

SVX Drives

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SVX Drives

Product Description

SVX 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 480 V, 100 hp I_H 230 V
- 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
- Additional I/O and communication cards provide plug and play functionality
- I/O connections with simple quick connection terminals
- Hand-held auxiliary 24 V 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/380–500 V 3/4–15 hp/208–230 V
- 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

Standards and Certifications

Product

- IEC 61800-2

EMC (At Default Settings)

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

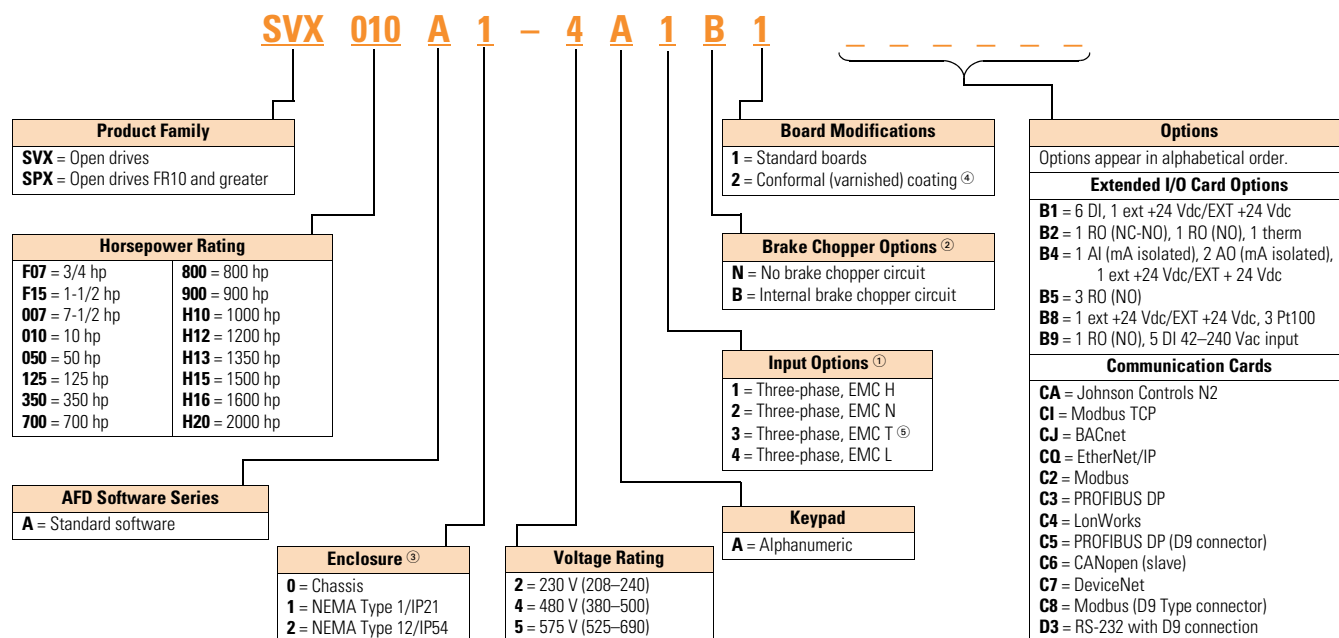
Safety

- UL 508C
- CE



Catalog Number Selection

SVX Adjustable Frequency Drives



Notes

- ^① All 230 V drives and 480 V drives up to 200 hp (IH) are only available with input option **1** (EMC Level H). 480 V drives 250 hp (IH) or larger are available with input option **2** (EMC Level N). 480 V drives are available with input option **4** (EMC Level L). 575 V drives 200 hp (IH) or larger are only available with input option **2**. 575 V drives up to 150 hp (IH) are only available with input option **4** (EMC Level L).
- ^② 480 V drives up to 30 hp (IH) are only available with brake chopper option **B**. 480 V drives 40 hp (IH) or larger come standard with brake chopper option **N**. 230 V drives up to 15 hp (IH) are only available with brake chopper option **B**. 230 V drives 20 hp or larger come standard with brake chopper option **N**. All 575 V drives come standard without brake chopper option (N). **N** = No brake chopper.
- ^③ 480 V drives 250 hp (IH) and larger are available with enclosure style **0** (chassis); 690 V drives 200 hp (IH) and larger are available with enclosure style **0** (chassis).
- ^④ Factory promise delivery. Consult sales office for availability.
- ^⑤ For high-resistance ground systems, any SVX/SPX drive can be used if the HRG system has ground supervision. If no ground supervision feature is available, use EMC class N or T.

Product Selection

230 V SVX Drives

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SVX Open Drives



208–240 V, 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

208–240 V, 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

480 V SVX Drives

SVX Open Drives



380–500 V, 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

380–500 V, 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

SVX Open Drives

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380–500 V, 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

575 V SVX Drives

525–690 V, 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
	25	27	30	34	SVX025A1-5A4N1
FR7	30	34	40	41	SVX030A1-5A4N1
	40	41	50	52	SVX040A1-5A4N1
FR8	50	52	60	62	SVX050A1-5A4N1
	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.

SVX Open Drives



525–690 V, 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

525–690 V, 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

9000X Series—SVX/SPX 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:

NEMA Type 12 / IP54 Conversion Kits

Frame Size	Catalog Number
Frame 4 Type 12/IP54 kit	OPTN12FR4
Frame 5 Type 12/IP54 kit	OPTN12FR5
Frame 6 Type 12/IP54 kit	OPTN12FR6

Flange Kits

The flange kit is used when the power section heat sink is mounted through the back panel of an enclosure. The kit includes hardware and supporting steel plates.

