9T	CPX20012AA
High Overload Drive				
7	25	75	FR7	CPX02512DA
	30	88	FR7	CPX03012DA
	40	114	FR8	CPX04012DA
	50	140	FR8	CPX05012DA
	60	170	FR8	CPX06012DA
8	75	205	FR9	CPX07512DA
9	100	300	FR8T	CPX10012DA
	125	340	FR8T	CPX12512DA
10	150	410	FR9T	CPX15012DA
	200	522	FR9T	CPX20012DA

Notes

^① See enclosure dimensions beginning on **Page V6-T2-258**.

^② hp ratings are provided as a guideline. Drives should be sized per motor nameplate FLA.

^③ The 18-pulse clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.

Enclosed 18-Pulse Drive



Enclosed 18-Pulse Base Drive NEMA 12 Filtered

Enclosure Size ^①	hp ^②	Current (A)	Chassis Frame	Base Catalog Number ^③
Low Overload Drive				
7	25	75	FR7	CPX02562AA
	30	88	FR7	CPX03062AA
	40	114	FR7	CPX04062AA
	50	140	FR8	CPX05062AA
	60	170	FR8	CPX06062AA
	75	205	FR8	CPX07562AA
8	100	300	FR9	CPX10062AA
9	125	340	FR8T	CPX12562AA
	150	410	FR8T	CPX15052AA
10	200	522	FR9T	CPX20062AA
High Overload Drive				
7	25	75	FR7	CPX02562DA
	30	88	FR7	CPX03062DA
	40	114	FR8	CPX04062DA
	50	140	FR8	CPX05062DA
	60	170	FR8	CPX06062DA
8	75	205	FR9	CPX07562DA
9	100	300	FR8T	CPX10062DA
	125	340	FR8T	CPX12562DA
10	150	410	FR9T	CPX15062DA
	200	522	FR9T	CPX20062DA

Enclosed 18-Pulse Base Drive Type 3R ^④

Enclosure Size ^①	hp ^②	Current (A)	Chassis Frame	Base Catalog Number ^③
Low Overload Drive				
7	25	75	FR7	CPX02532AA
	30	88	FR7	CPX03032AA
	40	114	FR7	CPX04032AA
	50	140	FR8	CPX05032AA
	60	170	FR8	CPX06032AA
	75	205	FR8	CPX07532AA
8	100	300	FR9	CPX10032AA
9	125	340	FR8T	CPX12532AA
High Overload Drive				
7	25	75	FR7	CPX02532DA
	30	88	FR7	CPX03032DA
	40	114	FR8	CPX04032DA
	50	140	FR8	CPX05032DA
	60	170	FR8	CPX06032DA
8	75	205	FR9	CPX07532DA
9	100	300	FR8T	CPX10032DA

Notes

- ① See enclosure dimensions beginning on **Page V6-T2-258**.
- ② hp ratings are provided as a guideline. Drives should be sized per motor nameplate FLA.
- ③ The 18-pulse clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.
- ④ All Type 3R drives use the Size F enclosure.

480V Drives

Enclosed 18-Pulse Drive



Enclosed 18-Pulse Base Drive Type 1

Enclosure Size ^①	hp ^②	Current (A)	Chassis Frame	Base Catalog Number ^③
Low Overload Drive				
7	25	38	FR6	CPX02514BA
	30	46	FR6	CPX03014BA
	40	61	FR6	CPX04014BA
	50	72	FR7	CPX05014AA
	60	87	FR7	CPX06014AA
	75	105	FR7	CPX07514AA
	100	140	FR8	CPX10014AA
	125	170	FR8	CPX12514AA
	150	205	FR8	CPX15014AA
8	200	261	FR9	CPX20014AA
	250	300	FR9	CPX25014AA
9	300	385	FR10	CPX30014AA
	350	460	FR10	CPX35014AA
	400	520	FR10	CPX40014AA
10	500	590	FR11	CPX50014AA
	550	650	FR11	CPX55014AA
	600	730	FR11	CPX60014AA
11	650	820	FR11	CPX65014AA
	700	920	FR12	CPX70014AA
	800	1030	FR12	CPX80014AA
High Overload Drive				
7	25	38	FR6	CPX02514EA
	30	46	FR6	CPX03014EA
	40	61	FR7	CPX04014DA
	50	72	FR7	CPX05014DA
	60	87	FR7	CPX06014DA
	75	105	FR8	CPX07514DA
	100	140	FR8	CPX10014DA
	125	170	FR8	CPX12514DA
8	150	205	FR9	CPX15014DA
	200	245	FR9	CPX20014DA
9	250	300	FR10	CPX25014DA
	300	385	FR10	CPX30014DA
	350	460	FR10	CPX35014DA
10	400	520	FR11	CPX40014DA
	500	590	FR11	CPX50014DA
	550	650	FR11	CPX55014DA
11	600	720	FR12	CPX60014DA
	650	820	FR12	CPX65014DA
	700	840	FR12	CPX70014DA

Notes

① See enclosure dimensions beginning on **Page V6-T2-258**.

② hp ratings are provided as a guideline. Drives should be sized per motor nameplate FLA.

③ The 18-pulse clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.

Enclosed 18-Pulse Drive



Enclosed 18-Pulse Base Drive NEMA 12 Filtered

Enclosure Size ^①	hp ^②	Current (A)	Chassis Frame	Base Catalog Number ^③
Low Overload Drive				
7	25	38	FR6	CPX02564BA
	30	46	FR6	CPX03064BA
	40	61	FR6	CPX04064BA
	50	72	FR7	CPX05064AA
	60	87	FR7	CPX06064AA
	75	105	FR7	CPX07564AA
	100	140	FR8	CPX10064AA
	125	170	FR8	CPX12564AA
	150	205	FR8	CPX15064AA
8	200	261	FR9	CPX20064AA
	250	300	FR9	CPX25064AA
9	300	385	FR10	CPX30064AA
	350	460	FR10	CPX35064AA
	400	520	FR10	CPX40064AA
10	500	590	FR11	CPX50064AA
	550	650	FR11	CPX55064AA
	600	730	FR11	CPX60064AA
11	650	820	FR11	CPX65064AA
	700	920	FR12	CPX70064AA
	800	1030	FR12	CPX80064AA
High Overload Drive				
7	25	38	FR6	CPX02564EA
	30	46	FR6	CPX03064EA
	40	61	FR7	CPX04064DA
	50	72	FR7	CPX05064DA
	60	87	FR7	CPX06064DA
	75	105	FR8	CPX07564DA
	100	140	FR8	CPX10064DA
	125	170	FR8	CPX12564DA
8	150	205	FR9	CPX15064DA
	200	245	FR9	CPX20064DA
9	250	300	FR10	CPX25064DA
	300	385	FR10	CPX30064DA
	350	460	FR10	CPX35014DA
10	400	520	FR11	CPX40064DA
	500	590	FR11	CPX50064DA
	550	650	FR11	CPX55064DA
11	600	720	FR12	CPX60064DA
	650	820	FR12	CPX65064DA
	700	840	FR12	CPX70064DA

Notes

① See enclosure dimensions beginning on **Page V6-T2-258**.

② hp ratings are provided as a guideline. Drives should be sized per motor nameplate FLA.

③ The 18-pulse clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.

Enclosed 18-Pulse Drive**Enclosed 18-Pulse Base Drive Type 3R ^①**

Enclosure Size ^②	hp ^③	Current (A)	Chassis Frame	Base Catalog Number ^④
Low Overload Drive				
7	25	38	FR6	CPX02534AA
	30	46	FR6	CPX03034AA
	40	61	FR6	CPX04034AA
	50	72	FR7	CPX05034AA
	60	87	FR7	CPX06034AA
	75	105	FR7	CPX07534AA
	100	140	FR8	CPX10034AA
	125	170	FR8	CPX12534AA
	150	205	FR8	CPX15034AA
8	200	261	FR9	CPX20034AA
	250	300	FR9	CPX25034AA
High Overload Drive				
7	25	38	FR6	CPX02534DA
	30	46	FR6	CPX03034DA
	40	61	FR7	CPX04034DA
	50	72	FR7	CPX05034DA
	60	87	FR7	CPX06034DA
	75	105	FR8	CPX07534DA
	100	140	FR8	CPX10034DA
	125	170	FR8	CPX12534DA
8	150	205	FR9	CPX15034DA
	200	245	FR9	CPX20034DA

Notes

- ① All Type 3R drives use the Size F enclosure.
- ② See enclosure dimensions beginning on **Page V6-T2-258**.
- ③ hp ratings are provided as a guideline. Drives should be sized per motor nameplate FLA.
- ④ The 18-pulse clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.

575V Drives

2

Enclosed 18-Pulse Drive



Enclosed 18-Pulse Base Drive Type 1

Enclosure Size ^①	hp ^②	Current (A)	Chassis Frame	Base Catalog Number ^③
Low Overload Drive				
7	25	27	FR6	CPX02515AA
	30	34	FR6	CPX03015AA
	40	41	FR7	CPX04015AA
	50	52	FR7	CPX05015AA
	60	62	FR8	CPX06015AA
	75	80	FR8	CPX07515AA
	100	100	FR8	CPX10015AA
8	125	125	FR9	CPX12515AA
	150	144	FR9	CPX15015AA
	200	208	FR9	CPX20015AA
9	250	261	FR10	CPX25015AA
	300	325	FR10	CPX30015AA
	400	385	FR10	CPX40015AA
10	500	502	FR11	CPX50015AA
	600	590	FR11	CPX60015AA
11	650	650	FR12	CPX65015AA
	700	750	FR12	CPX70015AA
	800	820	FR12	CPX80015AA
High Overload Drive				
7	25	27	FR6	CPX02515DA
	30	34	FR7	CPX03015DA
	40	41	FR7	CPX04015DA
	50	52	FR8	CPX05015DA
	60	62	FR8	CPX06015DA
	75	80	FR8	CPX07515DA
8	100	100	FR9	CPX10015DA
	125	125	FR9	CPX12515DA
	150	144	FR9	CPX15015DA
9	200	208	FR10	CPX20015DA
	250	261	FR10	CPX25015DA
	300	325	FR10	CPX30015DA
10	400	385	FR11	CPX40015DA
	450	460	FR11	CPX45015DA
	500	502	FR11	CPX50015DA
11	600	590	FR12	CPX60015DA
	650	650	FR12	CPX65015DA
	700	750	FR12	CPX70015DA

Notes

- ① See enclosure dimensions beginning on **Page V6-T2-258**.
- ② hp ratings are provided as a guideline. Drives should be sized per motor nameplate FLA.
- ③ The 18-pulse clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.

Enclosed 18-Pulse Drive**Enclosed 18-Pulse Base Drive NEMA 12 Filtered**

Enclosure Size ①	hp ②	Current (A)	Chassis Frame	Base Catalog Number ③
Low Overload Drive				
7	25	27	FR6	CPX02565AA
	30	34	FR6	CPX03065AA
	40	41	FR7	CPX04065AA
	50	52	FR7	CPX05065AA
	60	62	FR8	CPX06065AA
	75	80	FR8	CPX07565AA
	100	100	FR8	CPX10065AA
8	125	125	FR9	CPX12565AA
	150	144	FR9	CPX15065AA
	200	208	FR9	CPX20065AA
9	250	261	FR10	CPX25065AA
	300	325	FR10	CPX30065AA
	400	385	FR10	CPX40065AA
10	500	502	FR11	CPX50065AA
	600	590	FR11	CPX60065AA
11	650	650	FR12	CPX65065AA
	700	750	FR12	CPX70065AA
	800	820	FR12	CPX80065AA
High Overload Drive				
7	25	27	FR6	CPX02565DA
	30	34	FR7	CPX03065DA
	40	41	FR7	CPX04065DA
	50	52	FR8	CPX05065DA
	60	62	FR8	CPX06065DA
	75	80	FR8	CPX07565DA
8	100	100	FR9	CPX10065DA
	125	125	FR9	CPX12565DA
	150	144	FR9	CPX15065DA
9	200	208	FR10	CPX20065DA
	250	261	FR10	CPX25065DA
	300	325	FR10	CPX30065DA
10	400	385	FR11	CPX40065DA
	450	460	FR11	CPX45065DA
	500	502	FR11	CPX50065DA
11	600	590	FR12	CPX60065DA
	650	650	FR12	CPX65065DA
	700	750	FR12	CPX70065DA

Notes

- ① See enclosure dimensions beginning on **Page V6-T2-258**.
- ② hp ratings are provided as a guideline. Drives should be sized per motor nameplate FLA.
- ③ The 18-pulse clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.

Enclosed 18-Pulse Drive

Enclosed 18-Pulse Base Drive Type 3R ^①

Enclosure Size ^②	hp ^③	Current (A)	Chassis Frame	Base Catalog Number ^④
Low Overload Drive				
7	25	27	FR6	CPX02535AA
	30	34	FR6	CPX03035AA
	40	41	FR7	CPX04035AA
	50	52	FR7	CPX05035AA
	60	62	FR8	CPX06035AA
	75	80	FR8	CPX07535AA
	100	100	FR8	CPX10035AA
8	125	125	FR9	CPX12535AA
	150	144	FR9	CPX15035AA
	200	208	FR9	CPX20035AA
High Overload Drive				
7	25	27	FR6	CPX02535DA
	30	34	FR7	CPX03035DA
	40	41	FR7	CPX04035DA
	50	52	FR8	CPX05035DA
	60	62	FR8	CPX06035DA
	75	80	FR8	CPX07535DA
8	100	100	FR9	CPX10035DA
	125	125	FR9	CPX12535DA
	150	144	FR9	CPX15035DA

Notes

- ① All Type 3R drives use the Size F enclosure.
- ② See enclosure dimensions beginning on **Page V6-T2-258**.
- ③ hp ratings are provided as a guideline. Drives should be sized per motor nameplate FLA.
- ④ The 18-pulse clean power assembly includes a standard drive, door-mounted local/remote keypad and enclosure.

Options

Enclosed 18-Pulse Drive Option Board Kits

The enclosed 18-pulse drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of five option boards (see figure below).

The enclosed 18-pulse drives factory-installed standard board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B.

9000X Series Option Board Kits

Option Boards		Option Board Kits		Field Installed	Factory Installed	SVX Ready Programs					
Option Kit Description ^①	Allowed Slot Locations ^②	Catalog Number	Option Designator	Basic	Local/ Remote	Standard	MSS	PID	Multi-P.	PFC	
Standard I/O Cards											
2 RO (NC/NO)	B	OPTA2	—	■	■	■	■	■	■	■	
6 DI, 1 DO, 2 AI, 1AO, 1+10 Vdc ref, 2 ext +24 Vdc/ext +24 Vdc	A	OPTA9	—	■	■	■	■	■	■	■	
Extended I/O Cards											
6 DI	B, C, D , E	OPTB1	B1	—	—	—	—	—	■	■	
1 RO (NC/NO), 1 RO (NO), 1 therm	B, C, D , E	OPTB2	B2	—	—	—	—	—	■	■	
1 AI (mA isolated), 2 AO (mA isolated)	B, C, D , E	OPTB4	B4	■	■	■	■	■	■	■	
3 RO (NO)	B, C, D , E	OPTB5	B5	—	—	—	—	—	■	■	
3 Pt100 RTD board	B, C, D , E	OPTB8	B8	—	—	—	—	—	■	—	
1 RO (NO), 5 DI 42–240 Vac input	B, C, D , E	OPTB9	B9	—	—	—	—	—	■	■	
Communication Cards ^③											
Modbus	D, E	OPTC2	C2	■	■	■	■	■	■	■	
Modbus TCP	D, E	OPTC1	C1	■	■	■	■	■	■	■	
BACnet	D, E	OPTCJ	CJ	■	■	■	■	■	■	■	
EtherNet/IP	D, E	OPTCQ	CQ	■	■	■	■	■	■	■	
Johnson Controls N2	D, E	OPTC2	CA	■	■	■	■	■	■	■	
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■	■	■	
LonWorks	D, E	OPTC4	C4	■	■	■	■	■	■	■	
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■	■	■	
CANopen (slave)	D, E	OPTC6	C6	■	■	■	■	■	■	■	
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■	■	■	
Modbus (D9 type connector)	D, E	OPTC8	C8	■	■	■	■	■	■	■	
RS-232 with D9 connection	D, E	OPTD3	D3	■	■	■	■	■	■	■	

Notes

① AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

② Option card must be installed in one of the slots listed for that card. Slot indicated in bold is the preferred location.

③ OPTC2 is a multi-protocol option card.

Modbus RTU Network Communications

The Modbus Network Card OPTC2 is used for connecting the 9000X Drive as a slave on a Modbus network. The interface is connected by a 9-pin DSUB connector (female) and the baud rate ranges from 300 to 19,200 baud. Other communication parameters include an address range from 1 to 247; a parity of None, Odd or Even; and the stop bit is 1.

PROFIBUS Network Communications

The PROFIBUS Network Card OPTC3 is used for connecting the 9000X Drive as a slave on a PROFIBUS-DP network. The interface is connected by a 9-pin DSUB connector (female). The baud rates range from 9.6K baud to 12M baud, and the addresses range from 1 to 127.

LonWorks Network Communications

The LonWorks Network Card OPTC4 is used for connecting the 9000X Drive on a LonWorks network. This interface uses Standard Network Variable Types (SNVT) as data types. The channel connection is achieved using a FTT-10A Free Topology transceiver via a single twisted transfer cable. The communication speed with LonWorks is 78 kBits/s.

CANopen (Slave) Communications

The CANopen (Slave) Network Card OPTC6 is used for connecting the 9000X Drive to a host system. According to ISO® 11898 standard cables to be chosen for CAN bus should have a nominal impedance of 120 ohms, and specific line delay of nominal 5 nS/m. 120 ohm line termination resistors required for installation.

DeviceNet Network Communications

The DeviceNet Network Card OPTC7 is used for connecting the 9000X Drive on a DeviceNet Network. It includes a 5.08 mm pluggable connector. Transfer method is via CAN using a two-wire twisted shielded cable with two-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud.

Johnson Controls Metasys N2 Network Communications

The OPTC2 fieldbus board provides communication between the 9000X Drive and a Johnson Controls Metasys™ N2 network. With this connection, the drive can be controlled, monitored and programmed from the Metasys system. The N2 fieldbus is available as a factory-installed option and as a field-installable kit.

Modbus/TCP Network Communications

The Modbus/TCP Network Card OPTC1 is used for connecting the 9000X Drive to Ethernet networks using Modbus protocol. It includes an RJ-45 pluggable connector. This interface provides a selection of standard and custom register values to communicate drive parameters. The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable over Ethernet using a supplied software tool.

BACnet Network Communications

The BACnet Network Card OPTCJ is used for connecting the 9000X Drive to BACnet networks. It includes a 5.08 mm pluggable connector. Data transfer is Master-Slave/Token Passing (MS/TP) RS-485. This interface uses a collection of 30 Binary Value Objects (BVOs) and 35 Analog Value Objects (AVOs) to communicate drive parameters. The card supports 9.6, 19.2 and 38.4 Kbaud communication speeds and supports network addresses 1 to 127.

Ethernet/IP Network Communications

The Ethernet/IP Network Card OPTCK is used for connecting the 9000X Drive to Ethernet/Industrial Protocol networks. It includes an RJ-45 pluggable connector. The interface uses CIP objects to communicate drive parameters (CIP is "Common Industrial Protocol," the same protocol used by DeviceNet). The board supports 10 Mbps and 100 Mbps communication speeds. The IP address of the board is configurable by Static, BOOTP and DHCP methods.

Control/Communication Option Descriptions

For availability, see Product Selection for base drive voltage required.

Available Control/Communications Options

Option	Description	Option Type
K1	Door-Mounted Speed Potentiometer —Provides the enclosed 18-pulse drive with the ability to adjust the frequency reference using a door-mounted potentiometer. This option uses the 10 Vdc reference to generate a 0–10V signal at the analog voltage input signal terminal. When the HOA bypass option is added, the speed is controlled when the HOA switch is in the HAND position. Without the HOA bypass option, a two-position switch (labeled local/remote) is provided on the keypad to select speed reference from the speed potentiometer or a remote speed signal.	Control
K2	Door-Mounted Speed Potentiometer with HOA Selector Switch —Provides the enclosed 18-pulse drive with the ability to start/stop and adjust the speed reference from door-mounted control devices or remotely from customer-supplied inputs. In HAND position, the drive will start and the speed is controlled by the door-mounted speed potentiometer. The drive will be disabled in the OFF position. When AUTO is selected, the drive run and speed control commands are via user-supplied dry contact and 4–20 mA signal.	Control
K3	3–15 psig Follower —Provides a pneumatic transducer that converts a 3–15 psig pneumatic signal to either 0–8 Vdc or a 1–9 Vdc signal interface with the enclosed 18-pulse drive. The circuit board is mounted on the inside of the front enclosure panel and connects to the user's pneumatic control system via 6 ft (1.8m) of flexible tubing and a 1/4 inch (6.4 mm) brass tube union.	Control
K4	HAND/OFF/AUTO Switch for Non-Bypass Configurations —Provides a three-position selector switch that allows the user to select either a HAND or AUTO mode of operation. HAND mode is defaulted to keypad operation, and AUTO mode is defaulted to control from an external terminal source. These modes of operation can be configured via drive programming to allow for alternate combinations of start and speed sources. Start and speed sources include Keypad, I/O and fieldbus.	Control
K5	MANUAL/AUTO Speed Reference Switch —Provides door-mounted selector switch for MANUAL/AUTO speed reference.	Control
K6	START/STOP Pushbuttons —Provide door-mounted START and STOP pushbuttons for either bypass or non-bypass configurations.	Control
KF	Bypass Test Switch for RB and RA —Allows the user to energize the AF drive for testing while operating the motor on the bypass controller. The Test Switch is mounted on the inside of the enclosure door.	Addl. bypass
K0	Standard Elapsed Time Meter —Provides a door-mounted elapsed run-time meter.	Control
L1	Power On and Fault Power Lights —Provide a white Power On light that indicates power to the enclosed cabinet and a red fault light that indicates a drive fault has occurred.	Light
L2	Bypass Pilot Lights for RB, RA Bypass Options —A green light indicates when the motor is running in Inverter mode and an amber light indicates when the motor is running in Bypass mode. The lights are mounted on the enclosure door, above the switches.	Addl. bypass
LE	Red Run Pilot Light 0.87-Inch (22 mm) —Provides a red Run pilot light that indicates the drive is running.	Light
P1	Input Circuit Breaker —High interrupting circuit breaker that provides a means of short-circuit protection for the power cables between it and the enclosed 18-pulse drive, and protection from high-level ground faults on the power cable. Allows a convenient means of disconnecting the enclosed 18-pulse drive from the line and the operating mechanism can be padlocked in the OFF position. This is factory mounted in the enclosure. Standard rating is 65 kAIC at 208/480V. 100 kAIC is available as an option.	Input
PE	Output Contactor —Provides a means for positive disconnection of the drive output from the motor terminals. The contactor coil is controlled by the drive's run or permissive logic. NC and NO auxiliary contacts rated at 10A, 600 Vac are provided for customer use. Bypass options RB and RA include an output contactor as standard. This option includes a low VA 115 Vac fused control power transformer and is factory mounted in the enclosure.	Output
PF	Output Filter —Used to reduce the transient voltage (DV/DT) at the motor terminals. The output filter is recommended for cable lengths exceeding 100 ft (30.5m) with a drive of 3 hp and above, for cable lengths of 33 ft (10.1m) with a drive of 2 hp and below, or for a drive rated at 525–690V. This option is mounted in the enclosure.	Output
PG	MotoRx (300–600 Ft) 1000 V/μS DV/DT Filter —Used to reduce transient voltage (DV/DT) and peak voltages at the motor terminals. This option is comprised of a 0.5% line reactor, followed by capacitive filtering and an energy recovery/clamping circuit. Unlike the output filter (see option PF), the MotoRx recovers most of the energy from the voltage peaks, resulting in a lower voltage drop to the motor, and therefore conserving power. This option is used when the distance between a single motor and the drive is 300–600 ft (91.4–182.9m).	Output
PH	Single Overload Relay —Uses a bimetallic overload relay to provide additional overload current protection to the motor on configurations without bypass options. It is included with the bypass configurations for overload current protection in the bypass mode. The overload relay is mounted within the enclosure, and is manually resettable. Heater pack included.	Output
PI	Dual Overload Relays —This option is recommended when a single drive is operating two motors and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable. Heater packs not included.	Output
PN	Dual Overloads for Bypass —This option is recommended when a single drive is operating two motors in the Bypass mode and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable.	Addl. bypass

For availability, see Product Selection for base drive voltage required.

