E:T•N | Cutler-Hammer

9000X AF Drives

User Manual

Important Notice – Please Read

The product discussed in this literature is subject to terms and conditions outlined in Eaton Electrical Inc. selling policies. The sole source governing the rights and remedies of any purchaser of this equipment is the relevant Eaton Electrical Inc. selling policy.

NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN. In no event will Eaton Electrical Inc. be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein.

The information contained in this manual is subject to change without notice.

Cover Photo: Cutler-Hammer® SVX9000/SPX9000 AF Drives.

Table of Contents

List of Figures

List of Figures (Continued)

List of Figures (Continued)

List of Tables

List of Tables (Continued)

October 2007

Safety

Definitions and Symbols

⚡ **WARNING**

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

⚠

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

⚠ **WARNING**

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

⚠ **CAUTION**

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the equipment. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous High Voltage

⚡ **WARNING**

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

• Stand on an insulating pad and make it a habit to use only one hand when checking components.

• Always work with another person in case an emergency occurs.

• Disconnect power before checking controllers or performing maintenance.

• Be sure equipment is properly grounded.

• Wear safety glasses whenever working on electronic controllers or rotating machinery.

Warnings and Cautions

Read this manual thoroughly and make sure you understand the procedures before you attempt to install, set up, or operate this Cutler-Hammer® SVX9000/SPX9000 Adjustable Frequency Drive from Eaton's electrical business.

Warnings

⚡ WARNING

Be sure to ground the unit following the instructions in this manual. Ungrounded units may cause electric shock and/or fire.

⚡ WARNING

This equipment should be installed, adjusted, and serviced by qualified electrical maintenance personnel familiar with the construction and operation of this type of equipment and the hazards involved. Failure to observe this precaution could result in death or severe injury.

⚡ WARNING

Components within the SVX9000/SPX9000 power unit are live when the drive is connected to power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚡ WARNING

Line terminals (L1, L2, L3), motor terminals (U, V, W) and the DC-link/brake resistor terminals (-/+) are live when the drive is connected to power, even if the motor is not running. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚡ WARNING

Even though the control I/O-terminals are isolated from line voltage, the relay outputs and other I/O-terminals may have dangerous voltage present even when the drive is disconnected from power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

⚡ WARNING

The SVX9000/SPX9000 drive has a large capacitive leakage current during operation, which can cause enclosure parts to be above ground potential. Proper grounding, as described in this manual, is required. Failure to observe this precaution could result in death or severe injury.

⚡ WARNING

Before applying power to the SVX9000/SPX9000 drive, make sure that the front and cable covers are closed and fastened to prevent exposure to potential electrical fault conditions. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

An upstream disconnect/protective device must be provided as required by the National Electric Code (NEC). Failure to follow this precaution may result in death or severe injury.

⚠ WARNING

Before opening the SVX9000/SPX9000 drive covers:

• Disconnect all power to the SVX9000/SPX9000 drive.

• Wait a minimum of 5 (five) minutes after all the lights on the keypad are off. This allows time for the DC bus capacitors to discharge.

• A hazard voltage may still remain in the DC bus capacitors even if the power has been turned off. Confirm that the capacitors have fully discharged by measuring their voltage using a multimeter set to measure DC voltage.

Failure to follow the above precautions may cause death or severe injury.

Cautions

⚠ CAUTION

Do not perform any meggar or voltage withstand tests on any part of the SVX9000/SPX9000 drive or its components. Improper testing may result in damage.

⚠ CAUTION

Prior to any tests or measurements of the motor or the motor cable, disconnect the motor cable at the SVX9000/SPX9000 output terminals (U, V, W) to avoid damaging the SVX9000/SPX9000 during motor or cable testing.

⚠ CAUTION

Do not touch any components on the circuit boards. Static voltage discharge may damage the components.

⚠ CAUTION

Any electrical or mechanical modification to this equipment without prior written consent of Eaton will void all warranties and may result in a safety hazard in addition and voiding of the UL listing.

⚠ CAUTION

Install the SVX9000/SPX9000 drive on flame-resistant material such as a steel plate to reduce the risk of fire.

⚠ CAUTION

Install the SVX9000/SPX9000 drive on a perpendicular surface that is able to support the weight of the drive and is not subject to vibration, to lessen the risk of the drive falling and being damaged and/or causing personal injury.

⚠ CAUTION

Prevent foreign material such as wire clippings or metal shavings from entering the drive enclosure, as this may cause arcing damage and fire.

⚠ CAUTION

Install the SVX9000/SPX9000 drive in a well-ventilated room that is not subject to temperature extremes, high humidity, or condensation, and avoid locations that are directly exposed to sunlight, or have high concentrations of dust, corrosive gas, explosive gas, inflammable gas, grinding fluid mist, etc. Improper installation may result in a fire hazard.

Motor and Equipment Safety

⚠ CAUTION

Before starting the motor, check that the motor is mounted properly and aligned with the driven equipment. Ensure that starting the motor will not cause personal injury or damage equipment connected to the motor.