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

Frame Size	Catalog Number
Frame 4 flange kit Type 12/IP54	OPTTHR4
Frame 5 flange kit Type 12/IP54	OPTTHR5
Frame 6 flange kit Type 12/IP54	OPTTHR6
Frame 7 flange kit Type 12/IP54	OPTTHR7
Frame 8 flange kit Type 12/IP54	OPTTHR8
Frame 9 flange kit Type 12/IP54	OPTTHR9

Options

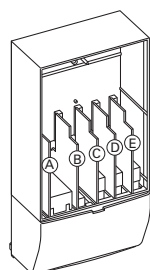
SVX Series Option Board Kits

The SVX 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 SVX 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, 1 AO, 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 +5 V/15 V/24 V—SPX only	C	OPTA4	A4	—	■	■	■	■	■	■
Encoder high volt +15 V/24 V—SPX only	C	OPTA5	A5	—	■	■	■	■	■	■
Double encoder—SPX only	C	OPTA7	A7	■	■	■	■	■	■	■
6 DI, 1 DO, 2 AI, 1 AO	A	OPTA8	A8	—	■	■	■	■	■	■
3 DI (encoder 10–24 V), out +15 V/+24 V, 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 RTU	D, E	OPTC2	C2	■	■	■	■	■	■	■
Modbus RTU (D9 connector)	D, E	OPTC8	C8	■	■	■	■	■	■	■
PROFIBUS DP	D, E	OPTC3	C3	■	■	■	■	■	■	■
PROFIBUS DP (D9 connector)	D, E	OPTC5	C5	■	■	■	■	■	■	■
Johnson Controls N2	D, E	OPTC2	CA	—	—	—	—	—	—	—
BACnet MSTP	D, E	OPTCJ	CJ	■	■	■	■	■	■	■
LonWorks	D, E	OPTC4	C4	■	■	■	■	■	■	■
CANopen (slave)	D, E	OPTC6	C6	■	■	■	■	■	■	■
DeviceNet	D, E	OPTC7	C7	■	■	■	■	■	■	■
Modbus TCP	D, E	OPTCI	CI	■	■	■	■	■	■	■
EtherNet/IP	D, E	OPTCQ	CQ	■	■	■	■	■	■	■
PROFINET, Modbus TCP, EtherNet/IP (dual-port) ④	D, E	OPTC9	E9	■	■	■	■	■	■	■
EtherCAT (dual-port) ④	D, E	OPTCQ	EC	■	■	■	■	■	■	■
SPX adapter	D, E	OPTD1	D1	■	■	■	■	■	■	■
SPX adapter	D, E	OPTD2	D2	■	■	■	■	■	■	■
RS-232 adapter	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.

④ Available October 2016.

Modbus RTU Network Communications

The Modbus Network Card OPTC2 is used for connecting the SVX 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 SVX 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 9.6 Kbaud to 12 Mbaud, and the addresses range from 1 to 127.

LonWorks Network Communications

The LonWorks Network Card OPTC4 is used for connecting the SVX Drive on a LonWorks network. This interface uses Standard Network Variable Types (SNVT) as data types.

The channel connection is achieved using a FTT-10 A 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 SVX Drive to a host system. According to ISO11898 standard cables to be chosen for CANbus 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 SVX 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 125 Kbaud, 250 Kbaud and 500 Kbaud.

Johnson Controls Metasys N2 Network Communications

The OPTC2 fieldbus board provides communication between the SVX 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 SVX 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 SVX 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 SVX 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 SVX 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 SVX 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 SVX keypad. The footprint is compatible to the SV 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 SVX. 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 (1.8 m) 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 SVX 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-T2-111

Open Drive Options**Brake Chopper Options**

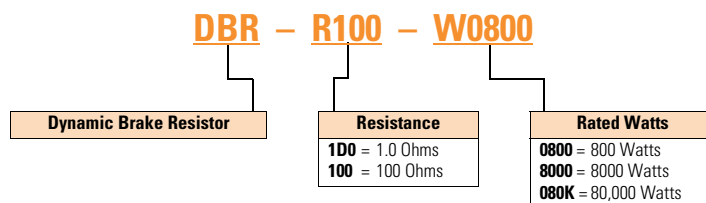
The brake chopper circuit option is used for applications that require dynamic braking. Dynamic braking resistors are not included with drive purchase. Consult the factory for additional dynamic braking resistor selections that are supplied separately. A list of common resistors are listed below and 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**230 V Brake Resistors**

Drive hp (CT/l _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

480 V 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.

575 V Brake Resistors

Drive hp (CT/l _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.

Line and Load Reactors

A line and load reactor is a three-phase inductance filter that can be placed on the line and load side of the AFD to help improve the harmonic performance of the system. Consult the factory for additional filtering options and further technical details.

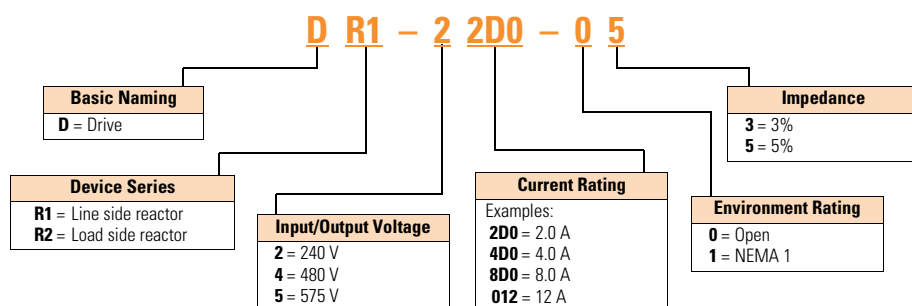
DR1 Line Reactor

A line reactor helps to provide a moderate reduction in current harmonics similar to a DC choke. It also provides increased input protection for AFD and its semiconductors from line transients helping to extend the life of the AFD.

DR2 Output Reactor

An output filter is used to reduce the transient voltage (dV/dt) at the motor terminals. The output filter is recommended for cable lengths exceeding 100 ft (30 m) with a drive of 3 hp and above and for cable lengths of 33 ft (10 m) with a drive of 2 hp and below.