2 Available Control/Communications Options, continued

Option	Description	Option Type
RA	Manual HOA Bypass Controller —The manual HAND/OFF/AUTO (HOA)—three-contactor—bypass option provides a means of bypassing the enclosed 18-pulse drive, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input HMCP, a fused control power transformer, and a full voltage bypass starter with a door-mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in the inverter mode. IEC type input, bypass and input contactors are provided. The contactors are mechanically and electrically interlocked (see wiring diagram on Page V6-T2-257).	Bypass
RB	Manual IOB Bypass Controller —The manual INVERTER/OFF/BYPASS (IOB)—three-contactor—bypass option provides a means of bypassing the enclosed 18-pulse drive, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input HMCP, a fused control power transformer, and a full voltage bypass starter with a door-mounted IOB selector switch. IEC type input, bypass and input contactors are provided. The contactors are mechanically and electrically interlocked (see wiring diagram on Page V6-T2-257).	Bypass
RC	Auto Transfer HOA Bypass Controller —The manual HAND/OFF/AUTO (HOA)—three-contactor—bypass option provides a means of bypassing the enclosed 18-pulse drive, allowing the AC motor to be operated at full speed directly from the AC supply line. The circuitry provides an automatic transfer of the load to “across the line” operation after a drive trip. This option consists of an input HMCP, a fused control power transformer, and a full voltage bypass starter with a door-mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in either mode. IEC type input, bypass and input contactors are provided. The contactors are mechanically and electrically interlocked (see wiring diagram on Page V6-T2-257). Door-mounted pilot lights are provided that indicate bypass or inverter operation. A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode.	Bypass
WARNING: The motor may restart when the overcurrent relay is reset when operating in bypass, unless the IOB selector switch is turned to the OFF position.		
RD	Auto Transfer IOB Bypass Controller —The auto INVERTER/OFF/BYPASS (IOB)—three-contactor—bypass option provides a means of bypassing the enclosed 18-pulse drive, allowing the AC motor to be operated at full speed directly from the AC supply line. The circuitry provides an automatic transfer of the load to “across the line” operation after a drive trip. This option consists of an input HMCP, a fused control power transformer, and a full voltage bypass starter with a door-mounted IOB selector switch. IEC type input, bypass and input contactors are provided. The contactors are mechanically and electrically interlocked (see wiring diagram on Page V6-T2-257). Door-mounted pilot lights are provided that indicate bypass or inverter operation. A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode.	Bypass
WARNING: The motor may restart when the overcurrent relay is reset when operating in bypass, unless the IOB selector switch is turned to the OFF position.		
RG	Reduced Voltage Starter for Bypass —Used in conjunction with bypass option RA, RB, RC or RD. This option adds reduced voltage soft starter to bypass assembly for soft starting in bypass mode.	Bypass
S7	10.00-Inch (254.0 mm) Expansion —Expansion cabinet allows for special components, customer-supplied components or oversized cables. NOTE: Enclosure expansion rated Type 1 only.	Enclosure
S8	20.00-Inch (508.0 mm) Expansion —Expansion cabinet allows for special components, customer-supplied components or oversized cables. NOTE: Enclosure expansion rated Type 1 only.	Enclosure
S9	Space Heater —Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. The heater requires a customer-supplied 115V remote supply source.	Enclosure

Dissipated Watt Losses

Horsepower	40	50	60	75	100	125	150	200	250	300	350	400	450	500	600	700	800
Watts	1844	2170	2540	3040	4011	4940	5730	8020	9383	11600	13600	15700	16250	17976	20393	27200	31400

Conformal (Varnished) Coating ^①

Chassis Frame	Delivery Code	Chassis Frame	Delivery Code
FR6	FP	FR9	FP
FR7	FP	FR10	FP
FR8	FP	FR11	FP
—	—	FR12	FP

480V Input Disconnect Selection ^②

Horsepower	P1 Input Breaker	Bypass Motor Circuit Protector (RA, RB, RC, RD)
25	HFD3050	HMCP050K2C
30	HFD3060	HMCP100R3C
40	HFD3080	HMCP100R3C
50	HFD3100	HMCP100R3C
60	HFD3100	HMCP150T4C
75	HFD3125	HMCP150T4C
100	HFD3150	HMCP150U4C
125	HFD3200	HMCP250W5C
150	HFD3225	HMCP250W5C
200	HKD3300	HMCP400X5C
250	HKD3400	HMCP400X5C
300–400	HLD3600	HMCP600L6W
500–600	HND3800	HMCP800X7W
650–800	HND312	^③

Notes

- ① See catalog number description to order.
- ② Contact factory for 208V and 575V applications.
- ③ Contact factory.

Enclosed Drive Options**Light Options**

Description	Catalog Number Suffix
Power on, run, fault LED lights (22 mm)	L1
Power on, fault LED lights (22 mm)	L3
Green LED run light (22 mm)	LA
Green LED stop light (22 mm)	LD
Red LED run light (22 mm)	LE
Red LED stop light (22 mm)	LF
Red LED fault light (22 mm)	LG
Power on white LED light (22 mm)	LJ
Miscellaneous LED light (22 mm)	LU

Control Options

Description	Catalog Number Suffix
Door-mounted speed potentiometer	K1
Door-mounted speed potentiometer with HOA selector switch	K2
3–15 psig follower	K3
HOA selector switch	K4
MANUAL/AUTO reference switch	K5
START-STOP pushbuttons	K6
Type D2 control relay	SD
On-delay relay	SE
Off-delay relay	SF
Additional terminal blocks per 4 points	SD

Bypass Control Options

Description	Catalog Number Suffix
Bypass test switch used with RA and RB	KF
Inverter/bypass pilot lights	L2

Meter Options

Description	Catalog Number Suffix
Standard elapsed time meter	KO
Frequency meter	KS
MP-3000 relay with URTD	KV
MP-3000 relay with URTD and CTs	KU

Enclosure Options

Enclosure Size	Catalog Number Suffix
10.00 Inch (254.0 mm) Expansion	
7	S7
8	S7
9	S7
10	S7
11	S7
20.00 Inch (508.0 mm) Expansion	
7	S8
8	S8
9	S8
10	S8
11	S8
Space Heater ^①	
7	S9
8	S9
9	S9
10	S9
11	S9
Plastic Nameplate	
7	SN
8	SN
9	SN
10	SN
11	SN

Note

① Requires customer-supplied 115 Vac supply.

208V and 230V Power Options, 25–200 hp

Description	Catalog Number Suffix
Input breaker	P1
Output contactor	PE
Single overload relay	PH
Dual overload relays	PI
MOV	P7
50 kA surge protective device	P8
100 kA surge protective device	P9

480 and 575V Power Options, 25–800 hp

Description	Catalog Number Suffix
Input breaker	P1
Output contactor	PE
Output filter	PF
MotoRx (300–600 Ft) DV/DT filter	PG
Single overload relay	PH
Dual overload relays	PI
Input MOV	P7
50 kA surge protective device	P8
100 kA surge protective device	P8

208V and 230V Bypass Options, 25–200 hp

Description	Catalog Number Suffix
Manual HOA bypass controller	RA
IOB bypass controller	RB
Auto transfer HOA bypass controller	RC
Auto transfer IOB bypass controller	RD
Reduced voltage starter for bypass	RG
Dual overloads for bypass	PN

480 and 575V Bypass Options, 25–800 hp

Description	Catalog Number Suffix
Manual HOA bypass controller	RA
IOB bypass controller	RB
Auto transfer HOA bypass controller	RC
Auto transfer IOB bypass controller	RD
Reduced voltage starter for bypass	RG
Dual overloads for bypass	PN

Technical Data and Specifications

Enclosed 18-Pulse Drives

Description	Specification	Description	Specification
Primary Design Features			
45–66 Hz input frequency	Standard	Setup adjustment provisions	
Output: AC volts maximum	Input voltage base	Remote keypad/display	Standard
Output frequency range	0–320 Hz	Personal computer	Standard
Initial output current (I_H)	250% for 2 seconds	Operator control provisions	
Overload (1 minute [I_H/I_L])	150%/110%	Drive mounted keypad/display	Standard
Enclosure space heater	Optional	Remote keypad/display	Standard
Oversize enclosure	Standard	Conventional control elements	Standard
Output contactor	Optional	Serial communications	Optional
Bypass motor starter	Optional	115 Vac control circuit	Optional
Listings	UL, cUL, 508C	Speed setting inputs	
Protection Features			
Incoming line fuses	Standard 200 kAIC rating	Keypad	Standard
AC input circuit disconnect	Optional	0–10 Vdc potentiometer/voltage signal	Standard
Phase rotation insensitive	Standard	4–20 mA isolated	Configurable
EMI filter	Standard FR6 thru FR9 ①	4–20 mA differential	Configurable
Input phase loss protection	Standard	3–15 psig	Optional
Input overvoltage protection	Standard	Analog outputs	
Line surge protection	Standard	Speed/frequency	Standard
Output short-circuit protection	Standard	Torque/load/current	Programmable
Output ground fault protection	Standard	Motor voltage	Programmable
Output phase protection	Standard	Kilowatts	Programmable
Overtemperature protection	Standard	0–10 Vdc signals	Configurable w/jumpers
DC overvoltage protection	Standard	4–20 mA DC signals	Standard
Drive overload protection	Standard	Isolated signals	Standard
Motor overload protection	Standard	Discrete outputs	
Programmer software	Optional	Fault alarm	Standard
Local/remote keypad	Standard	Drive running	Standard
Keypad lockout	Standard	Drive at set speed	Programmable
Fault alarm output	Standard	Optional parameters	14
Built-in diagnostics	Standard	Dry contacts	2 Form C contacts available
Surge protective device	Optional	Additional discrete outputs	Optional
Communications			
RS-232	Standard	RS-422/485	Optional
RS-422/485	Optional	DeviceNet™	Optional
Modbus RTU	Optional	CANopen (slave)	Optional
PROFIBUS-DP	Optional	LonWorks	Optional
Johnson Controls Metasys N2	Optional	EtherNet/IP/Modbus TCP	Optional
BACnet	Optional		

Note

① The EMI filter is optional in FR10 and larger.

Enclosed 18-Pulse Drives

Description	Specification
Performance Features	
Sensorless vector control	Standard
Volts/hertz control	Standard
IR and slip compensation	Standard
Electronic reversing	Standard
Dynamic braking	Optional
DC braking	Standard
PID set point controller	Programmable
Critical speed lockout	Standard
Current (torque) limit	Standard
Adjustable acceleration/deceleration	Standard
Linear or S curve accel/decel	Standard
Jog at preset speed	Standard
Thread/preset speeds	7
Automatic restart	Selectable
Coasting motor start	Standard
Coast or ramp stop selection	Standard
Elapsed time meter	Optional
Carrier frequency adjustment	1–16 kHz
Standard Conditions for Application and Service	
Maximum operating ambient temperature	0–50°C up to FR9 0–40°C FR10 and larger, consult factory for 50°C rating above FR9
Storage temperature	–40 to 60°C
Humidity (maximum), noncondensing	95%
Altitude (maximum without derate)	3300 ft (1000m)
Line voltage variation	+10–15%
Line frequency variation	45–66 Hz
Efficiency	>95%
Power factor (displacement)	0.99+
Power factor (apparent)	0.99

Standard I/O Specifications

Description	Specification
Six-digital input programmable	24V: "0" ≤10V, "1" ≥18V, $R_i > 5\text{ kohms}$
Two-analog input configurable w/jumpers	Voltage: 0–±10V, $R_i > 200\text{ kohms}$ Current: 0 (4)–20 mA, $R_i = 250\text{ ohms}$
Two-digital output programmable	Form C relays 250 Vac 30 Vdc 2 amp resistive
One-analog output programmable configurable w/jumper	0–20 mA, R_L max. 500 ohms 10 bits ±2%

I/O Specifications for Control/Communication Options

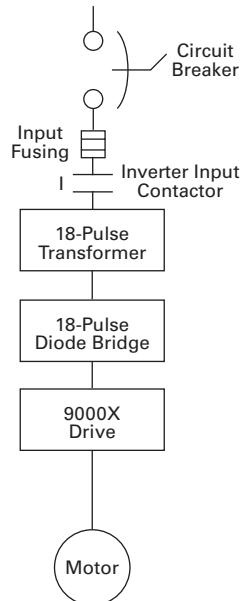
Description	Specification
Analog voltage, input	0–±10V, $R_i \geq 200$ kilohms
Analog current, input	0 (4)–20 mA, $R_i = 250$ ohms
Digital input	24V: "0" ≤10V, "1" ≥18V, $R_i > 5$ kilohms
Auxiliary voltage	24V (±20%), max. 50 mA
Reference voltage	10V ±3%, max. 10 mA
Analog current, output	0 (4)–20 mA, $R_L = 500$ kilohms, resolution 10 bit, accuracy ≤2%
Analog voltage, output	0 (2)–10V, $R_L \geq 1$ kilohm, resolution 10 bit, accuracy ≤2%
Relay output max. switching voltage	300 Vdc, 250 Vac
Relay output max. switching load	3A/24 Vdc, 300 Vdc, 250 Vac ①
Relay output max. continuous load	2A rms
Thermistor input	$R_{trip} = 4.7$ kilohms

Note

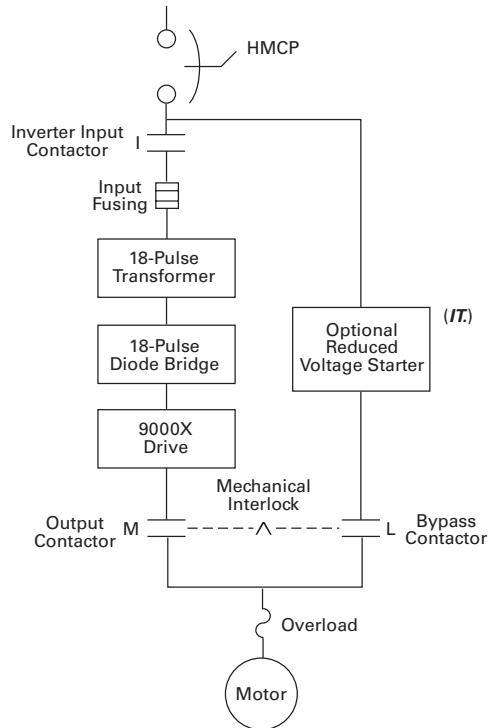
① For applications above 3A consult instruction manual.

Wiring Diagrams

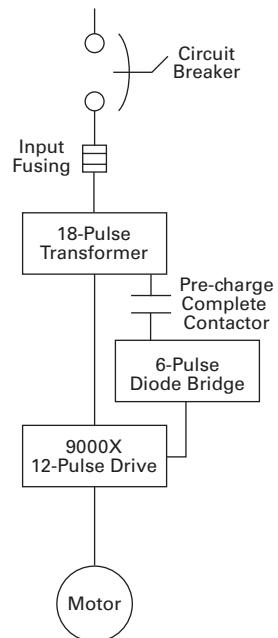
Power Diagram Up to FR9



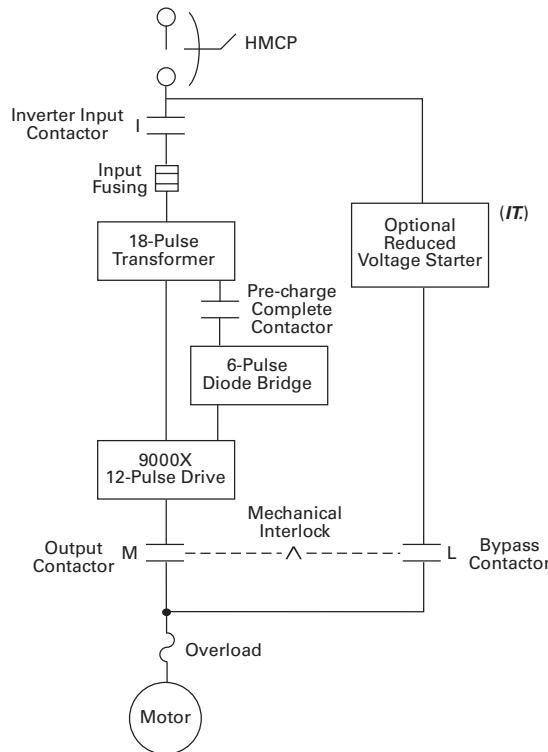
Power Diagram Up to FR9 with Bypass



Power Diagram FR10 and Larger

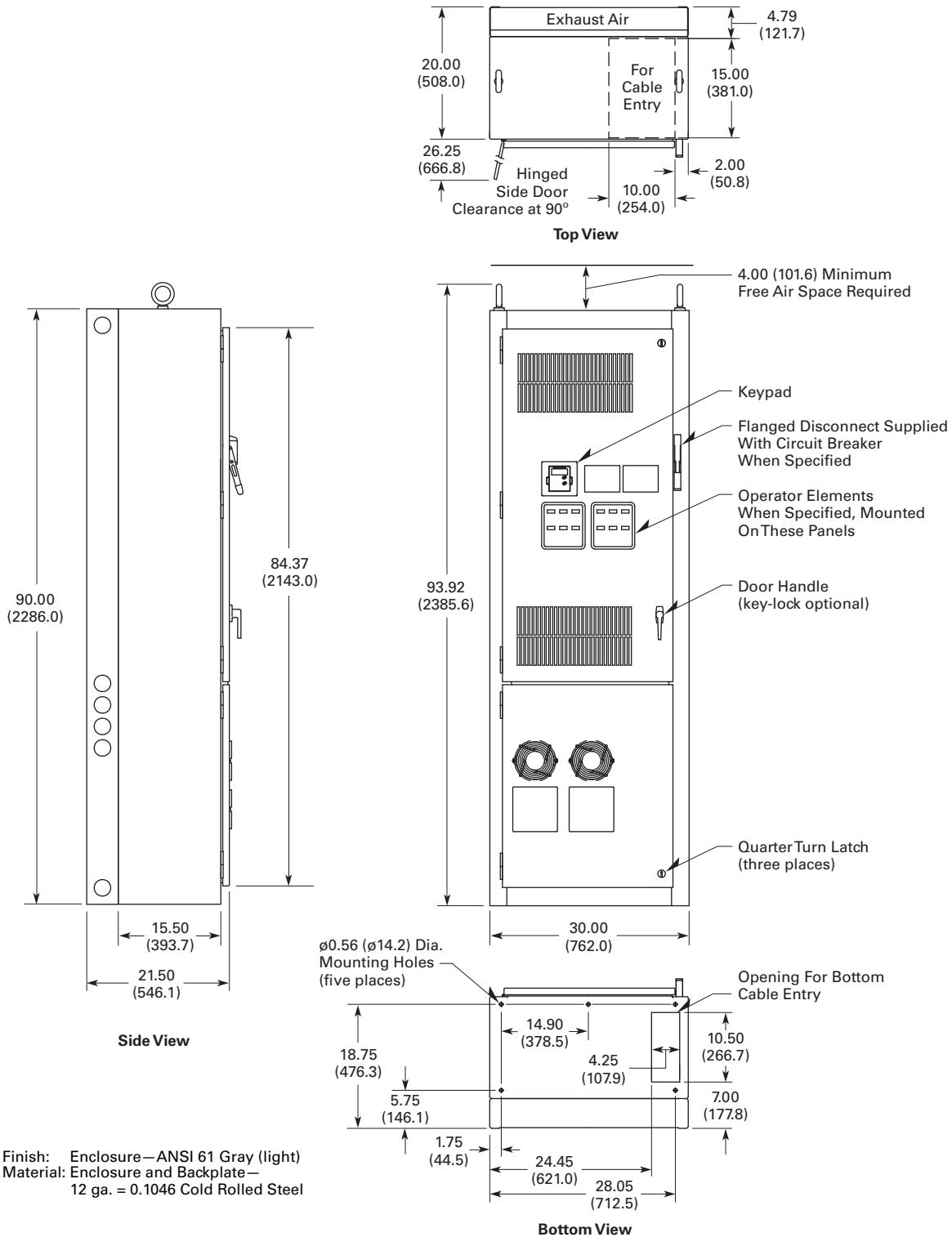


Power Diagram FR10 and Larger with Bypass



Dimensions

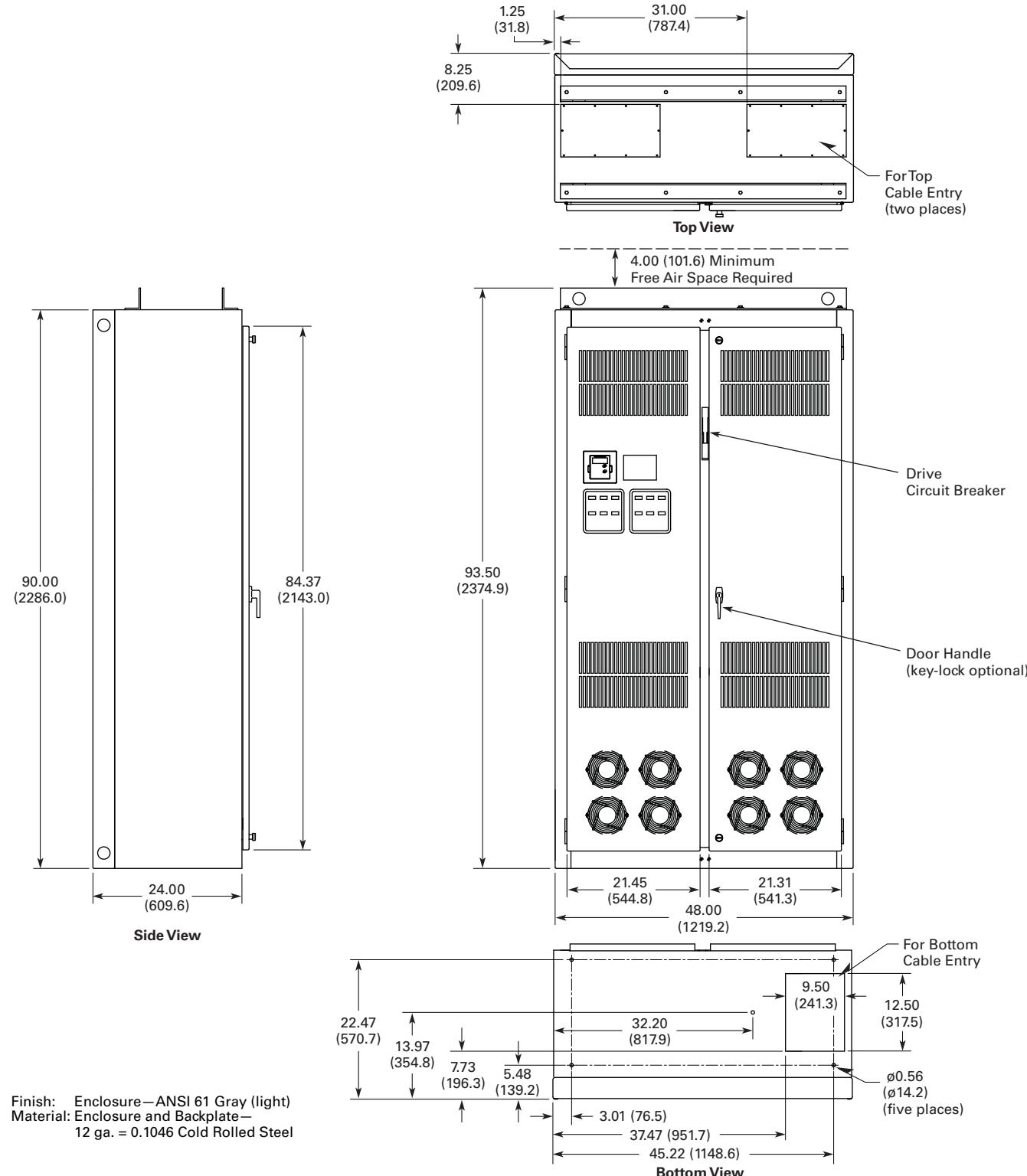
Approximate Dimensions in Inches (mm)