⚠ CAUTION

Set the maximum motor speed (frequency) in the SVX9000/SPX9000 drive according to the requirements of the motor and the equipment connected to it. Incorrect maximum frequency settings can cause motor or equipment damage and personal injury.

⚠ CAUTION

Before reversing the motor rotation direction, ensure that this will not cause personal injury or equipment damage.

⚠ CAUTION

Make sure that no power correction capacitors are connected to the SVX9000/SPX9000 output or the motor terminals to prevent SVX9000/SPX9000 malfunction and potential damage.

⚠ CAUTION

Make sure that the SVX9000/SPX9000 output terminals (U, V, W) are not connected to the utility line power as severe damage to the SVX9000/SPX9000 may occur.

Chapter 1 — Overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations and the Cutler-Hammer® SVX9000/SPX9000 catalog numbering system.

How to Use This Manual

The purpose of this manual is to provide you with information necessary to install, set and customize parameters, start up, troubleshoot and maintain the Cutler-Hammer SVX9000/SPX9000 AF Drives by Eaton's electrical business. To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to the SVX9000/SPX9000. Keep this user manual handy and distribute to all users, technicians and maintenance personnel for reference along with the appropriate application manual.

Chapter 1 – Overview is the chapter you are reading now.

Chapter 2 – Mounting

Chapter 3 – Power Wiring

Chapter 4 – Control Wiring

Chapter 5 – Menu Information

Chapter 6 – Start-Up

Appendix A – Technical Data

Appendix B – Fault and Warning Codes

Appendix C – Troubleshooting Charts

Appendix D – Spare Parts

Receiving and Inspection

This SVX9000/SPX9000 AC drive has met a stringent series of factory quality requirements before shipment. It is possible that packaging or equipment damage may have occurred during shipment. After receiving your SVX9000/SPX9000 drive, please check for the following:

● Check to make sure that the package(s) includes the proper drive, the User Manual, and rubber conduit covers, screws, conduit plate and ground straps.

● Inspect the unit to ensure it was not damaged during shipment.

● Make sure that the part number indicated on the nameplate corresponds with the Catalog Number on your order.

If shipping damage has occurred, please contact and file a claim with the carrier involved immediately.

If the delivery does not correspond to your order, please contact your Eaton representative.
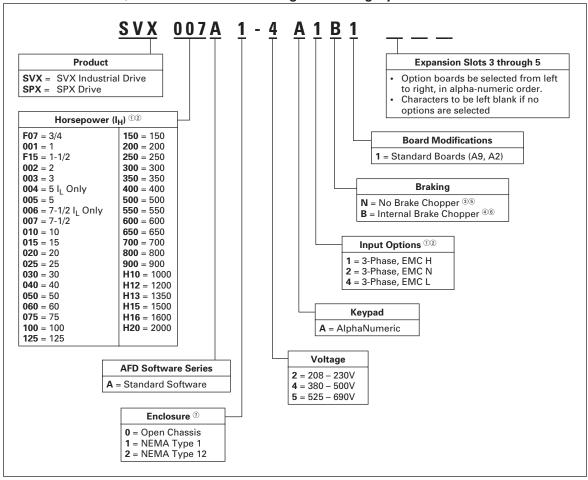
Note: Do not destroy the packing. The template printed on the protective cardboard can be used for marking the mounting points of the SVX9000/SPX9000 AF Drives on the wall or cabinet.

Open SVX9000/SPX9000 Catalog Numbers

Table 1-1: SVX9000/SPX9000 AF Drive Catalog Numbering System

S V X   0 0 7 A   1 - 4   A 1 B 1   _ _ _

Product	
SVX =	SVX Industrial Drive
SPX =	SPX Drive

Horsepower (I$_H$) [1][2]			
F07 = 3/4	**150** = 150
001 = 1	**200** = 200
F15 = 1-1/2	**250** = 250
002 = 2	**300** = 300
003 = 3	**350** = 350
004 = 5 I$_L$ Only	**400** = 400
005 = 5	**500** = 500
006 = 7-1/2 I$_L$ Only	**550** = 550
007 = 7-1/2	**600** = 600
010 = 10	**650** = 650
015 = 15	**700** = 700
020 = 20	**800** = 800
025 = 25	**900** = 900
030 = 30	**H10** = 1000
040 = 40	**H12** = 1200
050 = 50	**H13** = 1350
060 = 60	**H15** = 1500
075 = 75	**H16** = 1600
100 = 100	**H20** = 2000
125 = 125	

Expansion Slots 3 through 5
• Option boards be selected from left to right, in alpha-numeric order.
• Characters to be left blank if no options are selected

Board Modifications
1 = Standard Boards (A9, A2)

Braking
N = No Brake Chopper [3][5]
B = Internal Brake Chopper [4][6]

Input Options [1][2]
1 = 3-Phase, EMC H
2 = 3-Phase, EMC N
4 = 3-Phase, EMC L

Keypad
A = AlphaNumeric

Voltage
2 = 208 – 230V
4 = 380 – 500V
5 = 525 – 690V

AFD Software Series
A = Standard Software

Enclosure [7]
0 = Open Chassis
1 = NEMA Type 1
2 = NEMA Type 12

[1] All 230V Drives and 480V Drives up to 200 hp (I$_H$) are only available with Input Option **1**.