Line and Load Reactors—Catalog Number Selection



Line and Load Reactors—230 V

hp (CT)	Open Line Reactor		Load Reactor		NEMA 1 Line Reactor		Load Reactor	
	3%	5%	3%	5%	3%	5%	3%	5%
0.75	DR1-23D2-03	DR1-23D2-05	DR2-24D0-03	DR2-24D0-05	DR1-23D2-13	DR1-23D2-15	DR2-24D0-13	DR2-24D0-15
1	DR1-24D2-03	DR1-24D2-05	DR2-24D0-03	DR2-28D0-05	DR1-24D2-13	DR1-24D2-15	DR2-24D0-13	DR2-28D0-15
1.5	DR1-26D0-03	DR1-26D0-05	DR2-28D0-03	DR2-28D0-05	DR1-26D0-13	DR1-26D0-15	DR2-28D0-13	DR2-28D0-15
2	DR1-26D8-03	DR1-26D8-05	DR2-28D0-03	DR2-28D0-05	DR1-26D8-13	DR1-26D8-15	DR2-28D0-13	DR2-28D0-15
3	DR1-29D6-03	DR1-29D6-05	DR2-2012-03	DR2-2012-05	DR1-29D6-13	DR1-29D6-15	DR2-2012-13	DR2-2012-15
5	DR1-2015-03	DR1-2015-05	DR2-2018-03	DR2-2018-05	DR1-2015-13	DR1-2015-15	DR2-2018-13	DR2-2018-15
7.5	DR1-2022-03	DR1-2022-05	DR2-2025-03	DR2-2025-05	DR1-2022-13	DR1-2022-15	DR2-2025-13	DR2-2025-15
10	DR1-2028-03	DR1-2028-05	DR2-2035-03	DR2-2035-05	DR1-2028-13	DR1-2028-15	DR2-2035-13	DR2-2035-15
15	DR1-2042-03	DR1-2042-05	DR2-2045-03	DR2-2045-05	DR1-2042-13	DR1-2042-15	DR2-2045-13	DR2-2045-15
20	DR1-2054-03	DR1-2054-05	DR2-2055-03	DR2-2055-05	DR1-2054-13	DR1-2054-15	DR2-2055-13	DR2-2055-15
25	DR1-2068-03	DR1-2068-05	DR2-2080-03	DR2-2080-05	DR1-2068-13	DR1-2068-15	DR2-2080-13	DR2-2080-15
30	DR1-2080-03	DR1-2080-05	DR2-2080-03	DR2-2100-05	DR1-2080-13	DR1-2080-15	DR2-2080-13	DR2-2100-15
40	DR1-2104-03	DR1-2104-05	DR2-2100-03	DR2-2100-05	DR1-2104-13	DR1-2104-15	DR2-2100-13	DR2-2100-15
50	DR1-2130-03	DR1-2130-05	DR2-2130-03	DR2-2130-05	DR1-2130-13	DR1-2130-15	DR2-2130-13	DR2-2130-15
60	DR1-2154-03	DR1-2154-05	DR2-2160-03	DR2-2200-15	DR1-2154-13	DR1-2154-15	DR2-2160-13	DR2-2200-15
75	DR1-2192-03	DR1-2192-05	DR2-2200-13	DR2-2200-15	DR1-2192-13	DR1-2192-15	DR2-2200-13	DR2-2200-15
100	DR1-2248-03	DR1-2248-05	DR2-2225-13	DR2-2225-15	DR1-2248-13	DR1-2248-15	DR2-2225-13	DR2-2225-15

Line and Load Reactors—480 V

hp (CT)	Open Line Reactor	
	3%	5%
1	DR1-42D1-03	DR1-42D1-05
1.5	DR1-43D0-03	DR1-43D0-05
2	DR1-43D4-03	DR1-43D4-05
3	DR1-44D8-03	DR1-44D8-05
5	DR1-47D6-03	DR1-47D6-05
7.5	DR1-4011-03	DR1-4011-05
10	DR1-4014-03	DR1-4014-05
15	DR1-4021-03	DR1-4021-05
20	DR1-4027-03	DR1-4027-05
25	DR1-4034-03	DR1-4034-05
30	DR1-4040-03	DR1-4040-05
40	DR1-4052-03	DR1-4052-05
50	DR1-4065-03	DR1-4065-05
60	DR1-4077-03	DR1-4077-05
75	DR1-4096-03	DR1-4096-05
100	DR1-4124-03	DR1-4124-05
125	DR1-4156-03	DR1-4156-05
150	DR1-4180-03	DR1-4180-05
200	DR1-4240-03	DR1-4240-05
250	DR1-4302-03	DR1-4302-05
300	DR1-4361-03	DR1-4361-05
350	DR1-4414-03	DR1-4414-05
400	DR1-4477-03	DR1-4477-05
500	DR1-4590-03	DR1-4590-05
600	DR1-4708-03	DR1-4708-05

Load Reactor	
3%	5%
DR2-42D0-05	DR2-42D0-05
DR2-44D0-05	DR2-44D0-05
DR2-44D0-03	DR2-44D0-05
DR2-48D0-03	DR2-48D0-05
DR2-48D0-03	DR2-48D0-05
DR2-4012-03	DR2-4012-05
DR2-4018-03	DR2-4018-05
DR2-4025-03	DR2-4025-05
DR2-4025-03	DR2-4025-05
DR2-4035-03	DR2-4035-05
DR2-4045-03	DR2-4045-05
DR2-4055-03	DR2-4055-05
DR2-4080-03	DR2-4080-05
DR2-4100-03	DR2-4080-05
DR2-4100-03	DR2-4100-05
DR2-4130-03	DR2-4130-05
DR2-4160-03	DR2-4160-05
DR2-4200-13	DR2-4200-15
DR2-4250-13	DR2-4250-15
DR2-4320-13	DR2-4320-15
DR2-4400-13	DR2-4400-15
DR2-4400-13	DR2-4400-15
DR2-4500-03	DR2-4500-05
DR2-4600-03	DR2-4600-05
DR2-4750-03	DR2-4750-05

NEMA 1 Line Reactor	
3%	5%
DR1-42D1-13	DR1-42D1-15
DR1-43D0-13	DR1-43D0-15
DR1-43D4-13	DR1-43D4-15
DR1-44D8-13	DR1-44D8-15
DR1-47D6-13	DR1-47D6-15
DR1-4011-13	DR1-4011-15
DR1-4014-13	DR1-4014-15
DR1-4021-13	DR1-4021-15
DR1-4027-13	DR1-4027-15
DR1-4034-13	DR1-4034-15
DR1-4040-13	DR1-4040-15
DR1-4052-13	DR1-4052-15
DR1-4065-13	DR1-4065-15
DR1-4077-13	DR1-4077-15
DR1-4096-13	DR1-4096-15
DR1-4124-13	DR1-4124-15
DR1-4156-13	DR1-4156-15
DR1-4180-13	DR1-4180-15
DR1-4240-13	DR1-4240-15
DR1-4302-13	DR1-4302-15
DR1-4361-13	DR1-4361-15
DR1-4414-13	DR1-4414-15
DR1-4477-13	DR1-4477-15
DR1-4590-13	DR1-4590-15
DR1-4708-13	DR1-4708-15