Enclosure Size 725-150 hp I_L and 25-125 hp I_H 480V—25-100 hp I_L and 25-75 hp I_H 575V

Approximate Dimensions in Inches (mm)

Enclosure Size 8

200–250 hp I_L and 150–200 hp I_H 480V—125–200 hp I_L and 100–150 hp I_H 575V



2.8

Adjustable Frequency Drives

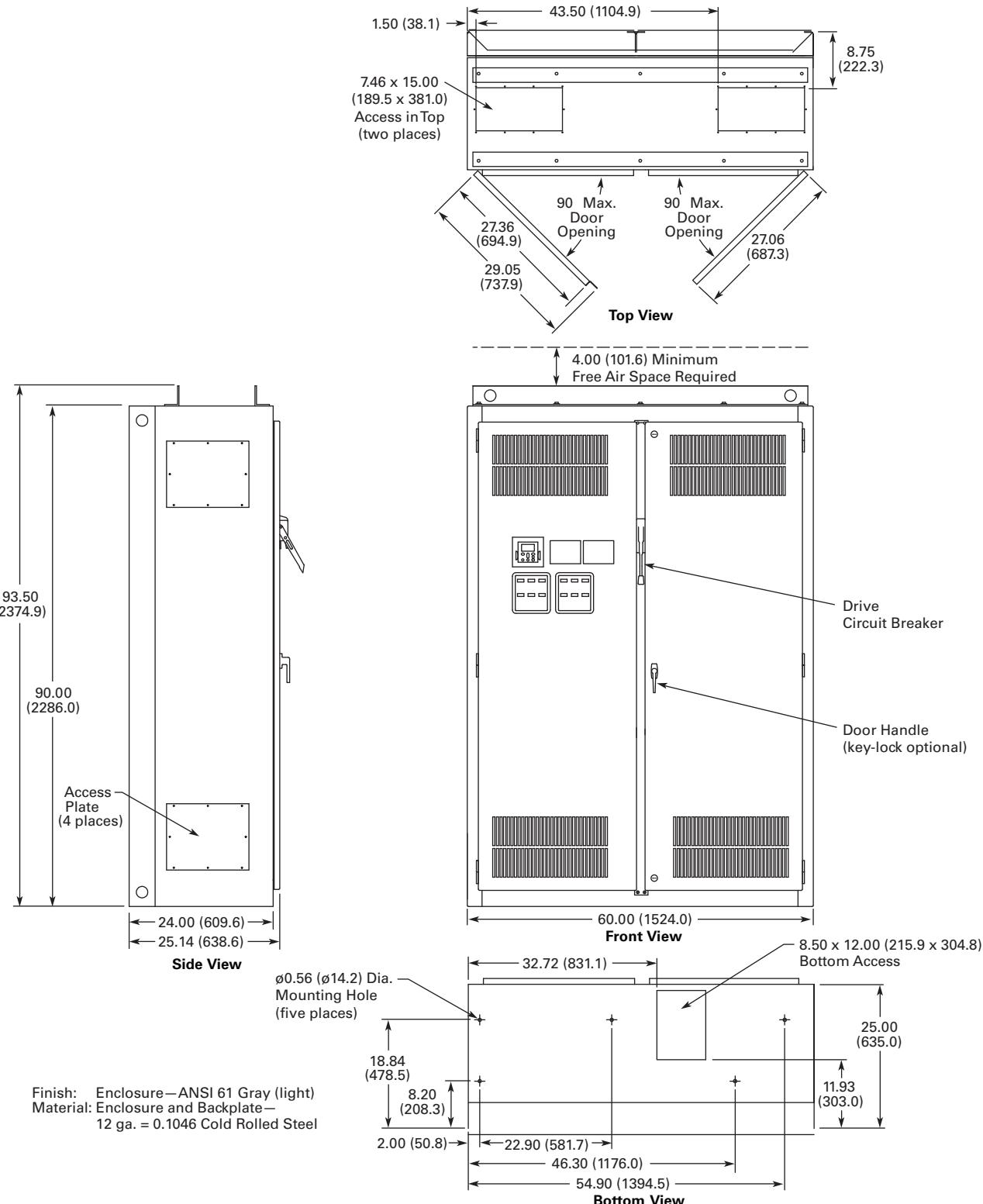
Low Harmonic Drives

Approximate Dimensions in Inches (mm)

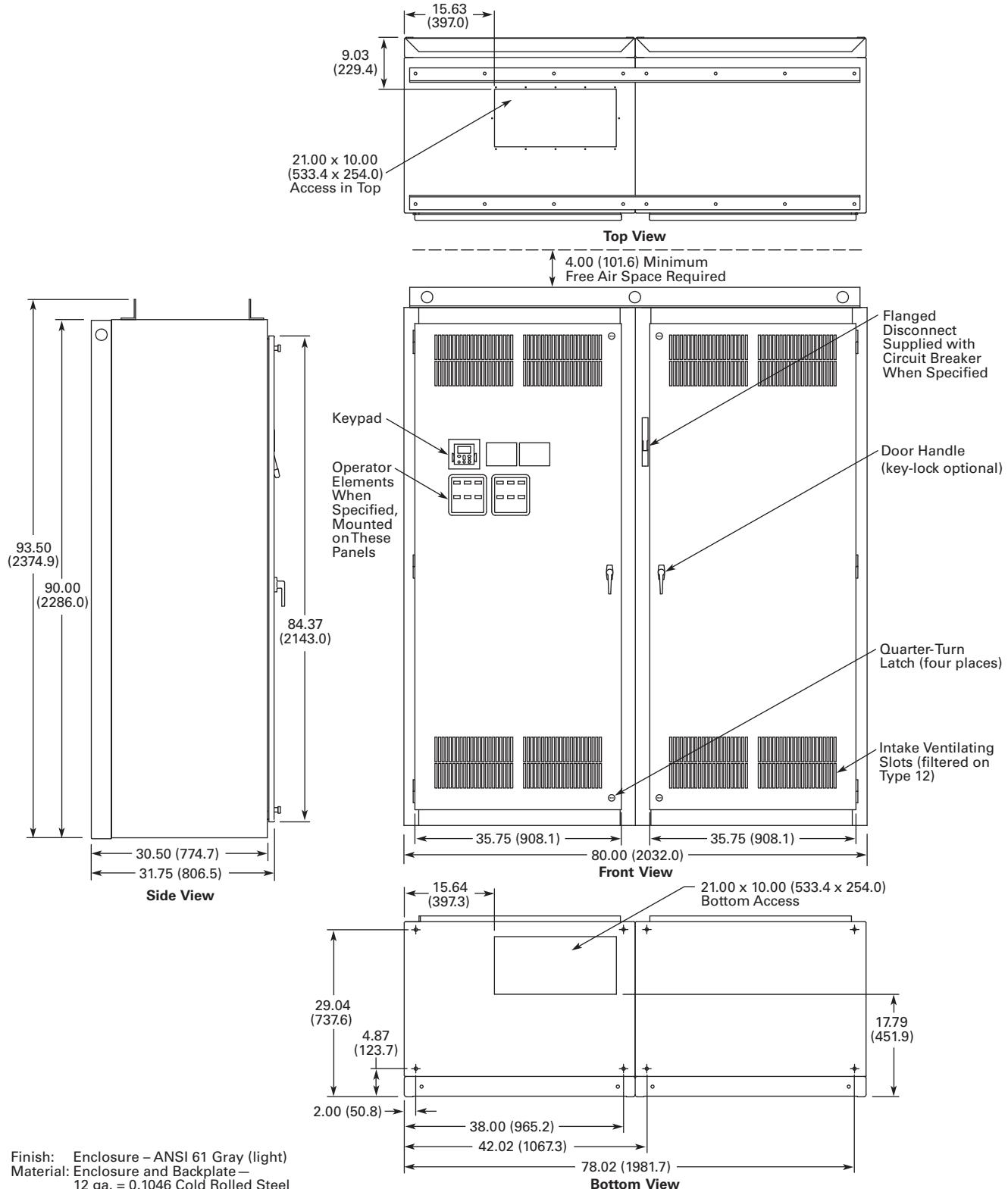
Enclosure Size 9

2

300–400 hp I_L and 250–350 hp I_H 480V—250–400 hp I_L and 200–300 hp I_H 575V



Approximate Dimensions in Inches (mm)

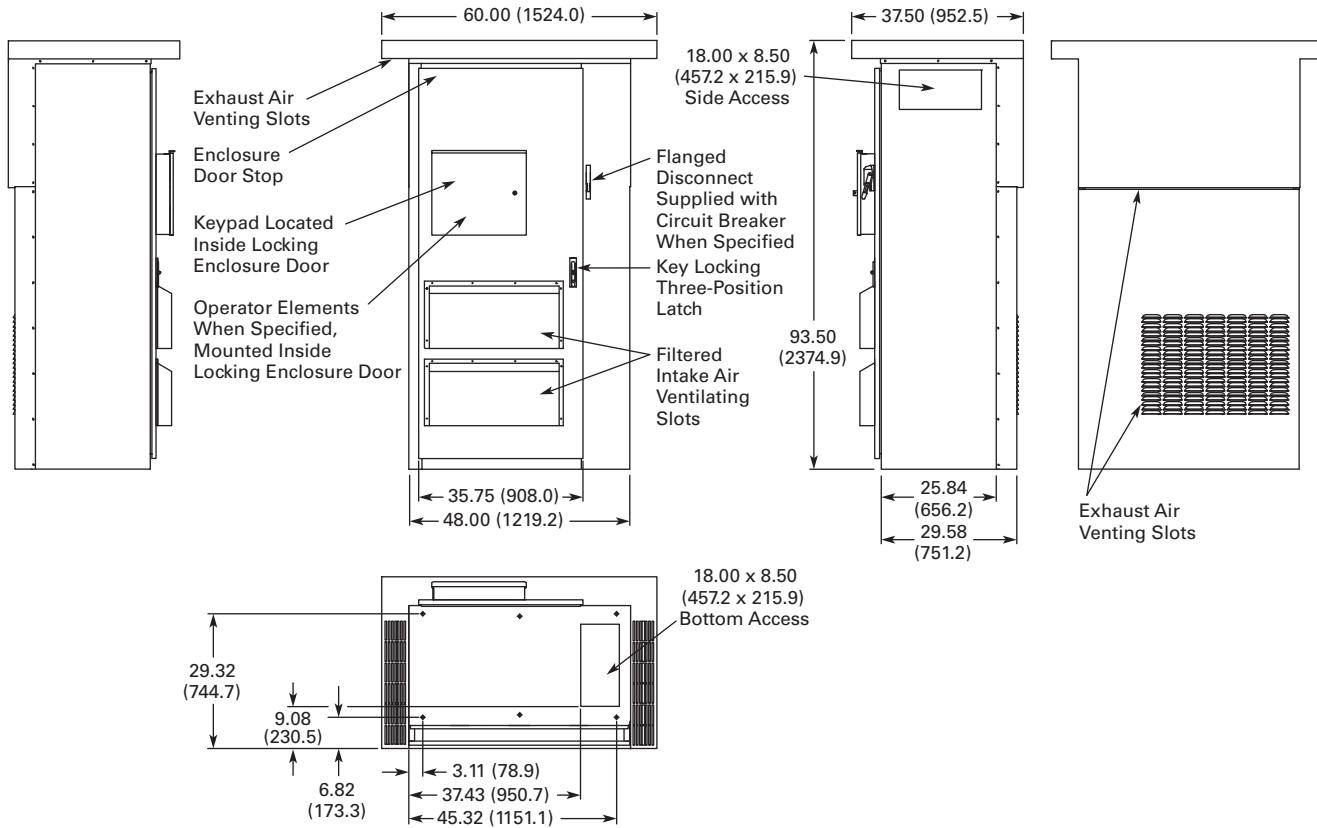
Enclosure Size 10**500–600 hp I_L and 400–500 hp I_H 480V—500–600 hp I_L and 400–500 hp I_H 575V**

Approximate Dimensions in Inches (mm)

Enclosure Size F Type 3R Drives

2

25–250 hp I_L and 25–200 hp I_H 480V—25–200 hp I_L and 25–150 hp I_H 575V Type 3R Drives



Enclosed 18-Pulse Drive Enclosure Dimensions

Enclosure Size ①	Width	Height	Depth	Approx. Shipping Weight in Lbs (kg)
7	30.00 (762.0)	90.00 (2286.0)	21.50 (546.1)	1000 (454)
8	48.00 (1219.2)	90.00 (2286.0)	26.14 (664.0)	1400 (636)
9	60.00 (1524.0)	90.00 (2286.0)	25.74 (653.8)	1800 (817)
10	80.00 (2032.0)	90.00 (2286.0)	31.75 (806.5)	2100 (953)
11 ②③	120.00 (3048.0)	90.00 (2286.0)	25.74 (653.8)	2500 (1,135)
F ④	60.00 (1524.0)	93.50 (2374.9)	37.50 (952.5)	2500 (1,135)

Notes

- ① Enclosure sizes accommodate drive and options, including bypass and disconnect. For other power options, consult your Eaton representative.
- ② Consult factory. Limited power options available.
- ③ Enclosure size 11 consists of two of the enclosure size 9.
- ④ All Type 3R drives use the Size F enclosure.

LCX9000 Liquid Cooled Adjustable Frequency Drives**Contents****Description**

	Page
LCX9000 Drives	2
Catalog Number Selection	V6-T2-264
Product Selection	V6-T2-265
Options	V6-T2-268
Technical Data and Specifications	V6-T2-270
Wiring Diagrams	V6-T2-271
Dimensions	V6-T2-273

Product Description

The LCX9000 Liquid Cooled Drive family continues Eaton's tradition of providing state-of-the-industry products, by taking advantage of liquid cooling technology in lieu of air-cooling techniques.

The LCX9000 drives are liquid-cooled products that utilize potable water or a water-glycol mixture as a cooling medium.

Features and Benefits

- Compact size and low heat transfer rates allow enclosure size to be greatly reduced, which is especially beneficial in UL Type 4X applications
- Design is modular, with control and power modules independent of each other. Connection between power and control modules can be direct or extended via a fiber optic cable
- Same reliable control module and operating system as the SPX9000 air-cooled drives

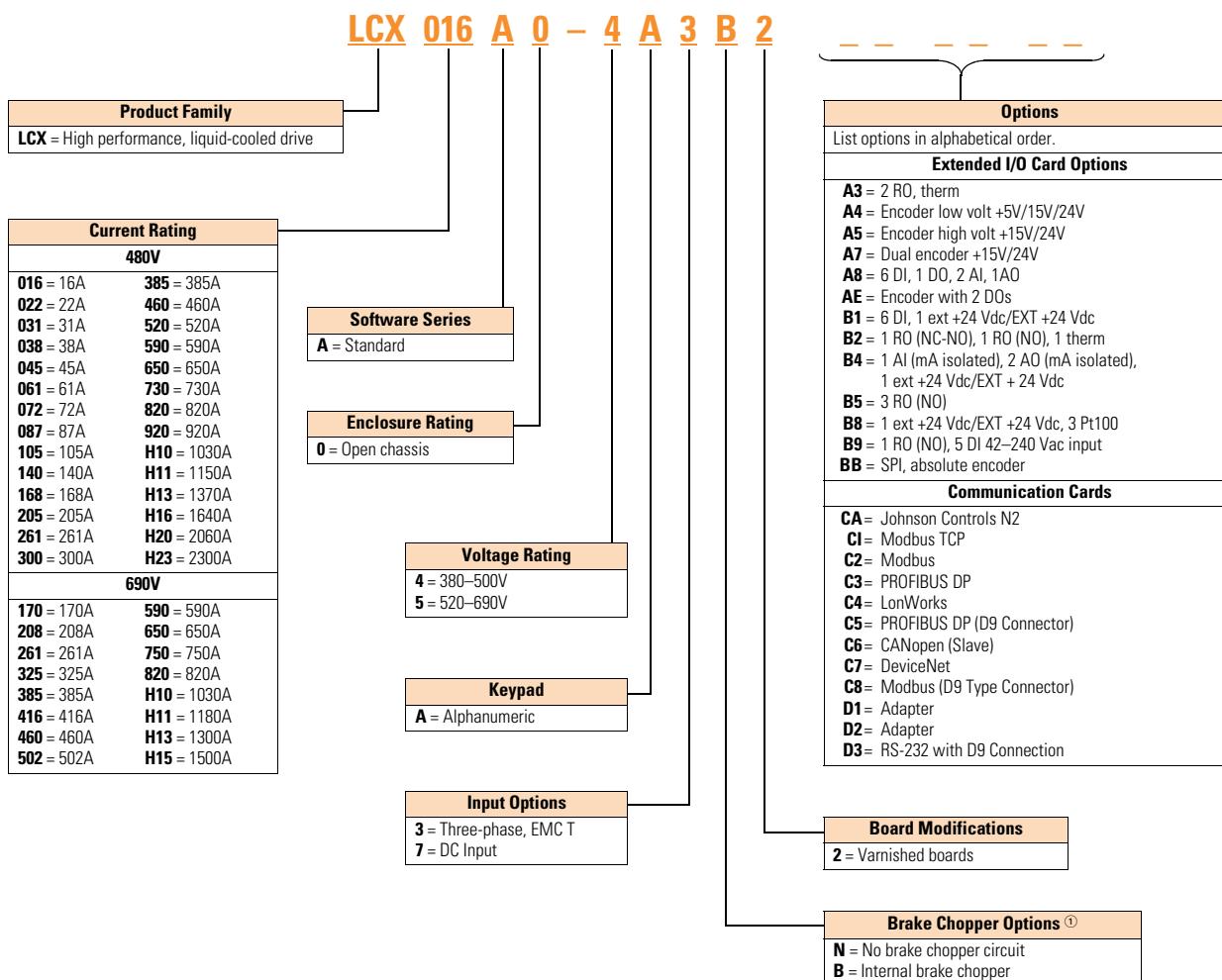
Standards and Certifications

- CE



Catalog Number Selection**LCX9000 Liquid Cooled Adjustable Frequency Drives**

2

**Note**

① Brake chopper is only available in 480V CH3 drives.