[2] 480V Drives 250 hp (I$_H$) or larger are only available with Input Option **2**.

[3] 480V Drives up to 30 hp (I$_H$) are only available with Brake Chopper Option **B**.

[4] 480V Drives 40 hp (I$_H$) and larger come with Brake Chopper Option **N** as standard.

[5] 230V Drives up to 15 hp (I$_H$) are only available with Brake Chopper Option **B**.

[6] 230V Drives 20 hp (I$_H$) or larger come with Brake Chopper Option **N** as standard.

[7] 480V Drives 250 hp, 300 hp and 350 hp (I$_H$) are only available with Enclosure Style **0** (Chassis).

October 2007

2-1

Chapter 2 — Mounting

The SVX9000/SPX9000 drive may be mounted side-by-side or stacked vertically, as outlined in the following section.

Space Requirements

To ensure proper air circulation and cooling, follow the guidelines below.

Table 2-1: Space Requirements for Mounting a SVX9000/SPX9000 Drive

Frame	Drive Type	Dimensions in Inches (mm) [1]				
		A	A_2	B	C	D
4	230V, 1 – 3 hp I_L, 3/4 – 3 hp I_H 480V, 1 – 5 hp I_H, 1-1/2 – 7-1/2 hp I_L	0.8 (20)	—	0.8 (20)	3.9 (100)	2.0 (50)
5	230V, 5 – 10 hp I_L, 5 – 7-1/2 hp I_H 480V, 7-1/2 – 15 hp I_H, 10 – 20 hp I_L	1.2 (30)	—	0.8 (20)	4.7 (120)	2.4 (60)
6	230V, 15 – 20 hp I_L, 10 – 15 hp I_H 480V, 20 – 30 hp I_H, 25 – 40 hp I_L 575V, 2 – 25 hp I_H, 3 – 30 hp I_L	1.2 (30)	—	0.8 (20)	6.3 (160)	3.1 (80)
7	230V, 25 – 40 hp I_L, 20 – 30 hp I_H 480V, 40 – 60 hp I_H, 50 – 75 hp I_L 575V, 30 – 40 hp I_H, 40 – 50 hp I_L	3.1 (80)	—	3.1 (80)	11.8 (300)	3.9 (100)
8	480V, 75 – 125 hp I_H, 100 – 150 hp I_L 575V, 50 – 75 hp I_H, 60 – 100 hp I_L	3.1 (80)	5.9 (150)	3.1 (80)	11.8 (300)	7.9 (200)
9	480V, 200 – 250 hp I_L, 150 – 200 hp I_H 575V, 100 – 150 hp I_H, 150 – 200 hp I_L	2.0 (50)	—	3.1 (80)	15.7 (400)	9.8 (250) 13.8 (350) [2]

[1] Dimensions represent the minimum clearance needed when mounting a SVX9000/SPX9000. See **Figure 2-1** below.
　　A = clearance around the SVX9000/SPX9000.
　　A_2 = clearance needed to change the fan without disconnecting the motor cables.
　　B = distance between adjacent SVX9000/SPX9000 drives or between the SVX9000/SPX9000 and an enclosure wall.
　　C = clearance above the SVX9000/SPX9000.
　　D = clearance below the SVX9000/SPX9000.
[2] Minimum clearance below the SVX9000/SPX9000 needed to change the fan.
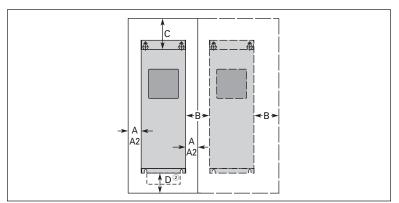
Figure 2-1: Mounting Space Requirements.

If several units are mounted above each other, the clearance between the drives should equal C + D (see **Table 2-1** and **Figure 2-1** above). In addition, the outlet air used for cooling the lower unit must be directed away from the inlet air used by the upper unit.

Environmental Requirements

Ensure that the environment meets the requirements listed in **Table A-1** of **Appendix A** for any storage or operating situation.

Table 2-2 specifies the minimum airflow required in the area where the drive will be mounted.

Table 2-2: Cooling Airflow Requirements

Drive Type	Cooling Air Required
230V, 3/4 – 3 hp I_H 480V, 1 – 5 hp I_H	41 cfm (70 m^3/h)
230V, 5 – 7-1/2 hp I_H 480V, 7-1/2 – 15 hp I_H	112 cfm (190 m^3/h)
230V, 10 – 15 hp I_H 480V, 20 – 30 hp I_H 575V, 2 – 25 hp I_H	250 cfm (425 m^3/h)
230V, 20 – 30 hp I_H 480V, 40 – 60 hp I_H 575V, 30 – 40 hp I_H	250 cfm (425 m^3/h)
480V, 75 – 125 hp I_H 575V, 60 – 75 hp I_H	383 cfm (650 m^3/h)
480V, 150 – 200 hp I_H 575V, 100 – 150 hp I_H	765 cfm (1300 m^3/h)

Standard Mounting Instructions

1. Measure the mounting space to ensure that it allows for the minimum space surrounding the drive. Drive dimensions are in **Appendix A**.