Load Reactor	
3%	5%
DR2-42D0-13	DR2-42D0-15
DR2-44D0-13	DR2-44D0-15
DR2-44D0-13	DR2-44D0-15
DR2-48D0-13	DR2-48D0-15
DR2-48D0-13	DR2-48D0-15
DR2-4012-13	DR2-4012-15
DR2-4018-13	DR2-4018-15
DR2-4025-13	DR2-4025-15
DR2-4025-13	DR2-4025-15
DR2-4035-13	DR2-4035-15
DR2-4045-13	DR2-4045-15
DR2-4055-13	DR2-4055-15
DR2-4080-13	DR2-4080-15
DR2-4100-13	DR2-4080-15
DR2-4100-13	DR2-4100-15
DR2-4130-13	DR2-4130-15
DR2-4160-13	DR2-4160-15
DR2-4200-13	DR2-4200-15
DR2-4250-13	DR2-4250-15
DR2-4320-13	DR2-4320-15
DR2-4400-13	DR2-4400-15
DR2-4400-13	DR2-4400-15
DR2-4500-13	DR2-4500-15
DR2-4600-13	DR2-4600-15
DR2-4750-13	DR2-4750-15

Line and Load Reactors—575 V

hp (CT)	Open Line Reactor	
	3%	5%
2	DR1-52D7-03	DR1-52D7-05
3	DR1-53D9-03	DR1-53D9-05
5	DR1-56D1-03	DR1-56D1-05
7.5	DR1-59D0-03	DR1-59D0-05
10	DR1-5011-03	DR1-5011-05
15	DR1-5017-03	DR1-5017-05
20	DR1-5022-03	DR1-5022-05
25	DR1-5027-03	DR1-5027-05
30	DR1-5032-03	DR1-5032-05
40	DR1-5041-03	DR1-5041-05
50	DR1-5052-03	DR1-5052-05
60	DR1-5062-03	DR1-5062-05
75	DR1-5077-03	DR1-5077-05
100	DR1-5100-03	DR1-5100-05
125	DR1-5125-03	DR1-5125-05
150	DR1-5144-03	DR1-5144-05
200	DR1-5192-03	DR1-5192-05
250	DR1-5242-03	DR1-5242-05
300	DR1-5289-03	DR1-5289-05
400	DR1-5382-03	DR1-5382-05
450	DR1-5412-03	DR1-5412-05
500	DR1-5472-03	DR1-5472-05
600	DR1-5576-03	DR1-5576-05

Load Reactor	
3%	5%
DR2-54D0-03	DR2-54D0-05
DR2-54D0-03	DR2-54D0-05
DR2-58D0-03	DR2-58D0-05
DR2-58D0-03	DR2-58D0-05
DR2-5012-03	DR2-5012-05
DR2-5018-03	DR2-5018-05
DR2-5025-03	DR2-5025-05
DR2-5025-03	DR2-5025-05
DR2-5035-03	DR2-5035-05
DR2-5045-03	DR2-5045-05
DR2-5055-03	DR2-5055-05
DR2-5080-03	DR2-5080-05
DR2-5080-03	DR2-5080-05
DR2-5100-03	DR2-5100-05
DR2-5130-03	DR2-5130-05
DR2-5160-03	DR2-5160-05
DR2-5200-13	DR2-5200-15
DR2-5250-13	DR2-5250-15
DR2-5320-13	DR2-5320-15
DR2-5400-13	DR2-5400-15
DR2-5400-13	DR2-5400-15
DR2-5500-03	DR2-5500-05
DR2-5600-03	DR2-5600-05

NEMA 1 Line Reactor	
3%	5%
DR1-52D7-13	DR1-52D7-15
DR1-53D9-13	DR1-53D9-15
DR1-56D1-13	DR1-56D1-15
DR1-59D0-13	DR1-59D0-15
DR1-5011-13	DR1-5011-15
DR1-5017-13	DR1-5017-15
DR1-5022-13	DR1-5022-15
DR1-5027-13	DR1-5027-15
DR1-5032-13	DR1-5032-15
DR1-5041-13	DR1-5041-15
DR1-5052-13	DR1-5052-15
DR1-5062-13	DR1-5062-15
DR1-5077-13	DR1-5077-15
DR1-5100-13	DR1-5100-15
DR1-5125-13	DR1-5125-15
DR1-5144-13	DR1-5144-15
DR1-5192-13	DR1-5192-15
DR1-5242-13	DR1-5242-15
DR1-5289-13	DR1-5289-15
DR1-5382-13	DR1-5382-15
DR1-5412-13	DR1-5412-15
DR1-5472-13	DR1-5472-15
DR1-5576-13	DR1-5576-15

Load Reactor	
3%	5%
DR2-54D0-13	DR2-54D0-15
DR2-54D0-13	DR2-54D0-15
DR2-58D0-13	DR2-58D0-15
DR2-58D0-13	DR2-58D0-15
DR2-5012-13	DR2-5012-15
DR2-5018-13	DR2-5018-15
DR2-5025-13	DR2-5025-15
DR2-5025-13	DR2-5025-15
DR2-5035-13	DR2-5035-15
DR2-5045-13	DR2-5045-15
DR2-5055-13	DR2-5055-15
DR2-5080-13	DR2-5080-15
DR2-5080-13	DR2-5080-15
DR2-5100-13	DR2-5100-15
DR2-5130-13	DR2-5130-15
DR2-5160-13	DR2-5160-15
DR2-5200-13	DR2-5200-15
DR2-5250-13	DR2-5250-15
DR2-5320-13	DR2-5320-15
DR2-5400-13	DR2-5400-15
DR2-5400-13	DR2-5400-15
DR2-5500-13	DR2-5500-15
DR2-5600-13	DR2-5600-15

Replacement Parts

FR4 Spare Parts

2

Category	Description	Quantity/ Drive	230 V Catalog Number	480 V Catalog Number	575 V 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	—
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	230 V Catalog Number	480 V Catalog Number	575 V 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	—
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	—

FR6 Spare Parts

Category	Description	Quantity/ Drive	230 V Catalog Number	480 V Catalog Number	575 V 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
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	230 V Catalog Number	480 V Catalog Number	575 V 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
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.