Product Selection**LCX9000 Liquid Cooled Drives****380–500 Vac Liquid Cooled Drives**

2

Motor Output**Current**

Thermal, I_{th} (A)	I_L (A)	I_H (A)	kW	Chassis	Catalog Number
16	15	11	7.5	CH3	LCX016A0-4A3N2
22	20	15	11	CH3	LCX022A0-4A3N2
31	28	21	15	CH3	LCX031A0-4A3N2
38	35	25	18.5	CH3	LCX038A0-4A3N2
45	41	30	22	CH3	LCX045A0-4A3N2
61	55	41	30	CH3	LCX061A0-4A3N2
72	65	48	37	CH4	LCX072A0-4A3N2
87	79	58	45	CH4	LCX087A0-4A3N2
105	95	70	55	CH4	LCX105A0-4A3N2
140	127	93	75	CH4	LCX140A0-4A3N2
168	153	112	90	CH5	LCX168A0-4A3N2
205	186	137	110	CH5	LCX205A0-4A3N2
261	237	174	132	CH5	LCX261A0-4A3N2
300	273	200	160	CH61	LCX300A0-4A3N2
385	350	257	200	CH61	LCX385A0-4A3N2
460	418	307	250	CH72	LCX460A0-4A3N2
520	473	347	250	CH72	LCX520A0-4A3N2
590	536	393	315	CH72	LCX590A0-4A3N2
650	591	433	355	CH72	LCX650A0-4A3N2
730	664	487	400	CH72	LCX730A0-4A3N2
820	745	547	450	CH63	LCX820A0-4A3N2
920	836	613	500	CH63	LCX920A0-4A3N2
1030	936	687	560	CH63	LCXH10A0-4A3N2
1150	1045	766	600	CH63	LCXH11A0-4A3N2
1370	1245	913	700	CH74	LCXH13A0-4A3N2
1640	1491	1093	900	CH74	LCXH16A0-4A3N2
2060	1873	1373	1100	CH74	LCXH20A0-4A3N2
2300	2091	1533	1200	CH74	LCXH23A0-4A3N2

LCX9000 Liquid Cooled Drives



2

525–690 Vac Liquid Cooled Drives

Motor Output

Current

Thermal, I_{th} (A)	I_L (A)	I_H (A)	kW	Chassis	Catalog Number
170	155	113	110	CH61	LCX170A0-5A3N2
208	189	139	132	CH61	LCX208A0-5A3N2
261	237	174	160	CH72	LCX261A0-5A3N2
325	295	217	200	CH72	LCX325A0-5A3N2
385	350	257	250	CH72	LCX385A0-5A3N2
416	378	277	250	CH72	LCX416A0-5A3N2
460	418	307	300	CH72	LCX460A0-5A3N2
502	456	335	355	CH72	LCX502A0-5A3N2
590	536	393	400	CH63	LCX590A0-5A3N2
650	591	433	450	CH63	LCX650A0-5A3N2
750	682	500	500	CH63	LCX750A0-5A3N2
820	745	547	560	CH74	LCX820A0-5A3N2
920	836	613	650	CH74	LCX920A0-5A3N2
1030	936	687	700	CH74	LCXH10A0-5A3N2
1180	1073	787	800	CH74	LCXH11A0-5A3N2
1300	1182	867	900	CH74	LCXH13A0-5A3N2
1500	1364	1000	1000	CH74	LCXH15A0-5A3N2

540–675 Vdc Liquid Cooled Inverter Units

Drive Output

Current

Thermal I_{th} (A)	Rated Cont. I_L (A)	Rated Cont. I_H (A)	Motor Output Power		Power Loss c/a/T (kW)	Chassis	Catalog Number
			Optimum Motor at I_{th} 400V (kW)	Optimum Motor at I_{th} 500V (kW)			
16	15	11	7.5	11	0.4/0.2/ 0.6	CH3	LCX016A0-4A7B2
22	20	15	11	15	0.5/0.2/ 0.7	CH3	LCX022A0-4A7B2
31	28	21	15	18.5	0.7/0.2/ 0.9	CH3	LCX031A0-4A7B2
38	35	25	18.5	22	0.8/0.2/ 1.0	CH3	LCX038A0-4A7B2
45	41	30	22	30	1.0/0.3/ 1.3	CH3	LCX045A0-4A7B2
61	55	41	30	37	1.3/0.3/ 1.5	CH3	LCX061A0-4A7B2
72	65	48	37	45	1.2/0.3/ 1.5	CH4	LCX072A0-4A7N2
87	79	58	45	55	1.5/0.3/ 1.8	CH4	LCX087A0-4A7N2
105	95	70	55	75	1.8/0.3/ 2.1	CH4	LCX105A0-4A7N2
140	127	93	75	90	2.3/0.3/ 2.6	CH4	LCX140A0-4A7N2
168	153	112	90	110	2.5/0.3/ 2.8	CH5	LCX168A0-4A7N2
205	186	137	110	132	3.0/0.4/ 3.4	CH5	LCX205A0-4A7N2
261	237	174	132	160	4.0/0.4/ 4.4	CH5	LCX261A0-4A7N2
300	273	200	160	200	4.5/0.4/ 4.9	CH61	LCX300A0-4A7N2
385	350	257	200	250	5.5/0.5/ 6.0	CH61	LCX385A0-4A7N2
460	418	307	250	315	5.5/0.5/ 6.0	CH62	LCX460A0-4A7N2
520	473	347	250	355	6.5/0.5/ 7.0	CH62	LCX520A0-4A7N2
590	536	393	315	400	7.5/0.6/ 8.1	CH62	LCX590A0-4A7N2

LCX9000 Liquid Cooled Drives



540–675 Vdc Liquid Cooled Inverter Units, continued

Drive Output

Thermal I _{th} (A)	Current		Motor Output Power		Power Loss c/a/T (kW)	Chassis	Catalog Number
	Rated Cont. I _L (A)	Rated Cont. I _H (A)	Optimum Motor at I _{th} 400V (kW)	Optimum Motor at I _{th} 500V (kW)			
650	591	433	355	450	8.5/0.6/ 9.1	CH62	LCX650A0-4A7N2
730	664	487	400	500	10.0/0.7/ 10.7	CH62	LCX730A0-4A7N2
820	745	547	450	560	12.5/0.8/ 13.3	CH63	LCX820A0-4A7N2
920	836	613	500	600	14.4/0.9/ 15.3	CH63	LCX920A0-4A7N2
1030	936	687	560	700	16.5/1.0/ 17.5	CH63	LCXH10A0-4A7N2
1150	1045	766	600	750	18.4/1.1/ 19.5	CH63	LCXH11A0-4A7N2
1370	1245	913	700	900	15.5/1.0/ 16.5	CH64	LCXH13A0-4A7N2
1640	1491	1093	900	1100	19.5/1.2/ 20.7	CH64	LCXH16A0-4A7N2
2060	1873	1373	1100	1400	26.5/1.5/ 28.0	CH64	LCXH20A0-4A7N2
2300	2091	1533	1250	1500	29.6/1.7/ 31.3	CH64	LCXH23A0-4A7N2
2470	2245	1647	1300	1600	36.0/2.0/ 38.0	2*CH64	LCXH24A0-4A7N2
2950	2681	1967	1550	1950	39.0/2.4/ 41.4	2*CH64	LCXH29A0-4A7N2
3710	3372	2473	1950	2450	48.0/2.7/ 50.7	2*CH64	LCXH37A0-4A7N2
4140	3763	2760	2150	2700	53.0/3.0/ 66.0	2*CH64	LCXH41A0-4A7N2

710–930 Vdc Liquid Cooled Inverter Unit

Drive Output

Thermal I _{th} (A)	Current		Motor Output Power		Power Loss c/a/T (kW)	Chassis	Catalog Number
	Rated Cont. I _L (A)	Rated Cont. I _H (A)	Optimum Motor at I _{th} 400V (kW)	Optimum Motor at I _{th} 500V (kW)			
170	155	113	110	160	4.5/0.2/ 4.7	CH61	LCX170A0-5A7N2
208	189	139	132	200	5.5/0.3/ 5.8	CH61	LCX208A0-5A7N2
261	237	174	160	250	5.5/0.3/ 5.8	CH61	LCX261A0-5A7N2
325	295	217	200	300	6.5/0.3/ 6.8	CH62	LCX325A0-5A7N2
385	350	257	250	355	7.5/0.4/ 7.9	CH62	LCX385A0-5A7N2
416	378	277	250	355	8.0/0.4/ 8.4	CH62	LCX416A0-5A7N2
460	418	307	300	400	8.5/0.4/ 8.9	CH62	LCX460A0-5A7N2
502	456	335	355	450	10.0/0.5/ 10.5	CH62	LCX502A0-5A7N2
590	536	393	400	560	10.0/0.5/ 10.5	CH63	LCX590A0-5A7N2
650	591	433	450	600	13.5/0.7/ 14.2	CH63	LCX650A0-5A7N2
750	682	500	500	700	16.0/0.8/ 16.8	CH63	LCX750A0-5A7N2
820	745	547	560	800	16.0/0.8/ 16.8	CH64	LCX820A0-5A7N2
920	836	613	650	850	18.0/0.9/ 18.9	CH64	LCX920A0-5A7N2
1030	936	687	700	1000	19.0/1.0/ 20.0	CH64	LCXH10A0-5A7N2
1180	1073	787	800	1100	21.0/10.1/ 20.1	CH64	LCXH11A0-5A7N2
1300	1182	867	900	1200	27.0/1.4/ 28.4	CH64	LCXH13A0-5A7N2
1500	1364	1000	1050	1400	32.0/1.6/ 33.6	CH64	LCXH15A0-5A7N2
1700	1545	1133	1150	1550	N/A	CH64	LCXH17A0-5A7N2
1850	1682	1233	1250	1650	34.2/1.8/ 36.0	2*CH64	LCXH18A0-5A7N2
2120	1927	1413	1450	1900	37.8/2.0/ 39.8	2*CH64	LCXH21A0-5A7N2
2340	2127	1560	1600	2100	48.6/2.5/ 51.1	2*CH64	LCXH23A0-5A7N2
2700	2455	1800	1850	2450	57.6/3.0/ 60.6	2*CH64	LCXH27A0-5A7N2
3100	2818	2066	2150	2800	N/A	2*CH64	LCXH31A0-5A7N2

Options

9000X Series Option Board Kits

2

The 9000X Series drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of five option boards.

The 9000X Series factory installed standard board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B.

Option Boards		Option Board Kits									
Option Kit Description ^①	Allowed Slot Locations ^②	Field Installed Catalog Number	Factory Installed Option Designator	SVX Ready Programs							
				Basic	Local/ Remote	Standard	MSS	PID	Multi-P.	PFC	
Standard I/O Cards											
2 RO (NC-NO)	B	OPTA2	—	■	■	■	■	■	■	■	
6 DI, 1 DO, 2 AI, 1AO, 1 +10 Vdc ref, 2 ext +24 Vdc/EXT +24 Vdc	A	OPTA9	—	■	■	■	■	■	■	■	
Extended I/O Cards											
2 RO, therm	B	OPTA3	A3	—	■	■	■	■	■	■	
Encoder low Volt +5V/15V/24V	C	OPTA4	A4	—	■	■	■	■	■	■	
Encoder high Volt +15V/24V	C	OPTA5	A5	—	■	■	■	■	■	■	
Dual encoder +15V/24V	C	OPTA7	A7	—	■	■	■	■	■	■	
6 DI, 1 DO, 2 AI, 1 AO	A	OPTA8	A8	—	■	■	■	■	■	■	
3 DI (encoder 10–24V, out +15V/+24V, 2 DO (pulse+direction)—SPX only	C	OPTAE	AE	■	■	■	■	■	■	■	
6 DI, 1 ext +24 Vdc/EXT +24 Vdc	B, C, D, E	OPTB1	B1	—	—	—	—	—	■	■	
1 RO (NC-NO), 1 RO (NO), 1 therm	B, C, D, E	OPTB2	B2	—	—	—	—	—	■	■	
1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24 Vdc/EXT +24 Vdc	B, C, D, E	OPTB4	B4	—	■	■	■	■	■	■	
3 RO (NO)	B, C, D, E	OPTB5	B5	—	—	—	—	—	■	■	
1 ext +24 Vdc/EXT +24 Vdc, 3 Pt100	B, C, D, E	OPTB8	B8	—	—	—	—	—	—	—	
1 RO (NO), 5 DI 42–240 Vac input	B, C, D, E	OPTB9	B9	—	—	—	—	—	■	■	
SPI, absolute encoder	C	OPTBB	BB	—	—	—	—	—	—	—	
Communication Cards ^③											
Modbus	D, E	OPTC2	C2	■	■	■	■	■	■	■	
Johnson Controls N2	D, E	OPTC2	CA	—	—	—	—	—	—	—	
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■	■	■	
LonWorks	D, E	OPTC4	C4	■	■	■	■	■	■	■	
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■	■	■	
CANopen (slave)	D, E	OPTC6	C6	■	■	■	■	■	■	■	
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■	■	■	
Modbus (D9 Type connector)	D, E	OPTC8	C8	■	■	■	■	■	■	■	
Modbus TCP	D, E	OPTCI	CI	■	■	■	■	■	■	■	
Adapter—SPX only	D, E	OPTD1	D1	■	■	■	■	■	■	■	
Adapter—SPX only	D, E	OPTD2	D2	■	■	■	■	■	■	■	
RS-232 with D9 connection	D, E	OPTD3	D3	■	■	■	■	■	■	■	
Keypad											
9000X Series standard keypad	—	KEYPAD-STD	—	—	—	—	—	—	—	■	
9000X Series remote mount keypad unit (keypad not included, includes 10 ft cable, keypad holder, mounting hardware)	—	OPTRMT-KIT-9000X	—	—	—	—	—	—	—	—	

Notes

^① AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

^② Option card must be installed in one of the slots listed for that card. Slot indicated in bold is the preferred location.

^③ OPTC2 is a multi-protocol option card.

Line Reactors

The line reactor carries out several functions in the liquid cooled drive. Connection of the line reactor is necessary except if you have a component in your system that performs the same tasks (e.g. a transformer). The line

reactor is needed as an essential component for motor control, to protect the input and DC-link components against abrupt changes of current and voltage as well as to function as a protection

against harmonics. The line reactors are included in the standard delivery of liquid-cooled drives (not inverters). However, you can also order your drive without a line reactor.

Line Reactor Specifications

Drive Rating 480V	Drive Rating 690V	Thermal Current (A)	Nominal Inductance (μ H) A/B ^①	Calculated Loss (W)	Choke Catalog Number (690 Vac)
16 to 22A	12 to 23A	23	1900	145	CHK0023N6A0
31 to 38A	31 to 38A	38	1100	170	CHK0038N6A0
45 to 61A	46 to 62A	62	700	210	CHK0062N6A0
72 to 87A	72 to 87A	87	480	250	CHK0087N6A0
105 to 140A	105 to 140A	145	290	380	CHK0145N6A0
168 to 261A	170 to 261A	261	139/187	460	CHK0261N6A0
300 to 385A	325 to 385A 820 to 1180A ^②	400	90/126	570	CHK0400N6A0
460 to 520A 1370A ^②	416 to 502A 1300 to 1500A ^②	520	65/95	610	CHK0520N6A0
590 to 650A 1640A ^②	590 to 650A	650	51/71	840	CHK0650N6A0
730A 2060A ^②	—	730	45/61	850	CHK0730N6A0
820A 2300A ^②	750A	N/A	N/A	N/A	CHK0820N6A0
920 to 1030A	—	1000	30/41	950	CHK1030N6A0
1150A	—	1150	26/36	1000	CHK1150N6A0

Dimensions, see Page V6-T2-273.

Notes

^① Inductances for different supply voltages: A = 400–480 Vac; B = 500–690 Vac.

^② Drives require three chokes of the designated catalog number with six-pulse supply.

Technical Data and Specifications

2

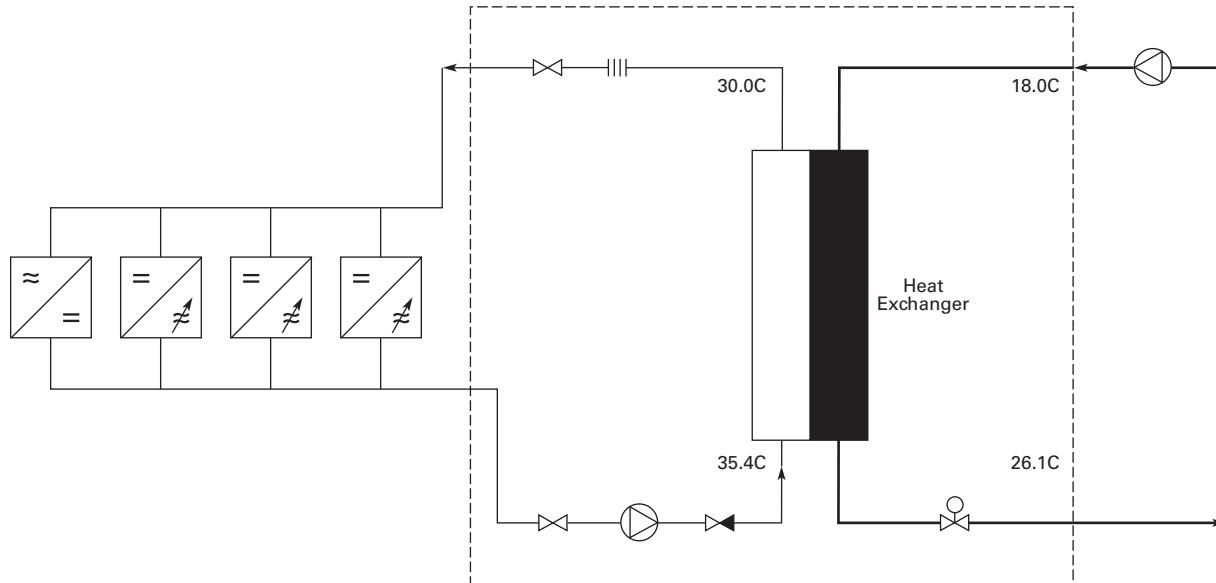
LCX9000 Products

Description	Specification
General Specifications	
Line voltage	400 to 500 Vac; 525 to 690 Vac; (-10% to 10%) 465 to 800 Vdc; 640 to 1100 Vdc; (-0 to 0%)
Frequency	50/60 Hz
Line voltage variation	-10% to 10%
Input frequency variation	45–66 Hz
Continuous output current	Rated current at incoming cooling liquid temperature of 30°C
Output frequency	0–320 Hz
Drive efficiency	>95%
Power factor (displacement)	0.96
Liquid coolant pressure	87 psi (6 bar) maximum
Liquid coolant flow rate	1.3 to 7.9 gal./min. (5 to 30 liter/min.) minimum depending on drive size
Liquid coolant fittings	Standard quick connect, NPT
Operating ambient temperature	-10/50°C
Storage temperature	-40/70°C
Humidity	95% maximum (non-condensing)
Altitude	3300 ft (1000 m) maximum without derating
Enclosure	IP00
Warranty	Standard terms, 3 years with certified start-up
Mains Connection	
Input voltage (V_{in})	400–500 Vac; 525–690 Vac; (-10%–10%) 465–800 Vdc; 640–1100 Vdc; (-0–0%)
Input frequency (f_{in})	45–66Hz
Connection to mains	Once per minute or less (normal case)
Motor Connection	
Output voltage	0– V_{in}
Continuous output current	Rated current at nominal inflow cooling water temperature of 30°C; Overload 2 sec./20 sec.
Starting current	Rated current at 2 sec./20 sec. if output frequency <30 Hz and temperature of heatsink <149°F (65°C)
Output frequency	0–320 Hz (standard); 7200 Hz (special software)
Frequency resolution	Application dependent
Control Characteristics	
Control method	Frequency control (V/f) Open loop: Sensorless vector control Closed loop: Frequency control Closed loop: Vector control
Switching frequency	Adjustable with parameter 2.6.9
480V ^①	Up to and including 61-Amp size: 1–16 kHz (factory default, 10 kHz) From 72-Amp size: 1–12 kHz (factory default, 3.6 kHz)
575V ^①	1–6kHz (factory default, 1.5kHz)
Frequency reference	Analog input: resolution 0.1% (10 bits); accuracy ±1% Panel reference: resolution 0.01 Hz
Field weakening point	30–320 Hz
Acceleration time	0.1–3000 seconds
Deceleration time	0.1–3000 seconds
Braking torque	DC brake: 30% x T_n (without brake option)
Ambient Conditions	
Ambient operating temperature	14°F (-10°C), no frost to 122°F (50°C) at I_{th} 122 to 158°F (50 to 70°C), derating required
Storage temperature	-40°F to 158°F (-40 to 70°C) No liquid in heatsink under 32°F (0°C)
Relative humidity	5–96% RH, noncondensing, no dripping water
Air quality	Chemical vapors: IEC 721-3-3, unit in operation, class 3C2 Mechanical particles: IEC 721-3-3, unit in operation, class 3S2 (no conductive dust allowed); No corrosive gases
Altitude	Up to 1,000m: 100% load capacity (no derating) Above 1,000m: Derating of 1% per each 100m required
Vibration	EN 50178, EN 60068-2-6; 5–150 Hz Displacement amplitude: 0.25 mm (peak) at 3–31 Hz Max. acceleration amplitude: 1G at 31–150 Hz
Shock	EN 50178, EN 60068-2-27, UPS drop test (for applicable UPS weights) Storage and shipping: Max. 15G, 11 ms (in package)
Enclosure class	IP00 open frame standard in entire kW/hp range
EMC	
Immunity	Fulfils all EMC immunity requirements
Emissions	EMC level N; EMC level T for IT networks
Safety	
Approvals	EN 50178, EN 60204-1, CE, UL, CUL, FI, GOST R, IEC 61800-5 (See unit nameplate for more detailed approvals.)
Control Connections	
Analog input voltage	0 to +10V, $R_i = 200$ kohm (-10V to +10V joystick control) Resolution 0.1%; accuracy ±1%
Analog input current	0(4)–20 mA, $R_i = 250$ ohm differential
Digital inputs	6 positive or negative logic; 18–24 Vdc
Auxiliary voltage	+24V, ±15%, max. 250 mA
Output reference voltage	+10V, +3%, max. load 10 mA
Analog output	0(4)–20 mA, R_i max. 500 ohm Resolution 10 bits; accuracy ±2%
Digital outputs	Open collector output, 50 mA/48V
Relay outputs	Two programmable change-over relay outputs Switching capacity: 24 Vdc/8A, 250 Vac/8A, 125 Vdc/0.4A Min. switching load: 5V/10 mA
Note	
① Derating required if higher switching frequency than the default is used.	

LCX9000 Products, continued

Description	Specification
Protections	
Overvoltage protection	
480V	911V
575V	1200V
Undervoltage protection	
480V	333V
575V	461V
Ground fault protection	In case of ground fault in motor or motor cable, only the drive is protected
Mains supervision	Trips if any of the input phases are missing (drives only)
Motor phase supervision	Trips if any of the output phases are missing
Unit overtemperature protection	
Alarm limit	149°F (65°C) for heatsink, 158°F (70°C) for circuit boards
Trip limit	158°F (70°C) for heatsink, 185°F (85°C) for circuit boards

Description	Specification
Protections, continued	
Overcurrent protection	Yes
Motor overload protection	Yes
Motor stall protection	Yes
Motor underload protection	Yes
Short-circuit protection	Yes (+24V and +10V reference voltages)
Liquid Cooling	
Allowed cooling agents	Drinking water Water-glycol mixture
Temperature of cooling agent	32 to 86°F (0 to 30°C) at I_{th} for input; 86 to 149°F (30 to 65°C) Max. temperature rise during circulation: 9°F (5°C), no condensation allowed
System max. working pressure	87 psi (6 bar)
System max. peak pressure	580 psi (40 bar)
Pressure loss (at nominal flow)	Varies according to size

Wiring Diagrams**Cooling System Diagrams****Example of a Typical Cooling System**

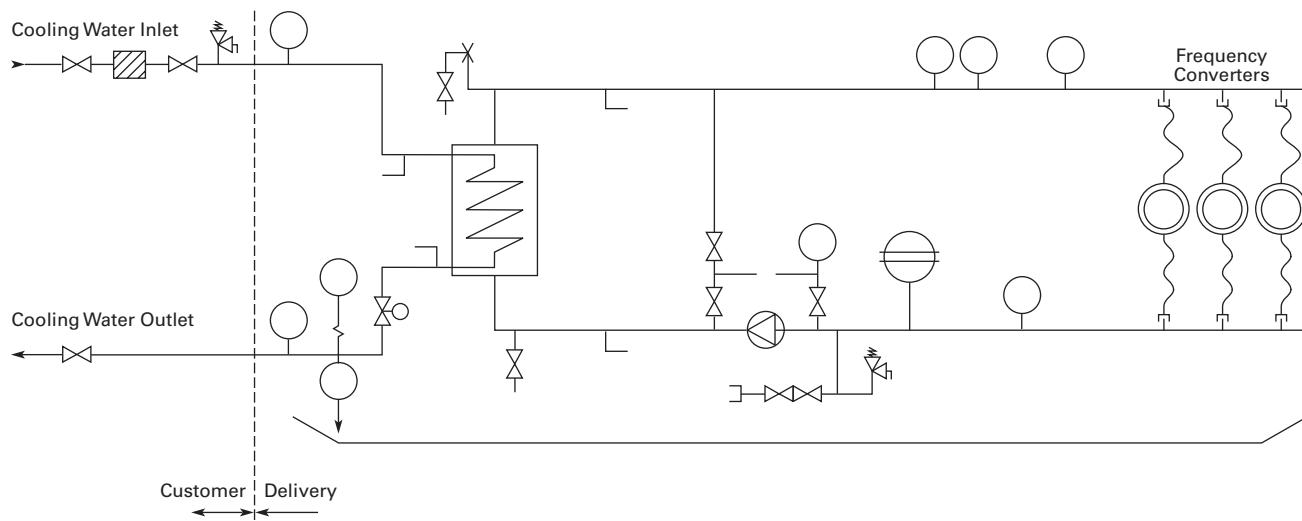
2.9

Adjustable Frequency Drives

LCX9000 Liquid Cooled Drives

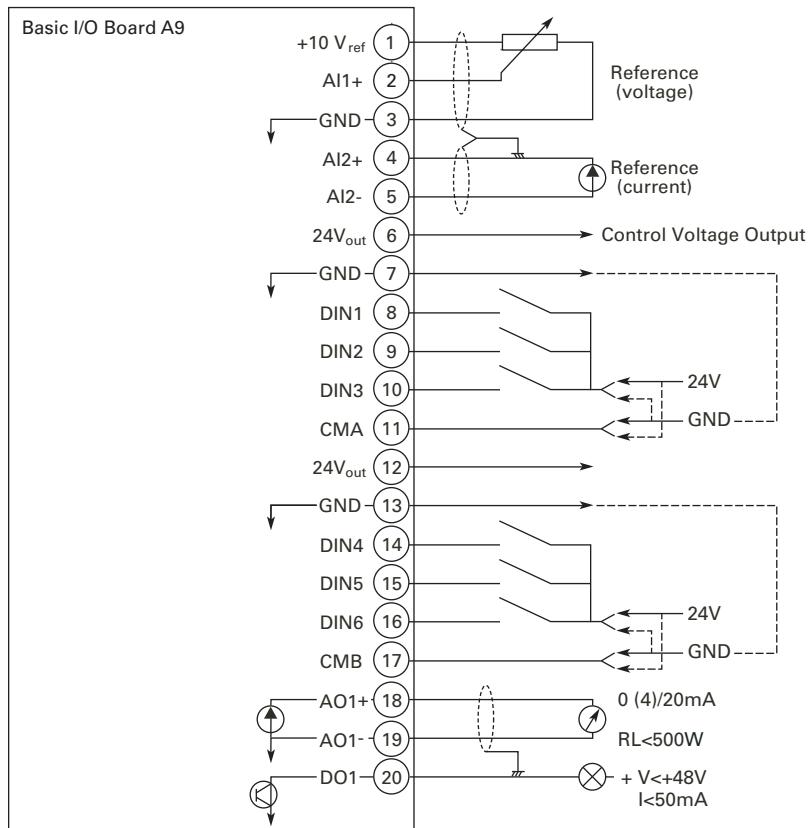
Example PI-Diagram of a Typical Cooling System and Connections