2. Make sure the mounting surface is flat and strong enough to support the drive, is not flammable, and is not subject to excessive motion or vibration.

3. Ensure that the minimum airflow requirements for your drive are met at the mounting location.

4. Mark the location of the mounting holes on the mounting surface, using the template provided on the cover of the cardboard shipping package.

5. Using fasteners appropriate to your drive and mounting surface, securely attach the drive to the mounting surface using all 4 screws or bolts.

Chapter 3 — Power Wiring

Guidelines

To ensure proper wiring, use the following guidelines:

● Use heat-resistant copper cables only, +75°C or higher.

● The input line cable and line fuses must be sized in accordance with the rated input current of the unit. See **Tables 3-2** through **3-8**.

● Provide a ground wire with both input power and output motor leads.

The control should be installed in accordance with all applicable codes. In accordance with NEC 430 Part IV, a protective device is required in the installation of the control. This protective device can be either a fuse or circuit breaker. An RK fuse is an acceptable component. For maximum protection Eaton recommends a Class T fuse.

Input line cable and line fuses must be sized in accordance with **Tables 3-2** through **3-6**.

● If the motor temperature sensing is used for overload protection, the output cable size may be selected based on the motor specifications.

● If three or more shielded cables are used in parallel for the output on the larger units, every cable must have its own overload protection.

● Avoid placing the motor cables in long parallel lines with other cables.

● If the motor cables run in parallel with other cables, note the minimum distances between the motor cables and other cables given in **Table 3-1** below:

Table 3-1: Cable Spacings

Minimum Distance Between Cables in Feet (m)	Cable in Feet (m)
1 (0.3)	≤ 164 (50)
3.3 (1.0)	≤ 656 (200)

● The spacings of **Table 3-1** also apply between the motor cables and signal cables of other systems.

● The maximum length of the motor cables is as follows:

  – 1 – 2 hp, 230V units, 328 ft. (100m)

  – All other hp units, 984 ft. (300m)

● The motor cables should cross other cables at an angle of 90 degrees.

● If conduit is being used for wiring, use separate conduits for the input power wiring, the output power wiring, the signal wiring and the control wiring.

UL Compatible Cable Selection and Installation

Use only copper wire with temperature rating of at least 75°C.

Table 3-2: 40°C Cable and Fuse Sizes — 230V Ratings

I_L hp	Frame Size	NEC I [A]	I [A]	Fuse [1] Quantity	Fuse [A]	Wire Size		Terminal Size	
						Power	Ground	Power	Ground
1 1-1/2 2 3	FR4	4.2 6 6.8 9.6	4.8 6.6 7.8 11	3 3 3 3	10 10 10 15	14 14 14 14	14 14 14 14	16 – 12 16 – 12 16 – 12 16 – 12	16 – 14 16 – 14 16 – 14 16 – 14
5 7-1/2 10	FR5	15.2 22 28	17.5 25 31	3 3 3	20 30 40	12 10 8	12 10 8	16 – 8 16 – 8 16 – 8	16 – 8 16 – 8 16 – 8
15 20	FR6	42 54	48 61	3 3	60 80	4 2	8 6	14 – 0 14 – 0	10 – 2 10 – 2
25 30 40	FR7	68 80 104	72 87 114	3 3 3	100 110 125	2 1 1/0	6 6 4	14 – 0 14 – 0 14 – 0	10 – 00 10 – 00 10 – 00
50 60 75	FR8	130 154 192	140 170 205	3 3 3	175 200 250	3/0 4/0 300	2 0 2/0	4 – 3/0 000 – 350 MCM 000 – 350 MCM	4 – 000 4 – 000 4 – 000
100	FR9	248	261	3	300	2x4/0	3/0	2x000 – 350 MCM	4 – 000

[1] UL recognized type JJS preferred but RK acceptable.