FR8 Spare Parts

Category	Description	Quantity/ Drive	230 V Catalog Number	480 V Catalog Number	575 V 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
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

FR9 Spare Parts

Category	Description	Quantity/ Drive	230 V Catalog Number	480 V Catalog Number	575 V 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
Inverter	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
Converter	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 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	230 V Catalog Number	480 V Catalog Number	575 V 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
Inverter	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
Converter	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 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	230 V Catalog Number	480 V Catalog Number	575 V 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
Inverter	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
Converter	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 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	230 V Catalog Number	480 V Catalog Number	575 V 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
Inverter	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
Converter	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 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

Category	Description	Quantity/ Drive	230 V Catalog Number	480 V Catalog Number	575 V 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
Inverter	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
Converter	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 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	230 V Catalog Number	480 V Catalog Number	575 V 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
Inverter	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
Converter	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 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

SVX 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)
High withstand rating	100 kAIC
Output Ratings	
Output voltage	0 to V_{in}
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
Overload current (I_H/I_L)	150% I_H , 110% I_L for 1 min.
Output frequency	0 to 320 Hz
Frequency resolution	0.01 Hz
Initial output current (I_H)	250% for 2 seconds
Efficiency	>96%
Control Characteristics	
Control method	Frequency control (V/f) Open loop: Sensorless vector control Closed loop: SPX drives only
Switching frequency Frame 4–6 Frame 7–12	Adjustable with parameter 2.6.9 1–16 kHz; default 10 kHz 1–10 kHz; default 3.6 kHz
Frequency reference	Analog input: Resolution 0.1% (10-bit), accuracy $\pm 1\%$ V/Hz Panel reference: Resolution 0.01 Hz
Field weakening point	30–320 Hz
Acceleration time	0–3000 sec.
Deceleration time	0–3000 sec.
Braking torque	DC brake: 30% $\times T_n$ (without brake option)
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)
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 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 (1000 m); 1% derating for each 328 ft (100 m) above 3280 ft (1000 m); max. 9842 ft (3000 m)
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. 15 g, 11 ms (in package)
Enclosure class	NEMA 1/IP21 or NEMA 12/IP54, open chassis/IP20

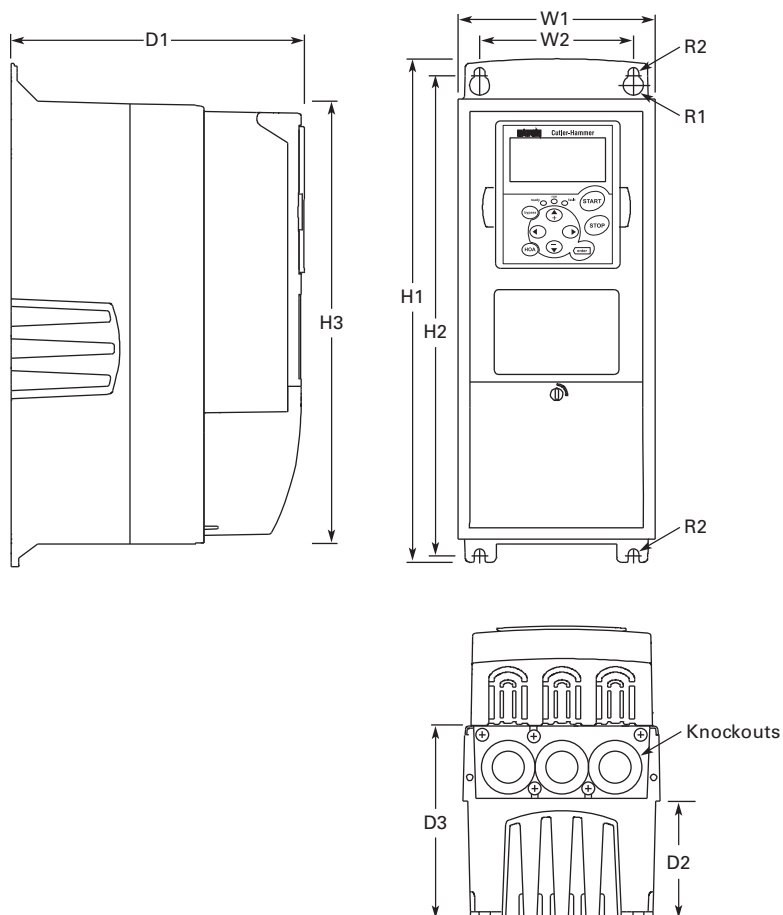
Description	Specification
Control Connections	
Analog input voltage	0 to 10 V, $R = 200$ kohms (–10 to 10 V joystick control) resolution 0.1%; accuracy $\pm 1\%$
Analog input current	0(4) to 20 mA; $R_i = 250$ ohms differential
Digital inputs (6)	Positive or negative logic; 18 to 30 Vdc
Auxiliary voltage	+24 V $\pm 15\%$, max. 250 mA
Output reference voltage	+10 V $\pm 3\%$, max. load 10 mA
Analog output	0(4) to 20 mA; R_i max. 500 ohms; resolution 10 bit; accuracy $\pm 2\%$
Digital outputs	Open collector output, 50 mA/48V
Relay outputs	Two programmable Form C relay outputs switching capacity: 24 Vdc/8 A, 250 Vac/8 A, 125 Vdc/0.4 A
Protections	
Overcurrent protection	Trip limit 4.0 $\times I_H$ instantaneously
Overvoltage protection	Yes
Undervoltage protection	Yes
Earth fault protection	In case of earth fault in motor or motor cable, only the frequency converter is protected
Input phase supervision	Trips if any of the input phases are missing
Motor phase supervision	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 (+24 V and +10 V reference voltages)

Standard I/O Specifications

Description	Specification
Six-digital input programmable	24 V: "0" ≤ 10 V, "1" ≥ 18 V, $R_i > 5$ kohms
Two-analog input configurable w/jumpers	Voltage: 0– ± 10 V, $R_i > 200$ 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_i max. 500 ohms 10 bits $\pm 2\%$
One digital output programmable	Open collector 48 Vdc 50 mA