2

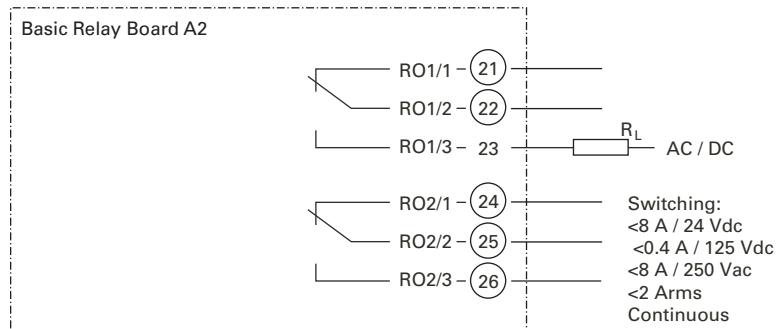


I/O Board Diagrams

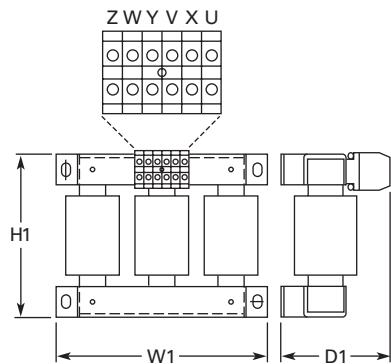
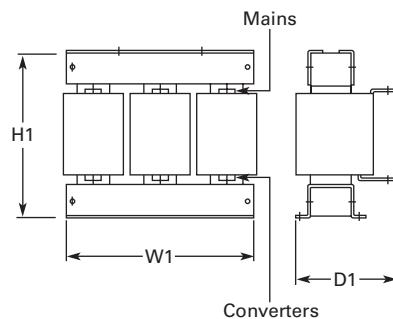
A9 Option Board Control Wiring



Dotted lines indicate the connections for inverted signals

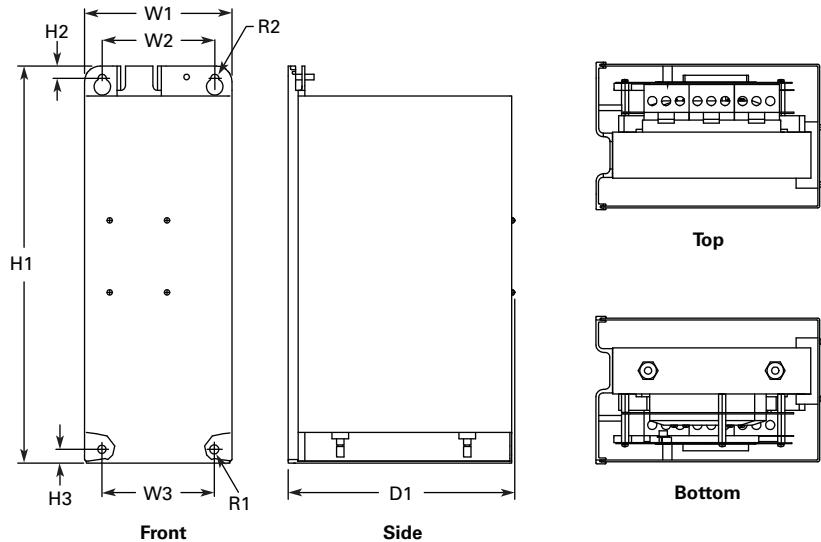
A2 Option Board Wiring**Dimensions**

Approximate Dimensions in Inches (mm)

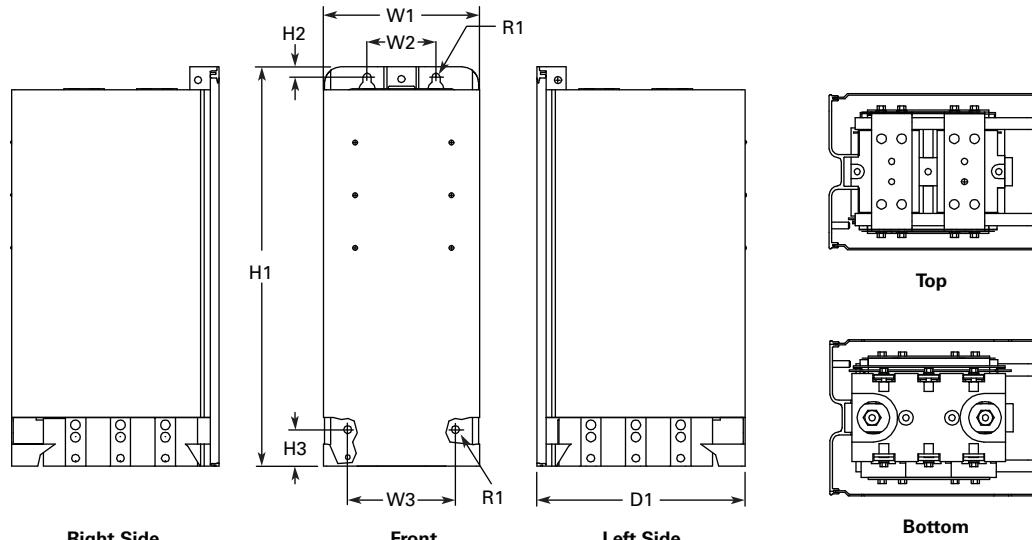
Line Reactors**Sizes Up To 61A****Sizes Larger Than 61A**

Catalog Number	H1	W1	D1	Weight Lbs (kg)
CHK0023N6A0	7.01 (178)	9.06 (230)	4.76 (121)	22 (10)
CHK0038N6A0	8.23 (209)	10.63 (270)	5.71 (145)	33 (15)
CHK0062N6A0	8.39 (213)	11.81 (300)	6.30 (160)	44 (20)
CHK0087N6A0	9.13 (232)	11.81 (300)	6.69 (170)	57 (26)
CHK0145N6A0	11.50 (292)	11.81 (300)	7.28 (185)	82 (37)
CHK0220N6A0	12.05 (306)	13.86 (352)	7.28 (185)	119 (54)
CHK0325N6A0	13.66 (347)	13.86 (352)	7.28 (185)	132 (60)
CHK0460N6A0	16.54 (423)	13.70 (348)	9.41 (239)	203 (92)
CHK0520N6A0	17.60 (447)	15.51 (394)	10.71 (272)	231 (105)
CHK0590N6A0	20.43 (519)	15.51 (394)	10.71 (272)	276 (125)
CHK0650N6A0	20.51 (521)	15.51 (394)	10.71 (272)	276 (125)
CHK0750N6A0	24.72 (628)	15.51 (394)	11.10 (282)	331 (150)
CHK0820N6A0	24.72 (628)	15.51 (394)	11.10 (282)	331 (150)
CHK1000N6A0	22.68 (576)	19.57 (497)	11.85 (301)	441 (200)
CHK1150N6A0	22.83 (580)	19.57 (497)	11.85 (301)	441 (200)

Approximate Dimensions in Inches (mm)

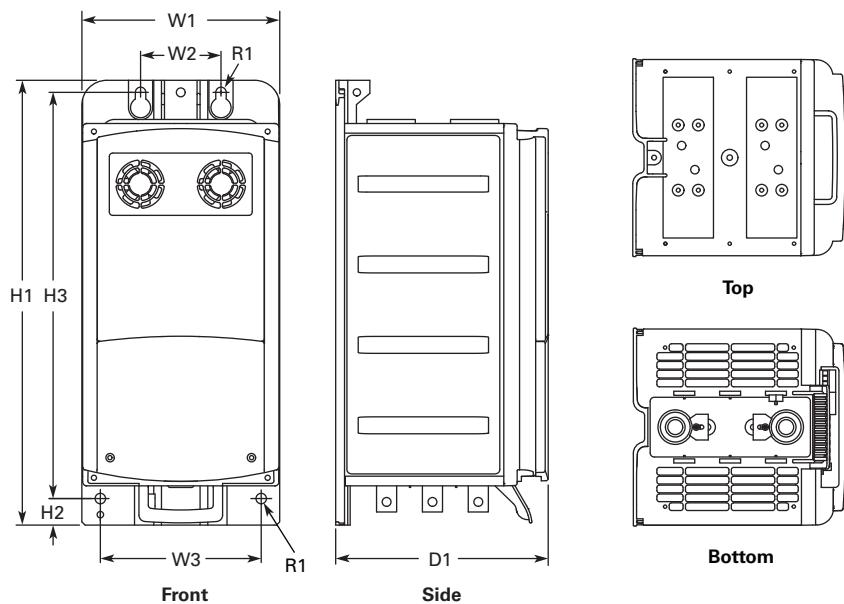
LCX9000 Drives**2****Chassis Size, CH3**

Voltage	Amps	H1	H2	H3	D1	W1	W2	W3	R1 Dia.	R2 Dia.	Weight Lbs (kg)
380–500 Vac	16–61	16.97 (431.0)	0.53 (13.5)	0.59 (15.0)	9.69 (246.0)	6.30 (160.0)	4.80 (122.0)	4.80 (122.0)	0.39 (10.0)	0.35 (9.0)	66 (30)

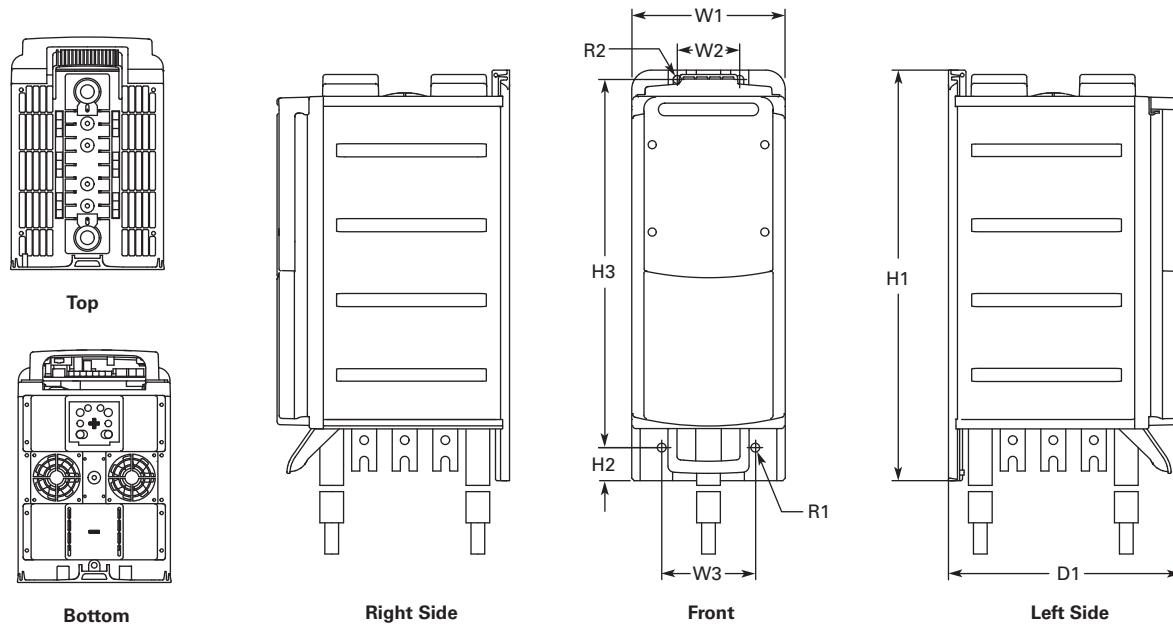
Chassis Size, CH4

Voltage	Amps	H1	H2	H3	D1	W1	W2	W3	R1 Dia.	R2 Dia.	Weight Lbs (kg)
380–500 Vac	72–140	19.41 (493.0)	0.49 (12.5)	1.77 (45.0)	10.14 (257.5)	7.60 (193.0)	3.35 (85.0)	5.24 (133.0)	0.39 (10.0)	—	77 (35)

Approximate Dimensions in Inches (mm)

Chassis Size, CH5

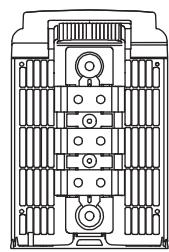
Voltage	Amps	H1	H2	H3	D1	W1	W2	W3	R1 Dia.	R2 Dia.	Weight Lbs (kg)
380–500 Vac	168–261	21.77 (553.0)	1.30 (33.0)	19.88 (505.0)	10.39 (264.0)	9.69 (246)	3.94 (100.0)	7.87 (200.0)	0.51 (13.0)	—	88 (40)

Chassis Size, CH61

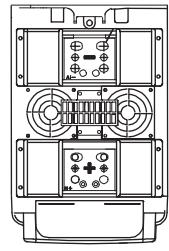
Voltage	Amps	H1	H2	H3	D1	W1	W2	W3	R1 Dia.	R2 Dia.	Weight Lbs (kg)
380–500 Vac	300–385	25.91 (658.0)	2.09 (53.0)	23.23 (590.0)	14.69 (373.0)	9.69 (246.0)	3.94 (100.0)	5.91 (150.0)	0.55 (14.0)	0.51 (13.0)	121 (55)
525–690 Vac	170–208										

Approximate Dimensions in Inches (mm)

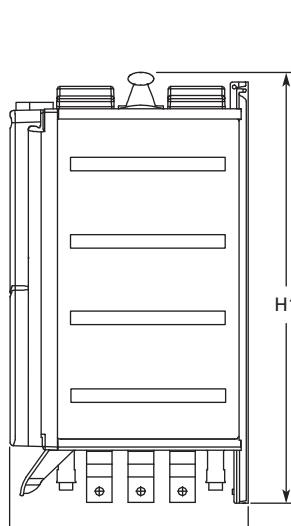
Liquid-Cooled Inverter—Chassis Size, CH62



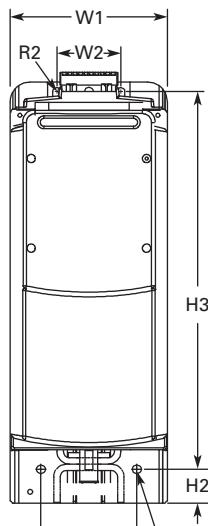
Top



Bottom



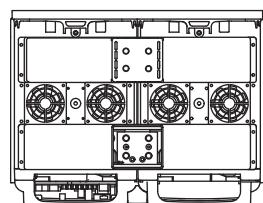
Side



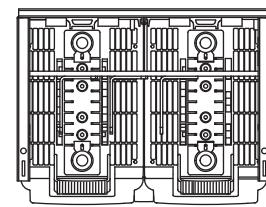
Front

Voltage	Amps	H1	H2	H3	D1	W1	W2	W3	R1 Dia.	R2 Dia.
540–675 Vdc	460–730	26.50 (673)	2.0 (53)	23.23 (590)	14.69 (373)	9.69 (246)	3.94 (100)	5.91 (150)	0.55 (14)	0.51 (13)
710–930 Vdc	325–502									

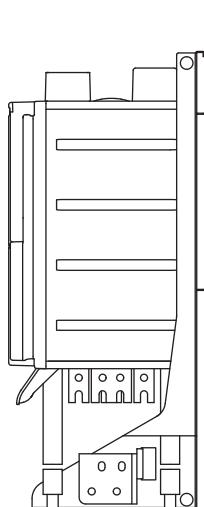
Chassis Size, CH63



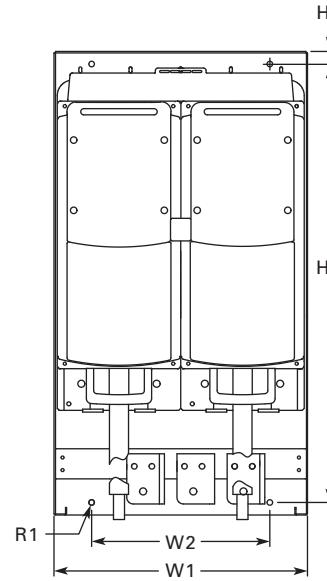
Top



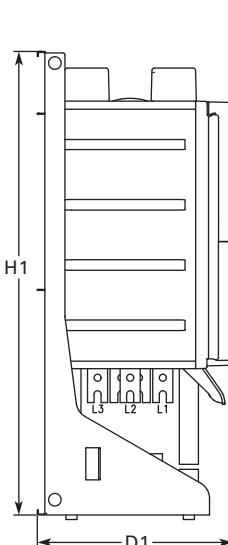
Bottom



Right Side



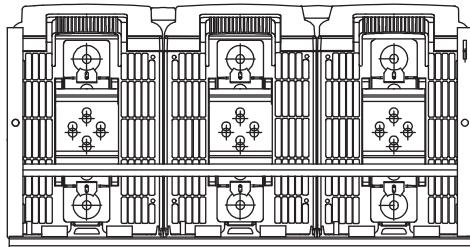
Front



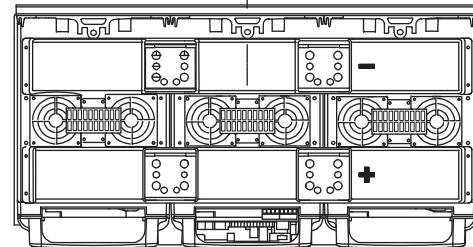
Left Side

Voltage	Amps	H1	H2	H3	D1	W1	W2	R1 Dia.	Weight Lbs (kg)
380–500 Vac	820–1030	36.36 (923.5)	0.91 (23.0)	34.39 (873.5)	15.35 (390.0)	19.88 (505.0)	13.98 (355.0)	0.43 (11.0)	264 (120)
525–690 Vac	590–750								

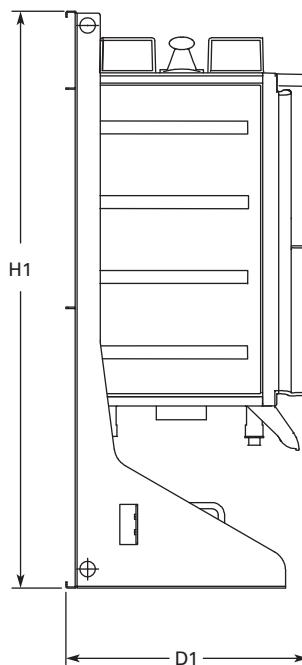
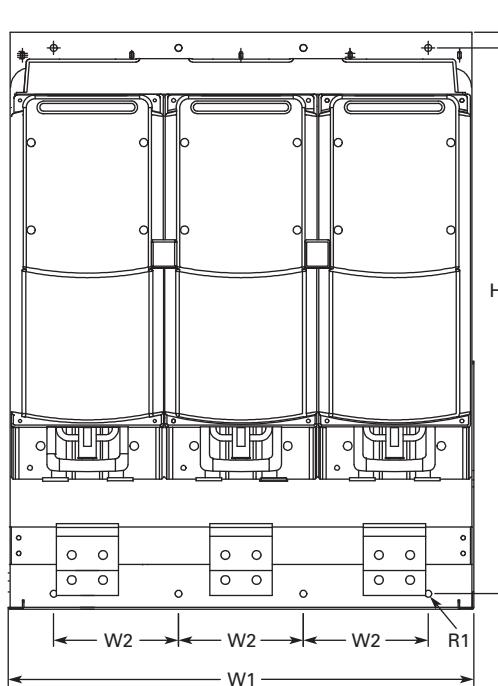
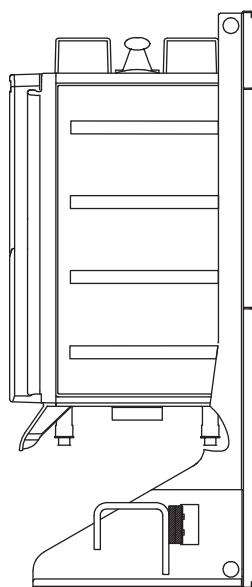
Approximate Dimensions in Inches (mm)