Table 3-3: 40°C Cable and Fuse Sizes — 480V Ratings

I_L hp	Frame Size	NEC I [A]	I [A]	Fuse [①] Quantity	Fuse [A]	Wire Size		Terminal Size	
						Power	Ground	Power	Ground
1-1/2	FR4	3	3.3	3	10	14	14	16 – 12	16 – 14
2		3.4	4.3	3	10	14	14	16 – 12	16 – 14
3		4.8	5.6	3	10	14	14	16 – 12	16 – 14
5		7.6	7.6	3	10	14	14	16 – 12	16 – 14
7-1/2		11	12	3	15	12	14	16 – 12	16 – 14
10	FR5	14	16	3	20	10	12	16 – 8	16 – 8
15		21	23	3	30	10	10	16 – 8	16 – 8
20		27	31	3	35	8	8	16 – 8	16 – 8
25	FR6	34	38	3	50	6	8	14 – 0	10 – 2
30		40	46	3	60	4	8	14 – 0	10 – 2
40		52	61	3	80	2	6	14 – 0	10 – 2
50	FR7	65	72	3	100	2	6	14 – 0	10 – 00
60		77	87	3	110	1	6	14 – 0	10 – 00
75		96	105	3	125	1/0	4	14 – 0	10 – 00
100	FR8	124	140	3	175	3/0	2	4 – 3/0	4 – 000
125		156	170	3	200	4/0	0	000 – 350 MCM	4 – 000
150		180	205	3	250	300	2/0	000 – 350 MCM	4 – 000
200	FR9	240	261	3	350	2x4/0	3/0	2x000 – 350 MCM	4 – 000
250		302	300	3	400	2x250	300	2x000 – 350 MCM	4 – 000
300	FR10	361	385	3	450	2x250	300	600 MCM	300 MCM
350		414	460	3	500	2x300	300	600 MCM	300 MCM
400		477	520	3	600	2x400	350	600 MCM	300 MCM
500	FR11	590	590	6	350	2x500	500	Bus Bar	Bus Bar
550		NS	650	6	400	4x4/0	500	Bus Bar	Bus Bar
600		NS	730	6	450	4x250	600	Bus Bar	Bus Bar
650	FR12	NS	820	6	500	4x300	600	Bus Bar	Bus Bar
700		NS	920	6	500	4x300	600	Bus Bar	Bus Bar
800		NS	1030	6	600	4x350		Bus Bar	Bus Bar

① UL recognized type JJS preferred but RK acceptable.

Table 3-4: 40°C Cable and Fuse Sizes — 575V Ratings

I_L hp	Frame Size	NEC I [A]	I [A]	Fuse [1] Quantity	Fuse [A]	Wire Size Power	Ground	Terminal Size Power	Ground
3	FR6	3.9	4.5	3	10	14	14	14 – 0	14 – 2
5		6.1	7.5	3	10	14	14	14 – 0	14 – 2
7-1/2		9	10	3	15	12	14	14 – 0	14 – 2
10		11	13.5	3	20	12	12	14 – 0	14 – 2
15		17	18	3	30	10	10	14 – 0	14 – 2
20		22	22	3	35	8	8	14 – 0	14 – 2
25		27	27	3	40	8	8	14 – 0	14 – 2
30		32	34	3	45	6	8	14 – 0	14 – 2
40	FR7	41	41	3	50	6	8	14 – 0	10 – 0
50		52	52	3	70	4	6	14 – 0	10 – 0
60	FR8	62	62	3	80	2	6	4 – 000	4 – 000
75		77	80	3	125	1/0	6	4 – 000	4 – 000
100		99	100	3	150	2/0	6	4 – 000	4 – 000
125		125	125	3	175	3/0	6	4 – 000	4 – 000
150	FR9	144	144	3	250	300	1/0	000 – 350 MCM	4 – 000
200		192	208	3	275	350	2/0	000 – 350 MCM	4 – 000
250	FR10	242	261	3	350	2x4/0	3/0	600 MCM	300 MCM
300		289	325	3	400	2x250	300	600 MCM	300 MCM
400		382	385	3	450	2x300	300	600 MCM	300 MCM
450	FR11	412	460	6	250	2x300	300	Bus Bar	Bus Bar
500		472	502	6	300	2x350	350	Bus Bar	Bus Bar
550		NS	590	6	350	2x500	500	Bus Bar	Bus Bar
600	FR12	NS	650	6	400	4x4/0	500	Bus Bar	Bus Bar
700		NS	750	6	450	4x250	600	Bus Bar	Bus Bar
800		NS	820	6	500	4x300	600	Bus Bar	Bus Bar

[1] UL recognized type JJS preferred but RK acceptable

Table 3-5: Cable and Busbar Sizes, SPX FR10 – FR12 — 480V Ratings

hp	Frame Size	Current	Internal Power Cables [2] Cu (per phase)	External Power Busbars Cu (in Inches)	Qty.
250	FR10	300	2 x 2/0	1.18 x 0.25	3
300		385	2 x 3/0	1.57 x 0.25	3
350		460	2 x 3/0	1.57 x 0.25	3
400	FR11	520	2 x 2 x 2/0	1.18 x 0.25	6
500		590	2 x 2 x 2/0	1.18 x 0.25	6
—		650	2 x 2 x 2/0	1.18 x 0.25	6
600	FR12	750	2 x 2 x 3/0	1.57 x 0.25	6
—		820	2 x 2 x 3/0	1.57 x 0.25	6
700		920	2 x 2 x 3/0	1.57 x 0.25	6

[2] 90°C rating recommended.