Dimensions

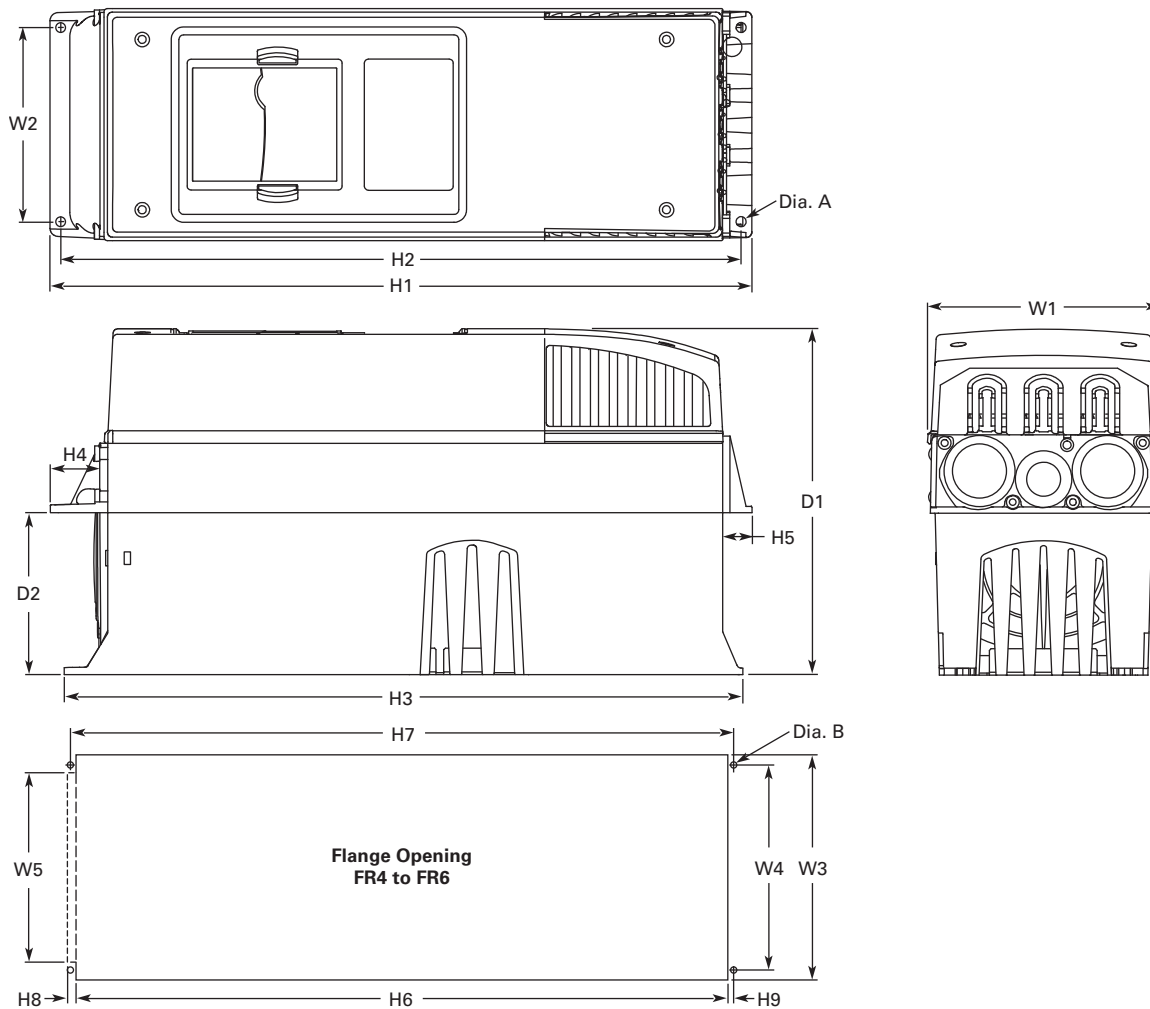
Approximate Dimensions in Inches (mm)

2**9000X Open Drives****NEMA Type 1/IP21 and NEMA Type 12/IP54, FR4, FR5 and FR6**