Liquid-Cooled Inverter with Mounting Bracket, Chassis Size CH64, IP90

Bottom



Top



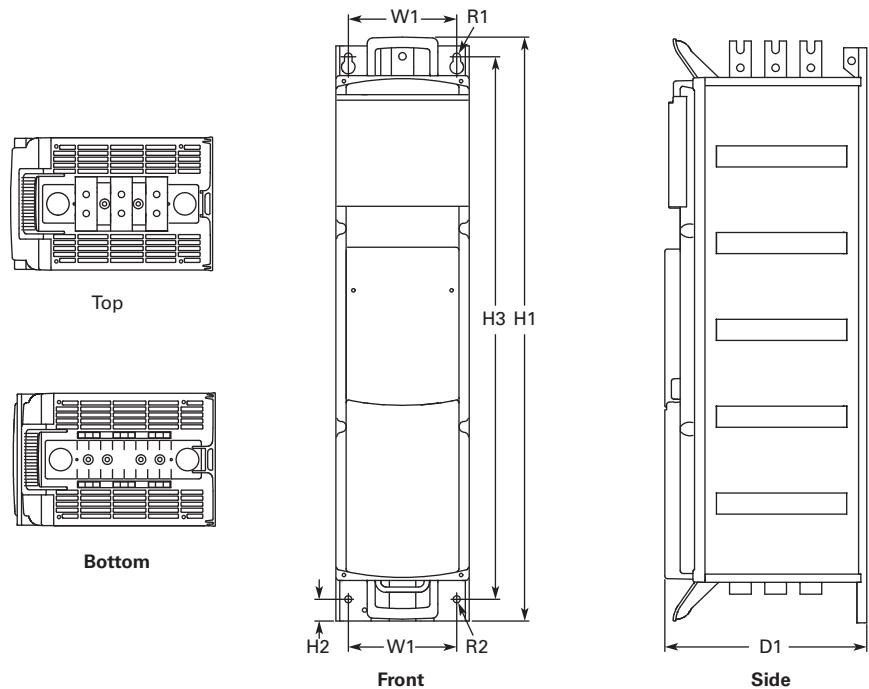
Right Side

Front

Left Side

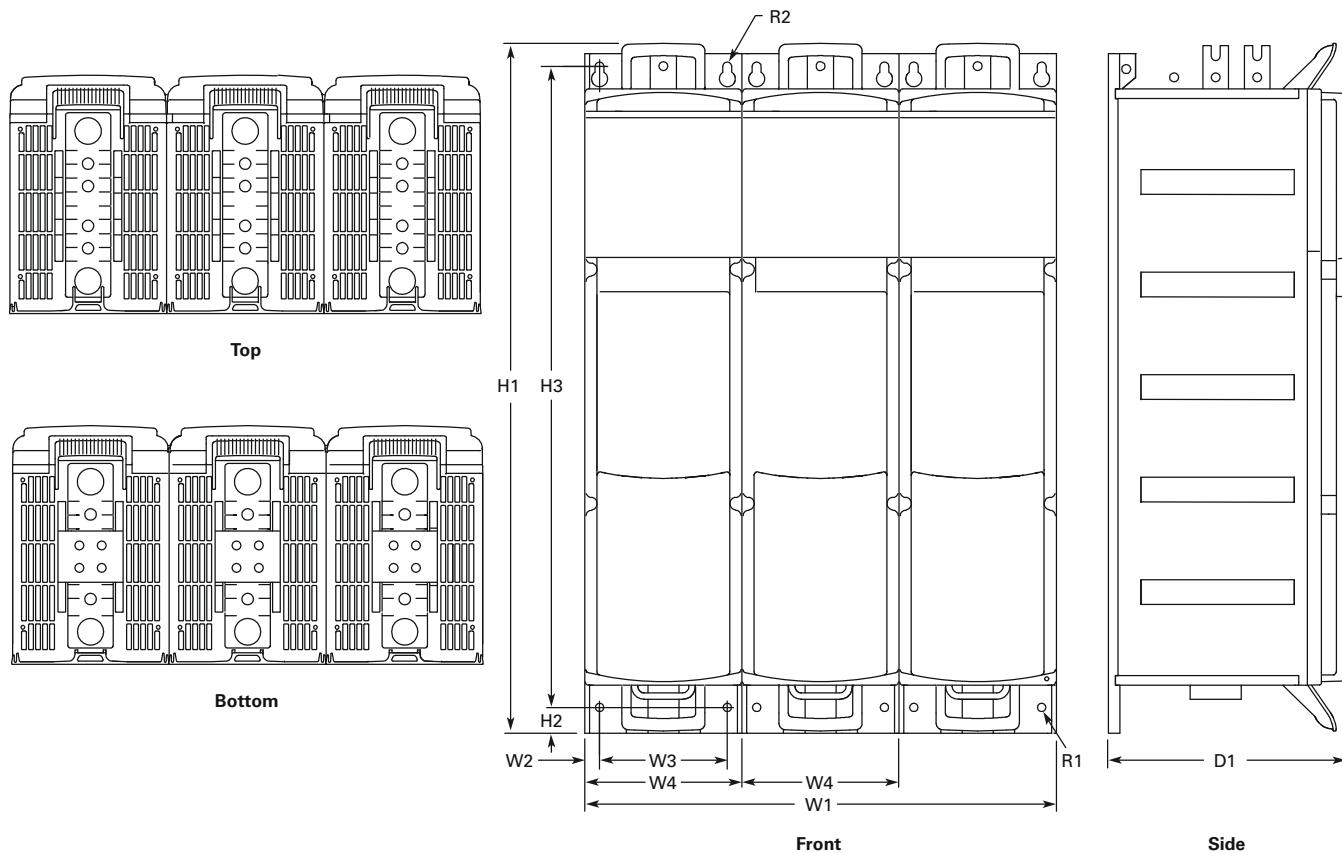
Voltage	Amps	H1	H2	H3	D1	W1	W2	R1 Dia.
540–675 Vdc	1370–4140	36.38 (924)	1.03 (26)	34.37 (873)	15.35 (390)	29.37 (746)	7.87 (200)	0.43 (11)
710–930 Vdc	820–3100							

Approximate Dimensions in Inches (mm)

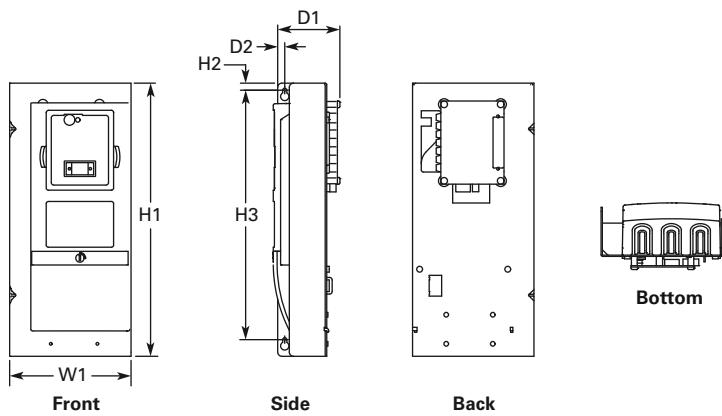
Chassis Size, CH72**2**

Voltage	Amps	H1	H2	H3	D1	W1	R1 Dia.	R2 Dia.	Weight Lbs (kg)
380–500 Vac	460–730	42.38 (1076.5)	1.57 (40.0)	39.37 (1000.0)	14.65 (372.0)	7.87 (200.0)	0.55 (14.0)	0.51 (13.0)	198 (90)
525–690 Vac	261–502								

Approximate Dimensions in Inches (mm)

Chassis Size, CH74

Voltage	Amps	H1	H2	H3	D1	W1	W2	W3	W4	R1 Dia.	R2 Dia.	Weight Lbs (kg)
380–500 Vac	1370–2300	42.38 (1076.5)	1.57 (40.0)	39.37 (1000.0)	14.65 (372.0)	29.06 (738.0)	0.91 (23.0)	7.87 (200.0)	9.69 (246)	0.51 (13.0)	0.55 (14.0)	617 (280)
525–690 Vac	820–1500											

Control Unit

H1	H2	H3	D1	D2	W1
12.93 (328.5)	0.33 (8.5)	11.81 (300.0)	2.95 (75.0)	0.33 (8.5)	5.75 (146.0)

SPA9000/SPN9000/SPI9000 Common DC Bus Drive Products**2****Contents****Description****Page**

SPA9000/SPN9000/SPI9000 Common DC Bus Drives	V6-T2-281
Application Description	V6-T2-281
Product Comparison	V6-T2-281
Features	V6-T2-282
Standards and Certifications	V6-T2-282
Catalog Number Selection	V6-T2-282
Product Selection	V6-T2-284
Options	V6-T2-287
Technical Data and Specifications	V6-T2-288
Wiring Diagrams	V6-T2-290
Dimensions	V6-T2-291

Product Description

Eaton offers a comprehensive range of common DC bus drive products. The product family covers a number of front-end units and inverter units in the entire power range from 1-1/2 to 2000 horsepower at 460V and 690V. The drive components are built on the SPX9000 technology.

Front-End Units

The front-end units convert a mains AC voltage and current into a DC voltage and current. The power is transferred from the mains to a common DC bus (and, in certain cases, vice versa).

The SPA (active front-end) unit is a bidirectional (regenerative) power converter for the front end of a common DC bus drive line up. An external LCL filter is used at the input. This unit is suitable in applications where low mains harmonics are required.

The SPN (non-regenerative front-end) unit is a uni-directional (motoring) power converter for the front-end of a common DC bus drive line-up. The device operates as a diode bridge using diode/thyristor components. A dedicated external choke is used at the input. The unit has the capacity to charge a common DC bus. This unit is suitable as a rectifying device when a "normal" level of harmonics is accepted and no regeneration to the mains is required.

Inverter Unit

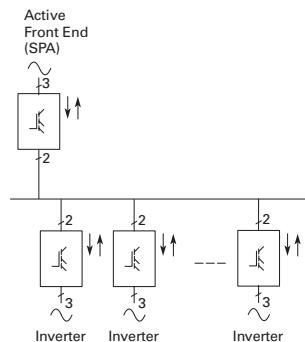
The SPI9000 Inverter Unit is a bidirectional DC-fed power inverter for the supply and control of AC motors. The inverter is supplied from a common DC bus drive line-up. A charging circuit is needed in case a connection to a live DC bus is required. The DC side charging circuit is integrated up to 75 kW (FR4–FR8) and external for higher power ratings (FI9–FI14).

Application Description

The common DC bus product portfolio fulfills all solution demands with a flexible architecture.

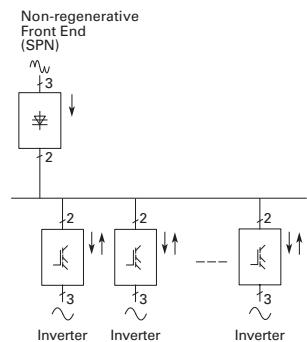
Front end units are selected according to the level of harmonics and power requirements. Typical drive system configurations are illustrated in the following figures.

SPA + Inverters



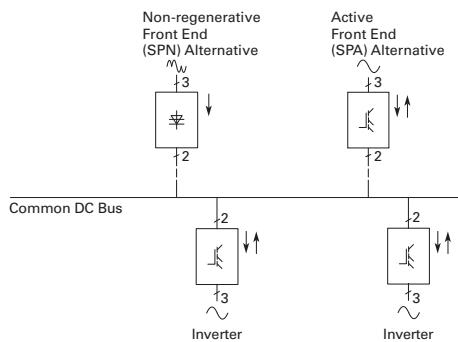
- Low harmonics, $-P_{\text{mains}} \approx +P_{\text{mains}}/P_{\text{mains}} \leq \sum P_{\text{INU}}$
- Suitable for almost every application

SPN + Inverters



- Low total mains power, $P_{\text{mains}} \leq \sum P_{\text{INU}}$
- Suitable e.g. for small processing line with un- and recoiler, em-stop coasting

Combination Configuration



Common DC bus components are used in a multitude of combinations. Drives which are braking can transfer the energy directly to the drives in motoring mode.

Product Comparison

Advantages over Conventional Front Ends

Eaton Front Ends vs. Conventional

	Non-Regenerative Front End	Active Front End	Conventional Regenerative Front End ①
Input device	Choke (L)	Filter (LCL)	Choke or auto-transformer (L)
Bridge type	Diode/thyristor bridge	IGBT bridge, two-level type	Anti-parallel connected thyristor bridge
Type of operation	Controlled half-bridge	High frequency modulation (1.5 to 3.6 kHz)	Firing angle controlled
Direction of power	Motoring	Motoring and regenerating	Motoring and regenerating
Charging	Constant current	External required	Usually internal
DC voltage	Nominal (approx. 1.35 alternative U_N)	Stable at +10% of nominal (approx. 110% of 1.35 alternative U_N)	Lowered DC voltage for commutation margin (e.g. 17% fi approx. 83% of 1.35 alternative U_N) or autotransformer on regenerative bridge
THD	Similar to six-pulse bridge normal <40%	Very low	Similar to six-pulse bridge or worse

Note

① Conventional regenerative front end (a.k.a. "anti-parallel thyristor bridge") is not available from Eaton.

Features

2

Standard Features

Feature	SP9000 FR4, 6, 7	FR8	FI9–FI14	SPA FI9–FI14	SPN FI9
IP00	—	■	■	■	■
IP21	■	—	—	—	—
Air cooling	■	■	■	■	■
Standard board	■	■	■	■	—
Varnished board	—	—	—	—	—
Alphanumeric keypad	■	■	■	■	—
EMC class T (EN 61800-3 for IT networks)	■	■	■	■	■
Safety CE/UL	■	■	■	■	■
Input choke	—	—	—	—	■
LCL filter	—	—	—	■	—
No integrated charging	—	—	■	■	—
Integrated charging (DC side)	■	■	—	—	■
Diode/thyristor rectifier	—	—	—	—	■
IGBT	■	■	■	■	—

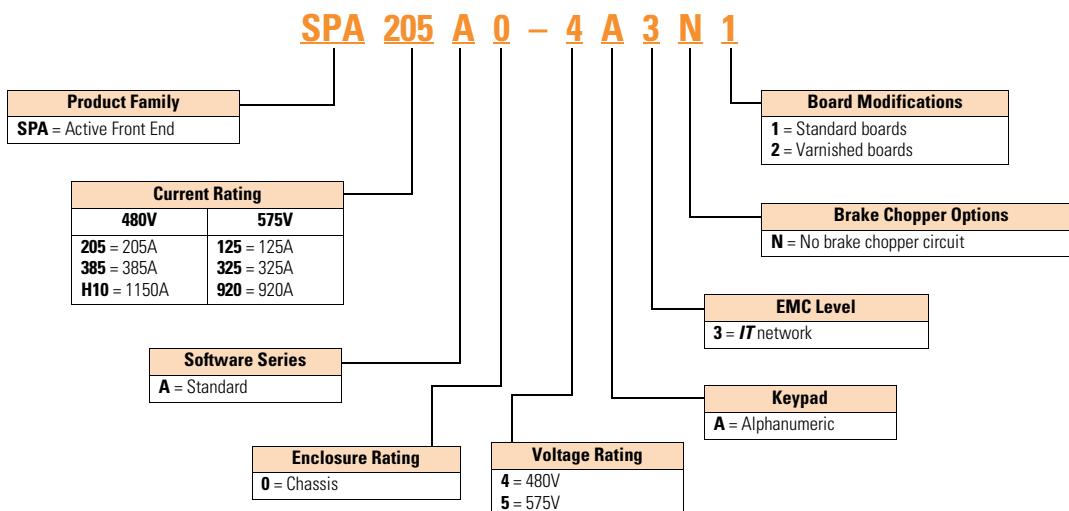
Standards and Certifications

- CE
- UL
- cUL
- EN 61800-5-1 (2003)



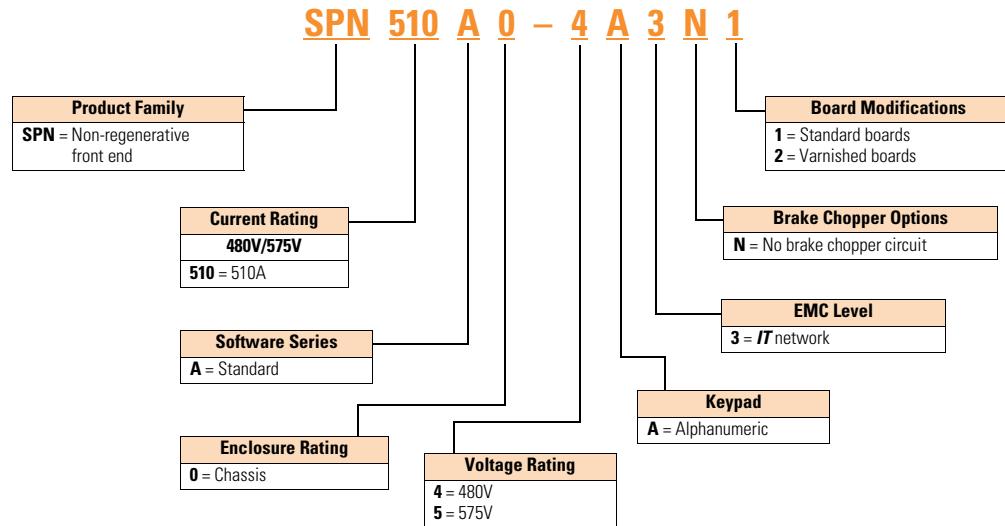
Catalog Number Selection

Active Front End

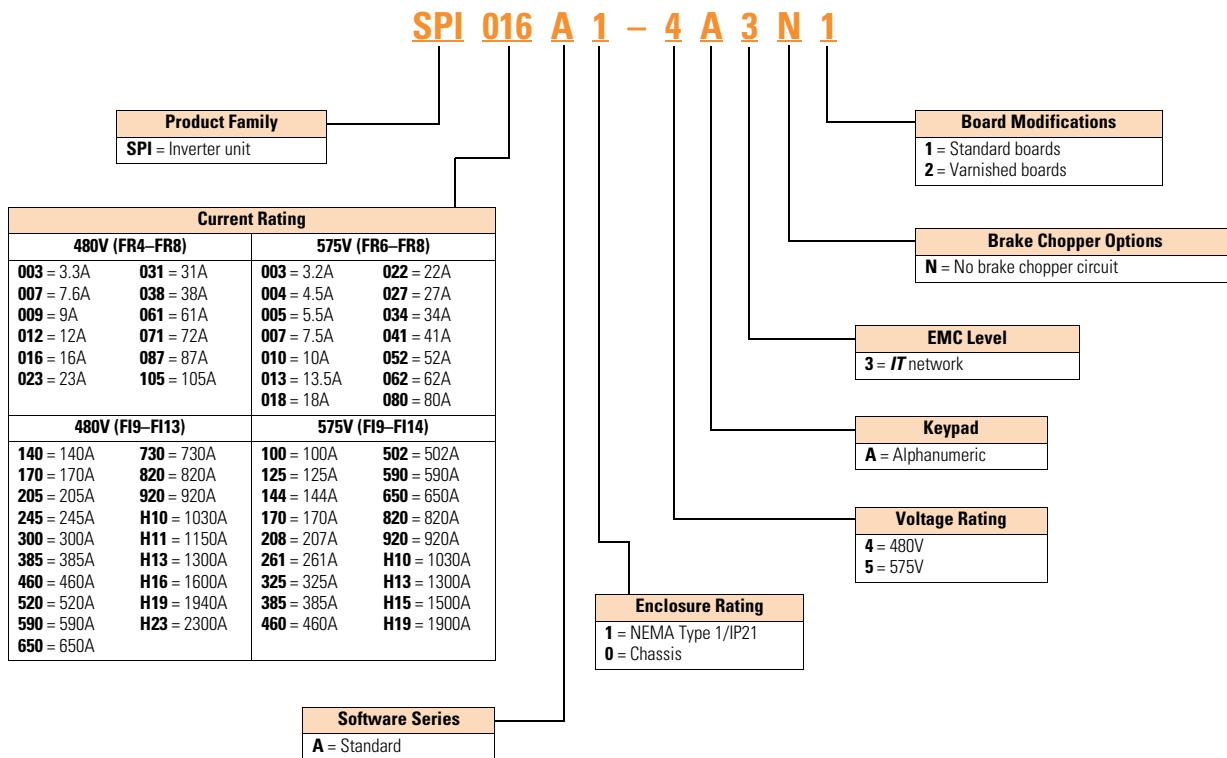


Non-Regenerative Front End

2



SPI9000 Inverter Unit



Product Selection

2

Common DC Bus Drive Products



SPA9000 Active Front End 480V

Frame	Low Overload (AC Current)		High Overload (AC Current)		Imax	Catalog Number
	I _{L-cont} (A)	I _{1min} (A)	I _{H-cont} (A)	I _{1min} (A)		
FI9	261	287	205	308	349	SPA205A0-4A3N1
FI10	460	506	385	578	693	SPA385A0-4A3N1
FI13	1300	1430	1150	1725	2070	SPAH11A0-4A3N1

SPN9000 Non-Regenerative Front End 480V

Frame	Low Overload (AC Current)		High Overload (AC Current)		Imax	Catalog Number
	I _{L-cont} (A)	I _{1min} (A)	I _{H-cont} (A)	I _{1min} (A)		
FI9	520	572	460	690	828	SPN460A0-4A3N1

SPI9000 Inverter Unit 480V

Frame	Low Overload (AC Current)		High Overload (AC Current)		Imax	Catalog Number
	I _{L-cont} (A)	I _{1min} (A)	I _{H-cont} (A)	I _{1min} (A)		
FR4	4.3	4.7	3.3	5	6.2	SPI003A1-4A3N1
	9	9.9	7.6	11.4	14	SPI007A1-4A3N1
	12	13.2	9	13.5	18	SPI009A1-4A3N1
FR6	16	17.6	12	18	24	SPI012A1-4A3N1
	23	25.3	16	24	32	SPI016A1-4A3N1
	31	34	23	35	46	SPI023A1-4A3N1
	38	42	31	47	62	SPI031A1-4A3N1
	46	51	38	57	76	SPI038A1-4A3N1
FR7	72	79	61	92	122	SPI061A1-4A3N1
	87	96	72	108	144	SPI072A1-4A3N1
	105	116	87	131	174	SPI087A1-4A3N1
FR8	140	154	105	158	210	SPI105A0-4A3N1
FI9	170	187	140	210	280	SPI140A0-4A3N1
	205	226	170	255	336	SPI170A0-4A3N1
	261	287	205	308	349	SPI205A0-4A3N1
	300	330	245	379	444	SPI245A0-4A3N1
FI10	385	424	300	450	540	SPI300A0-4A3N1
	460	506	385	578	693	SPI385A0-4A3N1
	520	572	460	690	828	SPI460A0-4A3N1
FI12	590	649	520	780	936	SPI520A0-4A3N1
	650	715	590	885	1062	SPI590A0-4A3N1
	730	803	650	975	1170	SPI650A0-4A3N1
	820	902	730	1095	1314	SPI730A0-4A3N1
	920	1012	820	1230	1476	SPI820A0-4A3N1
	1030	1133	920	1380	1656	SPI920A0-4A3N1
FI13	1150	1265	1030	1545	1854	SPI10A0-4A3N1
	1300	1430	1150	1720	2070	SPI11A0-4A3N1
	1450	1595	1300	1950	2340	SPI13A0-4A3N1
FI14	1770	1947	1600	2400	2880	SPI16A0-4A3N1
	2150	2365	1940	2910	3492	SPI19A0-4A3N1

NoteFor filter and line reactor information, see **Page V6-T2-286**.