October 2007

Table 3-6: Cable and Busbar Sizes, SPX FR13 – FR14 — 480V Ratings

hp	Frame Size	Current	Busbar Size NFE – INU (in Inches)	Busbar Size/ Phase [1] (Choke — NFE) (in Inches)	Cable Size/ Phase (Choke — NFE)	Cu (in Inches)	Qty.
			Internal Power Connections			Supply Busbars	
800	FR13	1030	2.36 x 0.39	1.57 x 0.25	2 x 300 MCM	1.57 x 0.25	6
900		1150	3.15 x 0.39	1.57 x 0.25	2 x 250 MCM	1.57 x 0.25	12
1000		1300	3.15 x 0.39	1.57 x 0.25	2 x 250 MCM	1.57 x 0.25	12
1200	FR14	1600	2.36 x 0.39	1.57 x 0.25	2 x 250 MCM	1.57 x 0.25	12
1600		1940	2.36 x 0.39	1.57 x 0.25	2 x 300 MCM	1.57 x 0.25	12

[1] Rigid copper connection.

Table 3-7: Cable and Busbar Sizes, SPX FR10 – FR12 — 575V Ratings

hp	Frame Size [2]	Current	Internal Power Cables [2] Cu (per phase)	External Power Busbars Cu (in Inches)	Qty.
200	FR10	208	2x2/0	1.18 x .25	3
250		261	2x2/0	1.18 x .25	3
300		325	2x2/0	1.18 x .25	3
400	FR11	385	2x3/0	1.57 x .25	3
450		460	2x3/0	1.57 x .25	3
500		502	2x2x2/0	1.18 x .25	6
—	FR12	590	2x2x2/0	1.18 x .25	6
600		650	2x2x2/0	1.18 x .25	6
700		750	2\x2x2/0	1.18 x .25	6

[2] 90°C rating recommended.

Table 3-8: Cable and Busbar Sizes, SPX FR13 – FR14 — 575V Ratings

hp	Frame Size	Current	Busbar Size NFE – INU (in Inches)	Busbar Size/ Phase [3] (Choke — NFE) (in Inches)	Cable Size/ Phase (Choke — NFE)	Cu (in Inches)	Qty.
			Internal Power Connections			Supply Busbars	
800	FR13	820	2.36 x 0.39	1.57 x .25	2 x 300 MCM	1.18 x .25	6
900		920	2.36 x 0.39	1.57 x .25	2 x 250 MCM	1.18 x .25	6
1000		1030	2.36 x 0.39	1.57 x .25	2 x 300 MCM	1.18 x .25	6
1350	FR14	1300	3.15 x 0.39	1.57 x .25	2 x 250 MCM	1.18 x .25	12
1500		1500	2.36 x 0.39	1.57 x .25	2 x 250 MCM	1.18 x .25	12
2000		1900	2.36 x 0.39	1.57 x .25	2 x 300 MCM	1.18 x .25	12

[3] Rigid copper connection.

Table 3-9: Maximum Symmetrical Supply Current

Product	Voltage	Maximum RMS Symmetrical Amperes on Supply Circuit
3/4 – 30 hp	230	100,000A
1-1/2 – 200 hp	480	100,000A

UL Compatible Cable Selection and Installation with Breaker

Use only copper wire with temperature rating of at least 75°C.

Table 3-10: Cable and Breaker [2] Sizes – 230V Ratings

hp	Frame Size	FLA	Breaker Current	Wire Size [1]		Terminal Size	
				Power	Ground	Power	Ground
1	FR4	4.8	15	14	14	12 – 16	14 – 16
1-1/2		6.6	15	14	14	12 – 16	14 – 16
2		7.8	15	14	14	12 – 16	14 – 16
3		11	15	12	12	12 – 16	14 – 16
5	FR5	17.5	20	10	10	8 – 16	8 – 16
7-1/2		25	30	8	8	8 – 16	8 – 16
10	FR6	31	40	8	8	1/0 – 14	2 – 14
15		48	60	4	6	1/0 – 14	2 – 14
20	FR7	61	80	2	6	1/0 – 14	2/0 – 10
25		72	100	2	6	1/0 – 14	2/0 – 10
30		87	100	1/0	4	1/0 – 14	2/0 – 10

[1] Based on a maximum environment of 104°F (40°C).
[2] A UL listed breaker must be used.