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

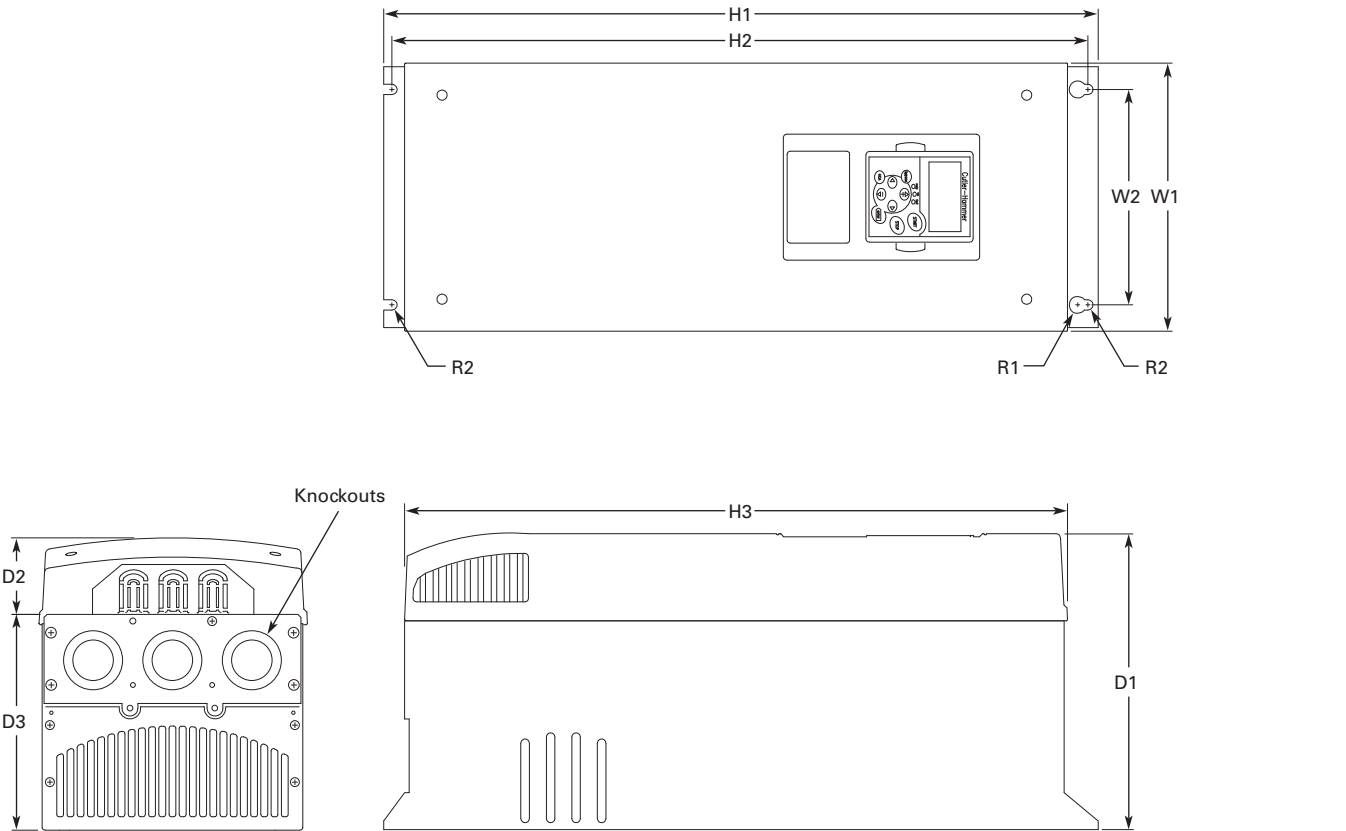
Adjustable Frequency Drives

SVX Drives

Approximate Dimensions in Inches (mm)

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

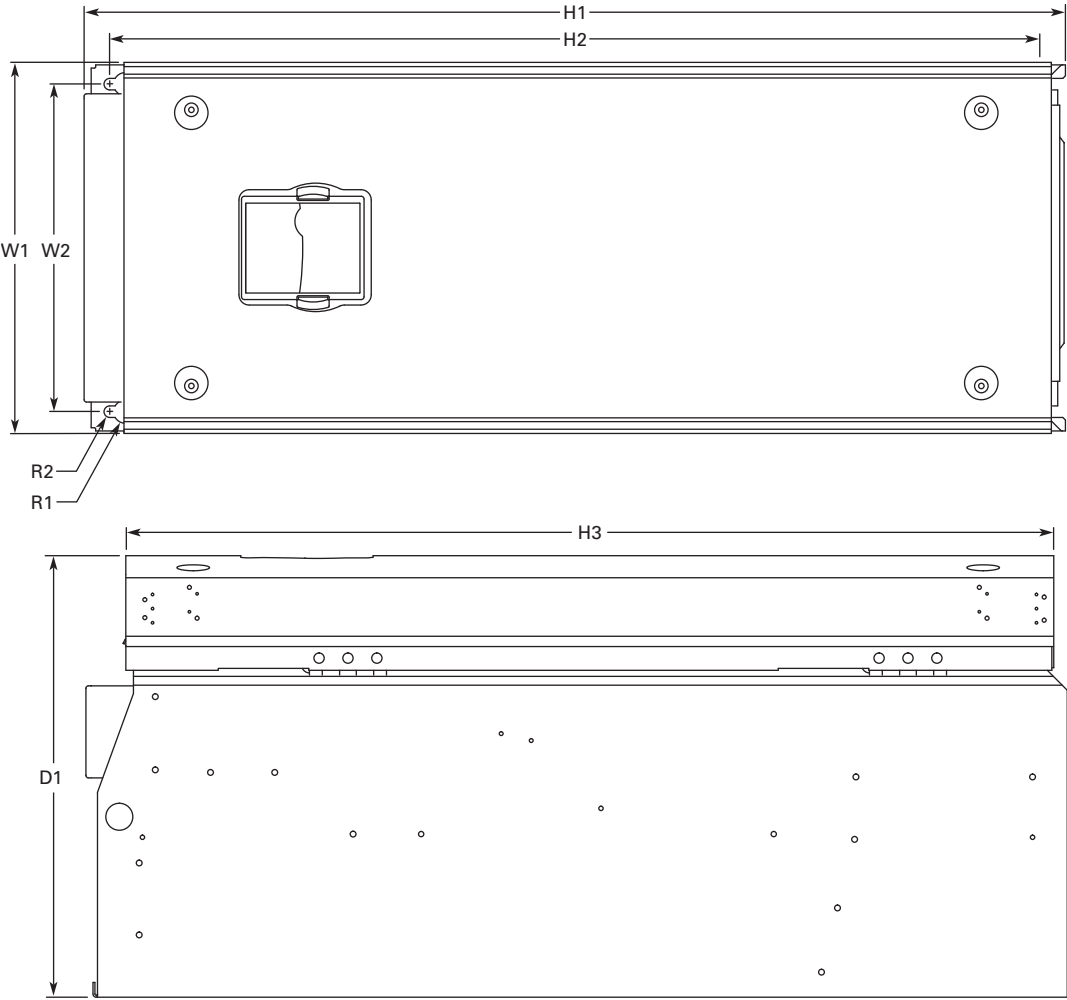
2



Voltage	hp (I _H)	H1	H2	H3	D1	D2	D3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)	Knockouts at Inches (mm) N1 (O.D.)
230 V	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)
480 V	40–60												
575 V	30–40												

Approximate Dimensions in Inches (mm)

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



Voltage	hp (I _H)	D1	H1	H2	H3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)
230 V	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)
480 V	75–125									
575 V	50–75									