Common DC Bus Drive Products



SPA9000 Active Front End 575V

Frame	Low Overload (AC Current)		High Overload (AC Current)		I _{max}	Catalog Number
	I _{L-cont} (A)	I _{1min} (A)	I _{H-cont} (A)	I _{1min} (A)		
FI9	144	158	125	188	213	SPA125A0-5A3N1
FI10	385	424	325	488	585	SPA325A0-5A3N1
FI13	1030	1133	920	1380	1656	SPA920A0-5A3N1

2

SPN9000 Non-Regenerative Front End 575V

Frame	Low Overload (AC Current)		High Overload (AC Current)		I _{max}	Catalog Number
	I _{L-cont} (A)	I _{1min} (A)	I _{H-cont} (A)	I _{1min} (A)		
FI9	600	660	510	732	888	SPN510A0-5A3N1

SPI9000 Inverter Unit 575V

Frame	Low Overload (AC Current)		High Overload (AC Current)		I _{max}	Catalog Number
	I _{L-cont} (A)	I _{1min} (A)	I _{H-cont} (A)	I _{1min} (A)		
FR6	4.5	5	3.2	5	6.4	SPI003A1-5A3N1
	5.5	6	4.5	7	9	SPI004A1-5A3N1
	7.5	8	5.5	8	11	SPI005A1-5A3N1
	10	11	7.5	11	15	SPI007A1-5A3N1
	13.5	15	10	15	20	SPI010A1-5A3N1
	18	20	13.5	20	27	SPI013A1-5A3N1
	22	24	18	27	36	SPI018A1-5A3N1
	27	30	22	33	44	SPI022A1-5A3N1
	34	37	27	41	54	SPI027A1-5A3N1
FR7	41	45	34	51	68	SPI034A1-5A3N1
	52	57	41	62	82	SPI041A1-5A3N1
FR8	62	68	52	78	104	SPI052A0-5A3N1
	80	88	62	93	124	SPI062A0-5A3N1
	100	110	80	120	160	SPI080A0-5A3N1
FI9	125	138	100	150	200	SPI100A0-5A3N1
	144	158	125	188	213	SPI125A0-5A3N1
	170	187	144	216	245	SPI144A0-5A3N1
	208	229	170	255	289	SPI170A0-5A3N1
FI10	261	287	208	312	375	SPI208A0-5A3N1
	325	358	261	392	470	SPI261A0-5A3N1
	385	424	325	488	585	SPI325A0-5A3N1
FI12	460	506	385	578	693	SPI385A0-5A3N1
	502	552	460	690	828	SPI460A0-5A3N1
	590	649	502	753	904	SPI502A0-5A3N1
	650	715	590	885	1062	SPI590A0-5A3N1
	750	825	650	975	1170	SPI650A0-5A3N1
FI13	920	1012	820	1230	1476	SPI820A0-5A3N1
	1030	1133	920	1380	1656	SPI920A0-5A3N1
	1180	1298	1030	1464	1755	SPIH10A0-5A3N1
FI14	1500	1650	1300	1950	2340	SPIH13A0-5A3N1
	1900	2090	1500	2250	2700	SPIH15A0-5A3N1
	2250	2475	1900	2782	3335	SPIH19A0-5A3N1

NoteFor filter and line reactor information, see **Page V6-T2-286**.

LCL Filters**2****LCL Filters for Active Front End (480V)**

Amps	Catalog Number
10	REG 10 5 0
18	REG 18 5 0
32	REG 32 5 0
48	REG 48 5 0
75	REG 75 5 0
110	REG 110 5 0
180	REG 180 5 0

Amps	Catalog Number
270	REG 270 5 0
410	REG 410 5 0
580	REG 580 5 0
840	REG 840 5 0
1160	REG 1160 5 0
1480	REG 1480 5 0

Line Reactor**Line Reactor for Non-Regenerative Front End (480/575VV)**

Amps	Watts Losses	Catalog Number
600	493	CHK600

LCL Filters for Active Front End (690V)

Amps	Catalog Number
14	REG 14 6 0
23	REG 23 6 0
35	REG 35 6 0
52	REG 52 6 0
85	REG 85 6 0
122	REG 122 6 0
185	REG 185 6 0

Amps	Catalog Number
287	REG 287 6 0
390	REG 390 6 0
460	REG 460 6 0
620	REG 620 6 0
780	REG 780 6 0
920	REG 920 6 0
1180	REG 1180 6 0

Options

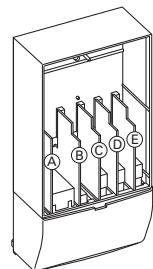
9000X Series Option Board Kits

The 9000X Series drives can accommodate a wide selection of expander and adapter option boards to customize the drive for your application needs. The drive's control unit is designed to accept a total of five option boards.

The 9000X Series factory installed standard board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B.

Option Boards

Option Board Kits



Option Kit Description ^①	Allowed Slot Locations ^②	Field Installed Catalog Number	Factory Installed Option Designator	SVX Ready Programs					
				Basic	Local/Remote	Standard	MSS	PID	Multi-P.
Standard I/O Cards									
2 RO (NC-NO)	B	OPTA2	—	■	■	■	■	■	■
6 DI, 1 DO, 2 AI, 1AO, 1+10 Vdc ref, 2 ext +24 Vdc/EXT +24 Vdc	A	OPTA9	—	■	■	■	■	■	■
Extended I/O Cards									
2 RO, therm	B	OPTA3	A3	—	■	■	■	■	■
Encoder low volt +5V/15V/24V	C	OPTA4	A4	—	■	■	■	■	■
Encoder high volt +15V/24V	C	OPTA5	A5	—	■	■	■	■	■
Double encoder	C	OPTA7	A7	■	■	■	■	■	■
6 DI, 1 DO, 2 AI, 1 AO	A	OPTA8	A8	—	■	■	■	■	■
3 DI (encoder 10–24V), out +15V/+24V, 2 DO (pulse+direction)	C	OPTAE	AE	■	■	■	■	■	■
6 DI, 1 ext +24 Vdc/EXT +24 Vdc	B, C, D , E	OPTB1	B1	—	—	—	—	■	■
1 RO (NC-NO), 1 RO (NO), 1 therm	B, C, D , E	OPTB2	B2	—	—	—	—	■	■
1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24 Vdc/EXT +24 Vdc	B, C, D , E	OPTB4	B4	—	■	■	■	■	■
3 RO (NO)	B, C, D , E	OPTB5	B5	—	—	—	—	■	■
1 ext +24 Vdc/EXT +24 Vdc, 3 Pt100	B, C, D , E	OPTB8	B8	—	—	—	—	—	—
1 RO (NO), 5 DI 42–240 Vac input	B, C, D , E	OPTB9	B9	—	—	—	—	■	■
SPI, absolute encoder	C	OPTBB	BB	—	—	—	—	—	—
Communication Cards ^③									
Modbus	D, E	OPTC2	C2	■	■	■	■	■	■
Johnson Controls N2	D, E	OPTC2	CA	—	—	—	—	—	—
Modbus TCP	D, E	OPTCI	CI	■	■	■	■	■	■
BACnet	D, E	OPTCJ	CJ	■	■	■	■	■	■
EtherNet/IP	D, E	OPTCQ	CQ	■	■	■	■	■	■
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■	■
LonWorks	D, E	OPTC4	C4	■	■	■	■	■	■
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■	■
CANopen (slave)	D, E	OPTC6	C6	■	■	■	■	■	■
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■	■
Modbus (D9 type connector)	D, E	OPTC8	C8	■	■	■	■	■	■
Adapter	D, E	OPTD1	D1	■	■	■	■	■	■
Adapter	D, E	OPTD2	D2	■	■	■	■	■	■
RS-232 with D9 connection	D, E	OPTD3	D3	■	■	■	■	■	■
Keypad									
9000X Series local/remote keypad (replacement keypad)	—	KEYPAD-LOC/REM	—	—	—	—	—	—	■
9000X Series remote mount keypad unit (keypad not included, includes 10 ft cable, keypad holder, mounting hardware)	—	OPTRMT-KIT-9000X	—	—	—	—	—	—	—
9000X Series RS-232 cable, 13 ft	—	PP00104	—	—	—	—	—	—	—

Notes

^① AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

^② Option card must be installed in one of the slots listed for that card. Slot indicated in bold is the preferred location.

^③ OPC2 is a multi-protocol option card.

Technical Data and Specifications

2

SPA9000/SPN9000/SPI9000

Description	Specification
Supply Connection	
Input voltage U_{in} (AC) front end modules	380–500 Vac/525–690 Vac –10% to 10%
Input voltage U_{in} (DC) inverter	465–800 Vdc/640–1100 Vdc –0% to 0%, the waviness of the inverter supply voltage, formed in rectification of the electric network's alternating voltage in basic frequency, must be less than 50V peak-to-peak
Output voltage U_{out} (AC) inverter	3 ~ 0– $U_{in}/1.4$
Output voltage U_{out} (DC) active front end module	10.10 x 1.35 x U_{in} (factory default)
Output voltage U_{out} (DC) non-regenerative front end module	1.35 x U_{in}
Ambient Conditions	
Ambient operating temperature	14 (no frost) to 122°F (–10 to 50°C): I_H 14 (no frost) to 104°F (–10 to 40°C): I_L
Storage temperature	–40 to 158°F (–40 to 70°C)
Relative humidity	0 to 95% RH, non-condensing, non-corrosive, no dripping water
Air quality	
Chemical vapors	IEC 721-3-3, unit in operation, class 3C2
Mechanical particles	IEC 721-3-3, unit in operation, class 3S2
Altitude	100% load capacity (no derating) up to 1000m 1% derating for each 100m above 1000m; max. 3000m
Vibration	5–150 Hz
EN50178/EN60068-2-6	Displacement amplitude 0.25 mm (peak) at 3–15.8 Hz Max acceleration amplitude 1G at 15.8–150 Hz
Shock EN50178, EN60068-2-27	UPS Drop Test (for applicable UPS weights) Storage and shipping: max 15G, 11 ms (in package)
Cooling capacity required	Approximately 2%
Cooling air required	FR4 41 cfm, FR6 250 cfm, FR7 250 cfm, FR8 383 cfm FI9 677 cfm, FI10 824 cfm, FI12 1648 cfm, FI13 2472 cfm
Unit enclosure class	FR4–FR7 NEMA Type 1/IP21; FR8, FI9–FI14 chassis (IP00)
EMC (at fault settings)	
Immunity	Fulfill all EMC immunity requirements
Safety	
Approvals	CE, UL, cUL, EN 61800-5-1 (2003), see unit nameplate for more detailed approvals
Control Connections	
Analog input voltage	0–10V, $R_i = 200$ kohms, (–10V to 10V joystick control) Resolution 0.1%, accuracy ±1%
Analog input current	0(4)–20 mA, $R_i = 250$ ohms differential
Digital inputs	6, positive or negative logic; 18–30 Vdc
Auxiliary voltage	+24V, ±15%, max. 250 mA
Output reference voltage	+10V, +3%, max. load 10 mA
Analog output	0(4)–20 mA; RL max. 500 ohms; resolution 10 bits Accuracy ±2%
Digital outputs	Open collector output, 50 mA/48V
Relay outputs	2 programmable change-over relay outputs Switching capacity: 24 Vdc/8A, 250 Vac/8A, 125 Vdc/0.4A Min. switching load: 5V/10 mA

SPA9000/SPN9000/SPI9000, continued

Description	Specification
Protections	
Overtoltage protection	480V/911 Vdc, 575V/1200 Vdc
Undervoltage protection	480V/333 Vdc, 575V/460 Vdc
Ground fault protection	In case of ground fault in motor or motor cable, only the inverter is protected
Motor phase supervision	Trips if any of the output phases is missing
Overspeed protection	Yes
Unit overtemperature protection	Yes
Motor overload protection	Yes
Motor stall protection	Yes
Motor underload protection	Yes
Short-circuit protection of 24V and 10V reference voltages	Yes

Input Fuses

SHT fuses can be assembled into same-size DIN fuse base.

SPA9000/SPN9000/SPI9000

Module	Component	Frame	Bussman Fuse Type (aR)	Size	U _N (V)	I _N (A)	Qty.
Inverter Units							
SPI003A1-4		FR4	170M1560	0	690	20	2
SPI007A1-4		FR4	170M1562	0	690	63	2
SPI009A1-4		FR4	170M1562	0	690	63	2
SPI012A1-4		FR6	170M1565	0	690	63	2
SPI016A1-4		FR6	170M1565	0	690	63	2
SPI023A1-4		FR6	170M1565	0	690	63	2
SPI031A1-4		FR6	170M1567	0	690	100	2
SPI038A1-4		FR6	170M1567	0	690	100	2
SPI061A1-4		FR7	170M1570	0	690	200	2
SPI072A1-4		FR7	170M1570	0	690	200	2
SPI087A1-4		FR7	170M1571	0	690	250	2
SPI105A0-4		FR8	170M3819	DIN1	690	400	2
SPI140A0-4		FR8	170M3819	DIN1	690	400	2
SPI170A0-4		FR8	170M3819	DIN1	690	400	2
SPI205A0-4		FI9	170M6812	DIN3	690	800	2
SPI245A0-4		FI9	170M6812	DIN3	690	800	2
SPI300A0-4		FI10	170M8547	3SHT	690	1250	2
SPI385A0-4		FI10	170M8547	3SHT	690	1250	2
SPI460A0-4		FI10	170M8547	3SHT	690	1250	2
SPI520A0-4		FI12	170M8547	3SHT	690	1250	2 x 2
SPI590A0-4		FI12	170M8547	3SHT	690	1250	2 x 2
SPI650A0-4		FI12	170M8547	3SHT	690	1250	2 x 2
SPI730A0-4		FI12	170M8547	3SHT	690	1250	2 x 2
SPI820A0-4		FI12	170M8547	3SHT	690	1250	2 x 2
SPI920A0-4		FI12	170M8547	3SHT	690	1250	2 x 2
SPIH10A0-4		FI13	170M8547	3SHT	690	1250	6
SPIH11A0-4		FI13	170M8547	3SHT	690	1250	6
SPIH13A0-4		FI13	170M8547	3SHT	690	1250	6
SPIH16A0-4		FI14	170M8547	3SHT	690	1250	2 x 6
SPIH19A0-4		FI14	170M8547	3SHT	690	1250	2 x 6
SPIH23A0-4		FI14	170M8547	3SHT	690	1250	2 x 6

SHT fuses can be assembled into same-size DIN fuse base.

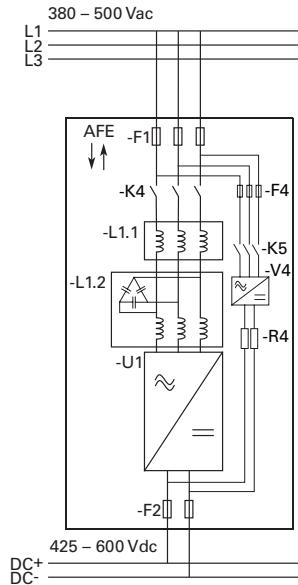
SPA9000/SPN9000/SPI9000, continued

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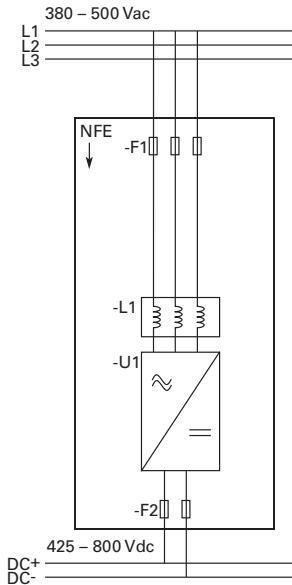
Module Component	Frame	Bussman Fuse Type (aR)	Size	U_N (V)	I_N (A)	Qty.
Active Front Ends						
SPA205A0-4	FI9	170M6202	3SHT	1250	500	3
SPA385A0-4	FI10	170M6277	3SHT	1250	1000	3
SPA10A0-4	FI13	170M6277	3SHT	1250	1000	3 x 3
Non-Regenerative Front Ends						
SPN468A0-4	FI9	170M8547	3SHT	690	1250	3

Wiring Diagrams

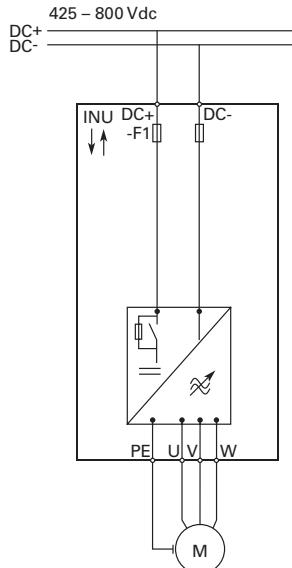
SPA9000—Active Front End



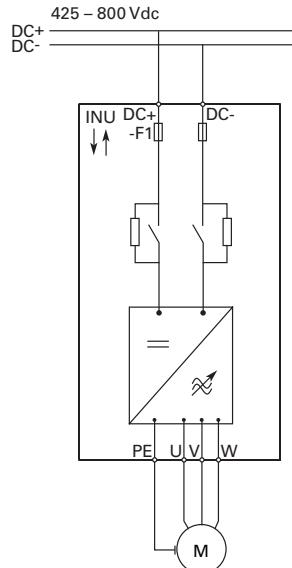
SPN9000—Non-Regenerative Front End



SPI9000—Inverter Unit (FR4–FR8)



SPI9000—Inverter Unit (FI9–FI14)



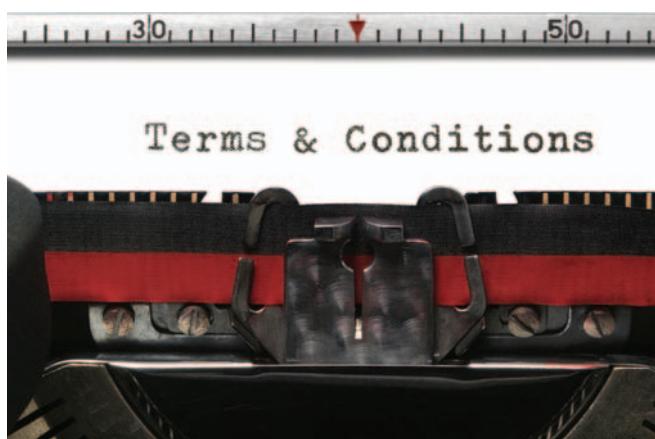
Dimensions

Approximate Dimensions in Inches (mm)

SPA9000/SPN9000/SPI9000

Frame	Height	Width	Depth	Weight Lbs (kg)
Active Front Ends				
FI9	40.6 (1030)	9.4 (239)	14.6 (372)	148 (67)
FI10	40.6 (1032)	9.4 (239)	21.7 (552)	220 (100)
FI12	40.6 (1032)	2 x 9.4 (2 x 239)	21.7 (552)	441 (200)
FI13	40.6 (1032)	27.9 (708)	21.8 (553)	674 (306)
FI14	40.6 (1032)	2 x 27.9 (2 x 708)	21.8 (553)	1348 (612)
Non-Regenerative Front Ends				
FI9	40.6 (1030)	9.4 (239)	14.6 (372)	148 (67)
Inverter Units				
FR4	11.5 (292)	5.0 (128)	7.5 (190)	11 (5)
FR6	20.4 (519)	7.7 (195)	9.3 (237)	35 (16)
FR7	23.3 (591)	9.3 (237)	10.1 (257)	64 (29)
FR8	29.8 (758)	11.4 (289)	13.5 (344)	106 (48)
FI9	40.6 (1030)	9.4 (239)	14.6 (372)	148 (67)
FI10	40.6 (1032)	9.4 (239)	21.7 (552)	220 (100)
FI12	40.6 (1032)	2 x 9.4 (2 x 239)	21.7 (552)	441 (200)
FI13	40.6 (1032)	27.9 (708)	21.8 (553)	674 (306)
FI14	40.6 (1032)	2 x 27.9 (2 x 708)	21.8 (553)	1348 (612)

Eaton Terms & Conditions



Contents

Description	Page
Terms and Conditions of Sale.....	V6-A1-1
Terms of Payment	V6-A1-2
Freight	V6-A1-3
Warranty.....	V6-A1-3

Selling Policy (Supersedes Selling Policy 25-000, dated February 20, 2006)

Terms and Conditions of Sale

The Terms and Conditions of Sale set forth herein, and any supplements which may be attached hereto, constitute the full and final expression of the contract for the sale of products or services (hereinafter referred to as Product(s) or Services by Eaton Corporation (hereinafter referred to as Seller) to the Buyer, and supersedes all prior quotations, purchase orders, correspondence or communications whether written or oral between the Seller and the Buyer.

Notwithstanding any contrary language in the Buyer's purchase order, correspondence or other form of acknowledgment, Buyer shall be bound by these Terms and Conditions of Sale when it sends a purchase order or otherwise indicates acceptance of this contract, or when it accepts delivery from Seller of the Products or Services.

THE CONTRACT FOR SALE OF THE PRODUCTS OR SERVICES IS EXPRESSLY LIMITED TO THE TERMS AND CONDITIONS OF SALE STATED HEREIN. ANY ADDITIONAL OR DIFFERENT TERMS PROPOSED BY BUYER ARE REJECTED UNLESS EXPRESSLY AGREED TO IN WRITING BY SELLER. No contract shall exist except as herein provided.

Complete Agreement

No amendment or modification hereto nor any statement, representation or warranty not contained herein shall be binding on the Seller unless made in writing by an authorized representative of the Seller. Prior dealings, usage of the trade or a course of performance shall not be relevant to determine the meaning of this contract even though the accepting or acquiescing party had knowledge of the nature of the performance and opportunity for objection.

Quotations

Written quotations are valid for 30 days from its date unless otherwise stated in the quotation or terminated sooner by notice.

Verbal quotations, unless accepted, expire the same day they are made.

A complete signed order must be received by Seller within 20 calendar days of notification of award, otherwise the price and shipment will be subject to re-negotiation.

Termination and Cancellation

Any order may be terminated by the Buyer only by written notice and upon payment of reasonable termination charges, including all costs plus profit.

Seller shall have the right to cancel any order at any time by written notice if Buyer breaches any of the terms hereof, becomes the subject of any proceeding under state or federal law for the relief of debtors, or otherwise becomes insolvent or bankrupt, generally does not pay its debts as they become due or makes an assignment for the benefit of creditors.

Appendix 1—Eaton Terms & Conditions

Effective Date: November 1, 2008

Prices

All prices are subject to change without notice. In the event of a price change, the effective date of the change will be the date of the new price or discount sheet, letter or telegram. All quotations made or orders accepted after the effective date will be on the new basis. For existing orders, the price of the unshipped portion of an order will be the price in effect at time of shipment.

Price Policy—Products and Services

When prices are quoted as firm for quoted shipment, they are firm provided the following conditions are met:

1. The order is released with complete engineering details.
2. Shipment of Products are made, and Services purchased are provided within the quoted lead time.
3. When drawings for approval are required for any Products, the drawings applicable to those Products must be returned within 30* calendar days from the date of the original mailing of the drawings by Seller. The return drawings must be released for manufacture and shipment and must be marked "APPROVED" or "APPROVED AS NOTED." Drawing re-submittals which are required for any other reason than to correct Seller errors will not extend the 30-day period.

* 60 days for orders through contractors to allow time for their review and approval before and after transmitting them to their customers.

If the Buyer initiates or in any way causes delays in shipment, provision of Services or return of approval drawings beyond the periods stated above, the price of the Products or Services will be increased 1% per month or fraction thereof up to a maximum of 18 months from the date of the Buyer's order. For delays resulting in shipment or provision of Services beyond 18 months from the date of the Buyer's order, the price must be renegotiated.

Price Policy—BLS

Refer to Price Policy 25-050.

Minimum Billing

Orders less than \$1,000 will be assessed a shipping and handling charge of 5% of the price of the order, with a minimum charge of \$25.00 unless noted differently on Product discount sheets.

Taxes

The price does not include any taxes. Buyer shall be responsible for the payment of all taxes applicable to, or arising from the transaction, the Products, its sale, value, or use, or any Services performed in connection therewith regardless of the person or entity actually taxed.

Terms of Payment

Products

Acceptance of all orders is subject to the Buyer meeting Seller's credit requirements. Terms of payment are subject to change for failure to meet such requirements. Seller reserves the right at any time to demand full or partial payment before proceeding with a contract of sale as a result of changes in the financial condition of the Buyer. Terms of Payment are either Net 30 days from the date of invoice of each shipment or carry a cash discount based on Product type. Specific payment terms for Products are outlined in the applicable Product discount schedules.