Table 3-11: Cable and Breaker [4] Sizes – 480V Ratings

hp	Frame Size	FLA	Breaker Current	Wire Size [3]		Terminal Size	
				Power	Ground	Power	Ground
1-1/2	FR4	3.3	15	14	14	12 – 16	14 – 16
2		4.3	15	14	14	12 – 16	14 – 16
3		5.6	15	14	14	12 – 16	14 – 16
5		7.6	15	14	14	12 – 16	14 – 16
7-1/2	FR5	12	20	12	12	8 – 16	8 – 16
10		16	30	10	10	8 – 16	8 – 16
15		23	30	8	8	8 – 16	8 – 16
20	FR6	31	40	8	8	1/0 – 14	2 – 14
25		38	50	6	8	1/0 – 14	2 – 14
30		46	60	4	6	1/0 – 14	2 – 14
40	FR7	61	80	2	6	1/0 – 14	2/0 – 10
50		72	100	2	6	1/0 – 14	2/0 – 10
60		87	100	1/0	4	1/0 – 14	2/0 – 10
75	FR8	105	125	2/0	2	3/0 – 4	3/0 – 4
100		140	150	4/0	1/0	350 MCM – 3/0	3/0 – 4
125		170	200	300	2/0	350 MCM – 3/0	3/0 – 4
150	FR9	205	250	350	3/0	350 MCM – 2x3/0	3/0 – 4
200		261	300	2x250	3/0	350 MCM – 2x3/0	3/0 – 4
250	FR10	300	400	2x250	300 MCM	600 MCM	600 MCM
300		385	500	2x300	300 MCM	600 MCM	600 MCM
350		460	600	2x400	300 MCM	600 MCM	600 MCM
400	FR11	520	700	2x500	500	Bus Bar	Bus Bar
500		590	800	4x4/0	500	Bus Bar	Bus Bar
550		650	900	4x250	600	Bus Bar	Bus Bar
600	FR12	750	1000	4x300	600	Bus Bar	Bus Bar
650		820	1000	4x300	600	Bus Bar	Bus Bar
700		920	1200	4x400		Bus Bar	Bus Bar

[3] Based on a maximum environment of 104°F (40°C).
[4] A UL listed breaker must be used.

Table 3-12: Cable and Breaker ② Sizes – 575V Ratings

hp	Frame Size	FLA	Breaker Current	Wire Size ①		Terminal Size	
				Power	Ground	Power	Ground
2	FR6	3.3	15	14	14	1/0 – 14	2 – 14
3		4.5	15	14	14	1/0 – 14	2 – 14
5		7.5	15	14	14	1/0 – 14	2 – 14
7-1/2		10	20	12	14	1/0 – 14	2 – 14
10		13.5	30	10	12	1/0 – 14	2 – 14
15		18	30	10	10	1/0 – 14	2 – 14
20		22	40	8	8	1/0 – 14	2 – 14
25		27	40	8	8	1/0 – 14	2 – 14
30	FR7	34	50	6	8	1/0 – 14	1/0 – 10
40		41	60	4	6	1/0 – 14	1/0 – 10
50	FR8	52	100	2	6	3/0 – 4	3/0 – 4
60		62	100	1	6	3/0 – 4	3/0 – 4
75		80	125	1/0	6	3/0 – 4	3/0 – 4
100		100	150	3/0	6	3/0 – 4	3/0 – 4
125	FR9	125	200	4/0	2	350 MCM – 2x3/0	3/0 – 4
150		144	250	350	1/0	350 MCM – 2x3/0	3/0 – 4
200	FR10	208	300	2x250	300 MCN	600 MCM	600 MCM
250		261	400	2x300	300 MCM	600 MCM	600 MCM
300		325	500	2x350	300 MCM	600 MCM	600 MCM
400	FR11	385	500	2x300	300	Bus Bar	Bus Bar
450		460	600	2x350	350	Bus Bar	Bus Bar
500		502	700	2x500	500	Bus Bar	Bus Bar
550	FR12	590	800	4x4/0	500	Bus Bar	Bus Bar
600		650	900	4x250	600	Bus Bar	Bus Bar
700		750	1000	4x300	600	Bus Bar	Bus Bar

① Based on a maximum environment of 104°F (40°C).
② A UL listed breaker must be used.

Note: The current interrupting of the breaker, up to 100 kAIC, will determine the overall current rating of the combination.

Table 3-13: Power Connection Tightening Torque

Rating	Frame Size	Tightening Torque (in-lbs)	Tightening Torque (Nm)
230V, 3/4 – 3 hp 480V, 1 – 5 hp	FR4	5 5	0.6 0.6
230V, 5 – 7-1/2 hp 480V, 7-1/2 – 15 hp	FR5	13 13	1.5 1.5
230V, 10 – 15 hp 480V, 20 – 30 hp 575V, 2 – 25 hp	FR6	35 35 35	4 4 4
230V, 20 – 30 hp 480V, 40 – 60 hp 575V, 30 – 40 hp	FR7	85 85 85	10 10 10
480V, 75 – 125 hp 575V, 50 – 75 hp	FR8	340/187 [1] 340/187 [1]	40/22 [1] 40/22 [1]
480V, 150 – 200 hp 575V, 100 – 175 hp	FR9	340/187 [1] 340/187 [1]	40/22 [1] 40/22 [1]

[1] The isolation standoff of the bus bar will not withstand the listed tightening torque. Use a wrench to apply a counter torque when tightening.