2.7

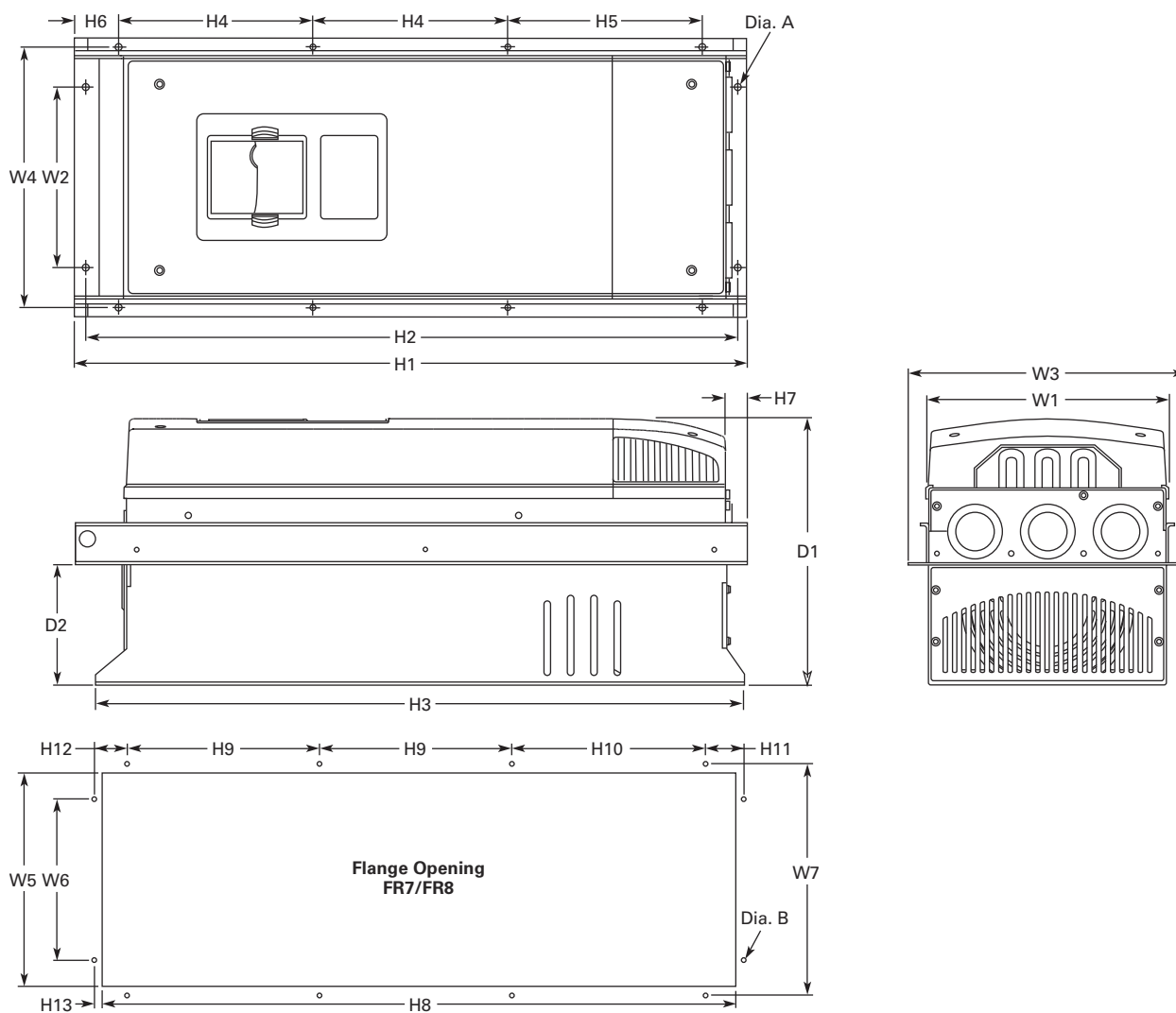
Adjustable Frequency Drives

SVX Drives

Approximate Dimensions in Inches (mm)

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

2



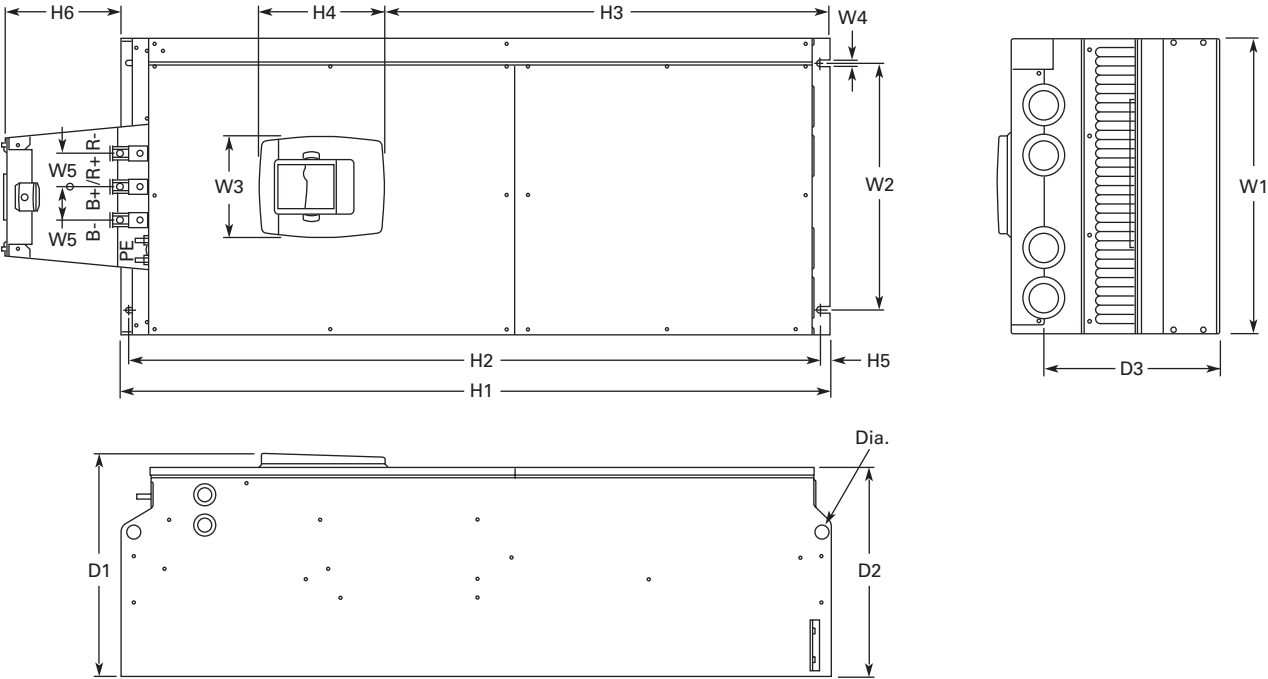
W1	W2	W3	W4	H1	H2	H3	H4	H5	H6	H7	D1	D2	Dia. A
FR7													
9.3 (237)	6.8 (175)	10.6 (270)	10.0 (253)	24.9 (652)	24.8 (632)	24.8 (630)	7.4 (189)	7.4 (189)	0.9 (23)	0.8 (20)	10.1 (257)	4.6 (117)	0.3 (6)
FR8													
11.2 (285)	—	14.0 (355)	13.0 (330)	32.8 (832)	—	29.3 (745)	10.2 (258)	10.4 (265)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



Voltage	hp (I _H)	W1	W2	W3	W4	H1	H2	H3	H4 ①	D1	D2	D3	Dia.	Weight Lbs (kg)
230 V	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)
480 V	150–200													
575 V	100–175													

Note

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