Services

Terms of payment are net within 30 days from date of invoice for orders amounting to less than \$50,000.00.

Terms of payment for orders exceeding \$50,000.00 shall be made according to the following:

1. Twenty percent (20%) of order value with the purchase order payable 30 days from date of invoice.
2. Eighty percent (80%) of order value in equal monthly payments over the performance period payable 30 days from date of invoice.

Except for work performed (i) under a firm fixed price basis or (ii) pursuant to terms of a previously priced existing contract between Seller and Buyer, invoices for work performed by Seller shall have added and noted on each invoice a charge of 3% (over and above the price of the work) which is related to Seller compliance with present and proposed environmental, health, and safety regulations associated with prescribed requirements covering hazardous materials management and employee training, communications, personal protective equipment, documentation and record keeping associated therewith.

Adequate Assurances

If, in the judgment of Seller, the financial condition of the Buyer, at any time during the period of the contract, does not justify the terms of payment specified, Seller may require full or partial payment in advance.

Delayed Payment

If payments are not made in accordance with these terms, a service charge will, without prejudice to the right of Seller to immediate payment, be added in an amount equal to the lower of 1.5% per month or fraction thereof or the highest legal rate on the unpaid balance.

Freight

Freight policy will be listed on the Product discount sheets, or at option of Seller one of the following freight terms will be quoted.

F.O.B.—P/S—Frt./Ppd. and Invoiced

Products are sold F.O.B. point of shipment freight prepaid and invoiced to the Buyer.

F.O.B.—P/S—Frt./Ppd. and Allowed

Products sold are delivered F.O.B. point of shipment, freight prepaid and included in the price.

F.O.B. Destination—Frt./Ppd. and Allowed

At Buyer's option, Seller will deliver the Products F.O.B. destination freight prepaid and 2% will be added to the net price.

The term "freight prepaid" means that freight charges will be prepaid to the accessible common carrier delivery point nearest the destination for shipments within the United States and Puerto Rico unless noted differently on the Product discount sheets. For any other destination contact Seller's representative.

Shipment and Routing

Seller shall select the point of origin of shipment, the method of transportation, the type of carrier equipment and the routing of the shipment.

If the Buyer specifies a special method of transportation, type of carrier equipment, routing, or delivery requirement, Buyer shall pay all special freight and handling charges.

When freight is included in the price, no allowance will be made in lieu of transportation if the Buyer accepts shipment at factory, warehouse, or freight station or otherwise supplies its own transportation.

Risk of Loss

Risk of loss or damage to the Products shall pass to Buyer at the F.O.B. point.

Concealed Damage

Except in the event of F.O.B. destination shipments, Seller will not participate in any settlement of claims for concealed damage.

When shipment has been made on an F.O.B. destination basis, the Buyer must unpack immediately and, if damage is discovered must:

1. Not move the Products from the point of examination.
2. Retain shipping container and packing material.
3. Notify the carrier in writing of any apparent damage.
4. Notify Seller representative within 72 hours of delivery.
5. Send Seller a copy of the carrier's inspection report.

Witness Tests/Customer Inspection

Standard factory tests may be witnessed by the Buyer at Seller's factory for an additional charge calculated at the rate of \$2,500 per day (not to exceed eight (8) hours per Product type). Buyer may final inspect Products at the Seller's factory for \$500 per day per Product type.

Witness tests will add one (1) week to the scheduled shipping date. Seller will notify Buyer fourteen (14) calendar days prior to scheduled witness testing or inspection. In the event Buyer is unable to attend, the Parties shall mutually agree on a rescheduled date. However, Seller reserves the right to deem the witness tests waived with the right to ship and invoice Products.

Held Orders

For any order held, delayed or rescheduled at the request of the Buyer, Seller may, at its sole option (1) require payment to be based on any reasonable basis, including but not limited to the contract price, and any additional expenses, or cost resulting from such a delay; (2) store Products at the sole cost and risk of loss of the Buyer; and/or (3) charge to the Buyer those prices under the applicable price policy. Payment for such price, expenses and costs, in any such event, shall be due by Buyer within thirty (30) days from date of Seller's invoice. Any order so held delayed or rescheduled beyond six (6) months will be treated as a Buyer termination.

Drawing Approval

Seller will design the Products in line with, in Seller's judgment, good commercial practice. If at drawing approval Buyer makes changes outside of the design as covered in their specifications, Seller will then be paid reasonable charges and allowed a commensurate delay in shipping date based on the changes made.

Drawing Re-Submittal

When Seller agrees to do so in its quotation, Seller shall provide Buyer with the first set of factory customer approval drawing(s) at Seller's expense. The customer approval drawing(s) will be delivered at the quoted delivery date. If Buyer requests drawing changes or additions after the initial factory customer approval drawing(s) have been submitted by Seller, the Seller, at its option, may assess Buyer drawing charges. Factory customer approval drawing changes required due to misinterpretation by Seller will be at Seller's expense. Approval drawings generated by Bid Manager are excluded from this provision.

Warranty

Warranty for Products

Seller warrants that the Products manufactured by it will conform to Seller's applicable specifications and be free from failure due to defects in workmanship and material for one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

In the event any Product fails to comply with the foregoing warranty Seller will, at its option, either (a) repair or replace the defective Product, or defective part or component thereof, F.O.B. Seller's facility freight prepaid, or (b) credit Buyer for the purchase price of the Product. All warranty claims shall be made in writing.

Seller requires all non-conforming Products be returned at Seller's expense for evaluation unless specifically stated otherwise in writing by Seller.

This warranty does not cover failure or damage due to storage, installation, operation or maintenance not in conformance with Seller's recommendations and industry standard practice or due to accident, misuse, abuse or negligence. This warranty does not cover reimbursement for labor, gaining access, removal, installation, temporary power or any other expenses, which may be incurred in connection with repair or replacement.

This warranty does not apply to equipment not manufactured by Seller. Seller limits itself to extending the same warranty it receives from the supplier.

Appendix 1—Eaton Terms & Conditions

Effective Date: November 1, 2008

Extended Warranty for Products

If requested by the Buyer and specifically accepted in writing by Seller, the foregoing standard warranty for Products will be extended from the date of shipment for the period and price indicated below:

- 24 months—2% of Contract Price
- 30 months—3% of Contract Price
- 36 months—4% of Contract Price

Special Warranty (In and Out) for Products

If requested by the Buyer and specifically accepted in writing by Seller, Seller will, during the warranty period for Products, at an additional cost of 2% of the contract price, be responsible for the direct cost of:

1. Removing the Product from the installed location.
2. Transportation to the repair facility and return to the site.
3. Reinstallation on site.

The total liability of Seller for this Special Warranty for Products is limited to 50% of the contract price of the particular Product being repaired and excludes expenses for removing adjacent apparatus, walls, piping, structures, temporary service, etc.

Warranty for Services

Seller warrants that the Services performed by it hereunder will be performed in accordance with generally accepted professional standards.

The Services, which do not so conform, shall be corrected by Seller upon notification in writing by the Buyer within one (1) year after completion of the Services.

Unless otherwise agreed to in writing by Seller, Seller assumes no responsibility with respect to the suitability of the Buyer's, or its customer's, equipment or with respect to any latent defects in equipment not supplied by Seller. This warranty does not cover damage to Buyer's, or its customer's, equipment, components or parts resulting in whole or in part from improper maintenance or operation or from their deteriorated condition. Buyer will, at its cost, provide Seller with unobstructed access to the defective Services, as well as adequate free working space in the immediate vicinity of the defective Services and such facilities and systems, including, without limitation, docks, cranes and utility disconnects and connects, as may be necessary in order that Seller may perform its warranty obligations. The conducting of any tests shall be mutually agreed upon and Seller shall be notified of, and may be present at, all tests that may be made.

Warranty for Power Systems Studies

Seller warrants that any power systems studies performed by it will conform to generally accepted professional standards. Any portion of the study, which does not so conform, shall be corrected by Seller upon notification in writing by the Buyer within six (6) months after completion of the study. All warranty work shall be performed in a single shift straight time basis Monday through Friday. In the event that the study requires correction of warranty items on an overtime schedule, the premium portion of such overtime shall be for the Buyer's account.

Limitation on Warranties for Products, Services and Power Systems Studies

THE FOREGOING WARRANTIES ARE EXCLUSIVE EXCEPT FOR WARRANTY OF TITLE. SELLER DISCLAIMS ALL OTHER WARRANTIES INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

CORRECTION OF NON-CONFORMITIES IN THE MANNER AND FOR THE PERIOD OF TIME PROVIDED ABOVE SHALL CONSTITUTE SELLER'S SOLE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR FAILURE OF SELLER TO MEET ITS WARRANTY OBLIGATIONS, WHETHER CLAIMS OF THE BUYER ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY), OR OTHERWISE.

Asbestos

Federal Law requires that building or facility owners identify the presence, location and quantity of asbestos containing material (hereinafter "ACM") at work sites. Seller is not licensed to abate ACM. Accordingly, for any contract which includes the provision of Services, prior to (i) commencement of work at any site under a specific Purchase Order, (ii) a change in the work scope of any Purchase Order, the Buyer will certify that the work area associated with the Seller's scope of work includes the handling of Class II ACM, including but not limited to generator wedges and high temperature gaskets which include asbestos materials. The Buyer shall, at its expense, conduct abatement should the removal, handling, modification or reinstallation, or some or all of them, of said Class II ACM be likely to generate airborne asbestos fibers; and should such abatement affect the cost of or time of performance of the work then Seller shall be entitled to an equitable adjustment in the schedule, price and other pertinent affected provisions of the contract.

Compliance with Nuclear Regulation

Seller's Products are sold as commercial grade Products not intended for application in facilities or activities licensed by the United States Nuclear Regulatory Commission for atomic purposes. Further certification will be required for use of the Products in any safety-related application in any nuclear facility licensed by the U.S. Nuclear Regulatory Commission.

Returning Products

Authorization and shipping instructions for the return of any Products must be obtained from Seller before returning the Products.

When return is occasioned due to Seller error, full credit including all transportation charges will be allowed.

Product Notices

Buyer shall provide the user (including its employees) of the Products with all Seller supplied Product notices, warnings, instructions, recommendations, and similar materials.

Force Majeure

Seller shall not be liable for failure to perform or delay in performance due to fire, flood, strike or other labor difficulty, act of God, act of any governmental authority or of the Buyer, riot, embargo, fuel or energy shortage, car shortage, wrecks or delays in transportation, or due to any other cause beyond Seller's reasonable control. In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended by a period of time reasonably necessary to overcome the effect of such delay.

Liquidated Damages

Contracts which include liquidated damage clauses for failure to meet shipping or job completion promises are not acceptable or binding on Seller, unless such clauses are specifically accepted in writing by an authorized representative of the Seller at its headquarters office.

Patent Infringement

Seller will defend or, at its option, settle any suit or proceeding brought against Buyer, or Buyer's customers, to the extent it is based upon a claim that any Product or part thereof, manufactured by Seller or its subsidiaries and furnished hereunder, infringes any United States patent, other than a claim of infringement based upon use of a Product or part thereof in a process, provided Seller is notified in reasonable time and given authority, information and assistance (at Seller's expense) for the defense of same. Seller shall pay all legal and court costs and expenses and court-assessed damages awarded therein against Buyer resulting from or incident to such suit or proceeding. In addition to the foregoing, if at any time Seller determines there is a substantial question of infringement of any United States patent, and the use of such Product is or may be enjoined, Seller may, at its option and expense: either (a) procure for Buyer the right to continue using and selling the Product; (b) replace the Product with non-infringing apparatus; (c) modify the Product so it becomes non-infringing; or (d) as a last resort, remove the Product and refund the purchase price, equitably adjusted for use and obsolescence. In no case does Seller agree to pay any recovery based upon its Buyer's savings or profit through use of Seller's Products whether the use be special or ordinary. The foregoing states the entire liability of Seller for patent infringement.

The preceding paragraph does not apply to any claim of infringement based upon: (a) any modification made to a Product other than by Seller; (b) any design and/or specifications of Buyer to which a Product was manufactured; or (c) the use or combination of Product with other products where the Product does not itself infringe. As to the above-identified claim situations where the preceding paragraph does not apply, Buyer shall defend and hold Seller harmless in the same manner and to the extent as Seller's obligations described in the preceding paragraph. Buyer shall be responsible for obtaining (at Buyer's expense) all license rights required for Seller to be able to use software products in the possession of Buyer where such use is required in order to perform any Service for Buyer.

With respect to a Product or part thereof not manufactured by Seller or its subsidiaries, Seller will attempt to obtain for Buyer, from the supplier(s), the patent indemnification protection normally provided by the supplier(s) to customers.

Compliance with OSHA

Seller offers no warranty and makes no representation that its Products comply with the provisions or standards of the Occupational Safety and Health Act of 1970, or any regulation issued thereunder. In no event shall Seller be liable for any loss, damage, fines, penalty or expenses arising under said Act.

Limitation of Liability

THE REMEDIES OF THE BUYER SET FORTH IN THIS CONTRACT ARE EXCLUSIVE AND ARE ITS SOLE REMEDIES FOR ANY FAILURE OF SELLER TO COMPLY WITH ITS OBLIGATIONS HEREUNDER.

NOTWITHSTANDING ANY PROVISION IN THIS CONTRACT TO THE CONTRARY, IN NO EVENT SHALL SELLER BE LIABLE IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE FOR DAMAGE TO PROPERTY OR EQUIPMENT OTHER THAN PRODUCTS SOLD HEREUNDER, LOSS OF PROFITS OR REVENUE, LOSS OF USE OF PRODUCTS, COST OF

CAPITAL, CLAIMS OF CUSTOMERS OF THE BUYER OR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, REGARDLESS OF WHETHER SUCH POTENTIAL DAMAGES ARE FORESEEABLE OR IF SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

THE TOTAL CUMULATIVE LIABILITY OF SELLER ARISING FROM OR RELATED TO THIS CONTRACT WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE, SHALL NOT EXCEED THE PRICE OF THE PRODUCT OR SERVICES ON WHICH SUCH LIABILITY IS BASED.

Appendix 2—Catalog Parent Number Index

C

- CFX V6-T2-210–V6-T2-212, V6-T2-214
 CHK V6-T2-269, V6-T2-286
 CPX V6-T2-241–V6-T2-248
 C25D V6-T1-55
 C440 V6-T1-45
 C441 V6-T1-45, V6-T1-78

D

- DA1 V6-T2-13
 DBR-R V6-T2-58, V6-T2-170
 DC1 V6-T2-4
 DG1 V6-T2-32, V6-T2-33
 DS7 V6-T1-23–V6-T1-31
 DXG V6-T2-38, V6-T2-39
 D77E V6-T1-54, V6-T1-55

E

- EMA V6-T1-68, V6-T1-91
 EML V6-T1-67, V6-T1-90
 EMM V6-T1-68, V6-T1-91
 EMS V6-T1-67, V6-T1-90

H

- HMX V6-T2-134, V6-T2-135, V6-T2-143–V6-T2-148

K

- KEYPAD V6-T2-57, V6-T2-169, V6-T2-268, V6-T2-287

L

- LCX V6-T2-265–V6-T2-267

M

- MMX V6-T2-22, V6-T2-23

O

- OPTA V6-T2-55, V6-T2-94, V6-T2-118, V6-T2-167,
 V6-T2-216, V6-T2-249, V6-T2-268, V6-T2-287
 OPTB V6-T2-55, V6-T2-94, V6-T2-118, V6-T2-167,
 V6-T2-216, V6-T2-249, V6-T2-268, V6-T2-287
 OPTC V6-T2-55, V6-T2-94, V6-T2-118, V6-T2-167,
 V6-T2-216, V6-T2-249, V6-T2-268, V6-T2-287
 OPTCON V6-T2-97
 OPTD V6-T2-55, V6-T2-94, V6-T2-118, V6-T2-167,
 V6-T2-216, V6-T2-249, V6-T2-268, V6-T2-287
 OPTN V6-T2-54, V6-T2-166
 OPTR V6-T2-57, V6-T2-169, V6-T2-268, V6-T2-287
 OPTT V6-T2-54, V6-T2-166

P

- PP00 V6-T2-287
 PSG V6-T1-67, V6-T1-78, V6-T1-90

R

- REG V6-T2-286

S

- SPA V6-T2-284, V6-T2-285
 SPI V6-T2-284, V6-T2-285
 SPN V6-T2-284, V6-T2-285
 SPX V6-T2-52, V6-T2-53, V6-T2-161–V6-T2-165
 SS-IP V6-T1-67, V6-T1-90
 SVDRIVE V6-T2-57, V6-T2-169
 SVX V6-T2-50–V6-T2-53, V6-T2-90–V6-T2-93,
 V6-T2-113–V6-T2-117
 S511 V6-T1-16
 S611 V6-T1-53–V6-T1-55
 S701 V6-T1-4, V6-T1-10, V6-T1-13
 S801+ V6-T1-65, V6-T1-66
 S811+ V6-T1-86–V6-T1-89, V6-T1-91

X

- XMX V6-T2-136, V6-T2-149

Numerics

- 9000X V6-T2-54, V6-T2-57, V6-T2-137, V6-T2-166,
 V6-T2-169

Appendix 3—Alphabetical Product Index

A

Accessories

Adjustable Frequency Drives	
H-Max Series	V6-T2-137
M-Max Series AC	V6-T2-23
PowerXL DC1, DA1 Series	V6-T2-6, V6-T2-15
PowerXL DG1	V6-T2-34
SPX9000	V6-T2-166
SVX9000	V6-T2-54
DS7 Solid-State Controllers	V6-T1-32
Type S801+, Soft Starters	V6-T1-67
Type S811+, Soft Starters	V6-T1-90

Adjustable Frequency Drives

H-Max Series	V6-T2-131–V6-T2-154
IntelliDisconnect	V6-T2-141
IntelliPass	V6-T2-141
H-Max Series (Open)	V6-T2-132
LCX9000	V6-T2-263–V6-T2-279
Low Harmonic Drives	V6-T2-200–V6-T2-262
M-Max Series AC	V6-T2-20–V6-T2-26
PowerXL DC1, DA1 Series	V6-T2-2, V6-T2-11
PowerXL DG1	V6-T2-30
SPA9000/SPN9000/SPI9000 Drive Products	V6-T2-280–V6-T2-291
SPX9000	V6-T2-158–V6-T2-199
SVX9000	V6-T2-48
SVX9000 Enclosed	V6-T2-87
SVX9000 Product Overview	V6-T2-45
SVX9000 VFD Pump Panels	V6-T2-111

Auxiliary Contacts

Type S701, Soft Start Controllers	V6-T1-9
-----------------------------------	---------

C

Communication Modules

BACnet Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168
CANopen (Slave) Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168
DeviceNet Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168
Ethernet/IP Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168
Johnson Controls Metasys N2 Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168

Communication Modules, continued

LonWorks Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168

Modbus

Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168

Modbus/TCP

Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168

PROFIBUS

Enclosed 18-Pulse Drives	V6-T2-250
Enclosed Passive Filtered Drives	V6-T2-217
SPX9000 Drives	V6-T2-168

Communications

H-Max Series Drives (IntelliDisconnect) Onboard Network	V6-T2-149
H-Max Series Drives (IntelliPass) Onboard Network	V6-T2-149
H-Max Series Drives (Open) Onboard Network	V6-T2-136

Contactors

Semiconductor Reversing, Type S511	V6-T1-15
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E

Eaton Terms & Conditions

Freight	V6-A1-3
Limitation of Liability	V6-A1-5
Terms and Conditions of Sale	V6-A1-1
Terms of Payment	V6-A1-2
Warranty	V6-A1-3

K

Kits

Enclosed 18-Pulse Drive Option Boards	V6-T2-249
Enclosed Passive Filtered Drives Option Boards	V6-T2-216
H-Max Series Drives (IntelliPass) Option Boards	V6-T2-149
H-Max Series Drives (Open) Flange	V6-T2-137
SPX9000 Drives 9000X Series Option Boards	V6-T2-167
SVX9000 Drives Option Boards	V6-T2-55
SVX9000 Open Drives 9000X Series Option Boards	V6-T2-94
SVX9000 VFD Pump Panels SVX Conversion	V6-T2-97
9000X Series Option Boards	V6-T2-118
Type S801+, Soft Starters	V6-T1-67
Type S811+, Soft Starters	V6-T1-90

Appendix 3—Alphabetical Product Index

O

Options

Enclosed 18-Pulse Drive	V6-T2-253
Enclosed 18-Pulse Drives Option Board Kits	V6-T2-249
Enclosed Passive Filtered Drives	V6-T2-219
Option Board Kits	V6-T2-216
H-Max Series Drives (IntelliDisconnect)	
Option Board Kits	V6-T2-149
H-Max Series Drives (Open)	
Option Board Kits	V6-T2-136
LCX9000 Series Drives	
9000X Series Option Board Kits	V6-T2-268
SPA9000/SPN9000/SPI9000 Drive Products	
9000X Series Option Board Kits	V6-T2-287
SPX9000 Drives	V6-T2-167
SVX9000 Drives	V6-T2-55, V6-T2-94
SVX9000 VFD Pump Panels	V6-T2-118
Type S801+, Soft Starters	V6-T1-68
Type S811+, Soft Starters	V6-T1-91

P

PowerXpert <i>inControl</i> Software	V6-T2-35
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R

Reduced Voltage Motor Starters

DS7	V6-T1-19
Solid-State	V6-T1-43
Solid-State Controllers	V6-T1-2
Type S511	V6-T1-15
Type S611	V6-T1-44
Type S701	V6-T1-3
Type S701 with Auxiliary Contact	V6-T1-9
Type S701 with Brake	V6-T1-12
Type S801+	V6-T1-61
Type S811+	V6-T1-77

Replacement Parts

Adjustable Frequency Drives	
H-Max Series (Open)	V6-T2-137
PowerXI DG1	V6-T2-38
SPX9000	V6-T2-174
SVX9000	V6-T2-61

S

Semiconductor Reversing Contactors	
Type S511	V6-T1-15
Soft Start Controllers	
DS7	V6-T1-19
Type S701	V6-T1-3
Type S701 with Auxiliary Contact	V6-T1-9
Type S701 with Brake	V6-T1-12
Soft Starters	
Type S611	V6-T1-44
Heavy Duty	V6-T1-54
Severe Duty	V6-T1-54
Standard Duty	V6-T1-53
Type S801+	V6-T1-61
Severe Duty	V6-T1-66
Standard Duty	V6-T1-65
Type S811+	V6-T1-77
Inside-the-Delta Severe Duty	V6-T1-89
Inside-the-Delta Standard Duty	V6-T1-88
Severe Duty	V6-T1-87
Standard Duty	V6-T1-86

Starters

Reduced Voltage Motor	
DS7	V6-T1-19
Solid-State	V6-T1-43
Solid-State Controllers	V6-T1-2
Type S511	V6-T1-15
Type S611	V6-T1-44
Type S701	V6-T1-3
Type S701 with Auxiliary Contact	V6-T1-9
Type S701 with Brake	V6-T1-12
Type S801+	V6-T1-61
Type S811+	V6-T1-77