Installation Instructions

1. Strip the motor and input power cables as shown in **Figure 3-1** and **Table 3-14**.
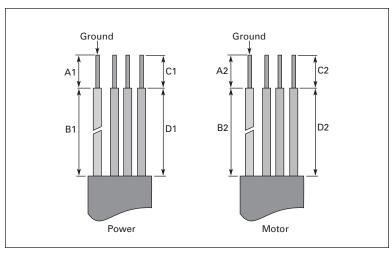
Figure 3-1: Input Power and Motor Cable Stripping and Wire Lengths

Cable Stripping Lengths for Power and Motor Cables

Table 3-14: Power and Motor Cable Stripping Lengths

Product		Frame Size	Power Wiring in Inches (mm)				Motor Wiring in Inches (mm)			
hp	Voltage		A1	B1	C1	D1	A2	B2	C2	D2
3/4 – 3 1 – 5	230V 480V	FR4	0.59 (15)	1.38 (35)	0.39 (10)	0.79 (20)	0.28 (7)	1.97 (50)	0.28 (7)	1.38 (35)
5 – 7-1/2 7-1/2 – 15	230V 480V	FR5	0.79 (20)	1.57 (40)	0.39 (10)	1.18 (30)	0.79 (20)	2.36 (60)	0.39 (10)	1.57 (40)
10 – 15 20 – 30 2 – 25	230V 480V 575V	FR6	0.79 (20)	3.54 (90)	0.59 (15)	2.36 (60)	0.79 (20)	3.54 (90)	0.59 (15)	2.36 (60)
20 – 30 40 – 60 30 – 40	230V 480V 575V	FR7	0.98 (25)	4.72 (120)	0.98 (25)	4.72 (120)	0.98 (25)	4.72 (120)	0.98 (25)	4.72 (120)
75 – 125 50 – 75	480V 575V	FR8	1.10 (28)	9.45 (240)	1.10 (28)	9.45 (240)	1.10 (28)	9.45 (240)	1.10 (28)	9.45 (240)
150 – 200 100 – 300	480V 575V	FR9	1.10 (28)	11.61 (295)	1.10 (28)	11.61 (295)	1.10 (28)	11.61 (295)	1.10 (28)	11.61 (295)

2. Locate the plastic bag containing the wiring plate.
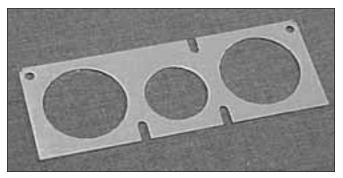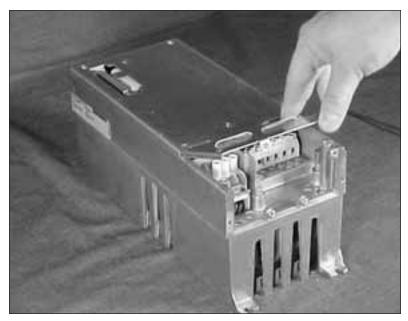
Figure 3-2: Wiring Plate

3. If conduit is being used, attach the wiring plate to drive then conduit.

4. Pass the motor and input power wires/cables through the holes of the wiring plate.

5. Connect the input power and motor and control wires to their respective terminals according to the wiring diagrams in the section marked "Standard Wiring Diagrams and Terminal Locations" on **Page 3-11**.

6. If an optional external brake resistor is used, connect its cable to the appropriate terminals. See "Standard Wiring Diagrams and Terminal Locations."

7. If shielded cable is used, connect the shields of the input line power cable and the motor cable to the ground terminals of the SVX9000/SPX9000 drive, the motor and the line power supply.

Figure 3-3: Ground Terminal Locations

8. If shielded cable is not used, check the connection of the ground cable to the motor, the SVX9000/SPX9000 drive and the input line power terminals marked with ⏚ .

9. Attach the wiring plate with the screws provided. Ensure that no wires are trapped between the frame and the wiring plate.

10. Insert the rubber grommets supplied into the wiring plate holes that have not been used, as illustrated in **Figure 3-4**.

Figure 3-4: Cable Protection Plate

Standard Wiring Diagrams and Terminal Locations

The following wiring diagrams show the line and motor connections of the frequency converter.
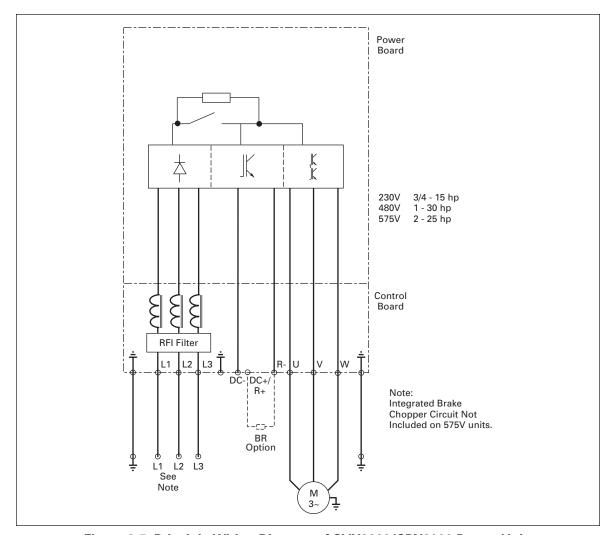
Figure 3-5: Principle Wiring Diagram of SVX9000/SPX9000 Power Unit, FR4 to FR5 and FR6

Note: When using a 1-phase supply, for units rated for such, connect the input power to terminals L1 and L2. Consult Eaton for more information.
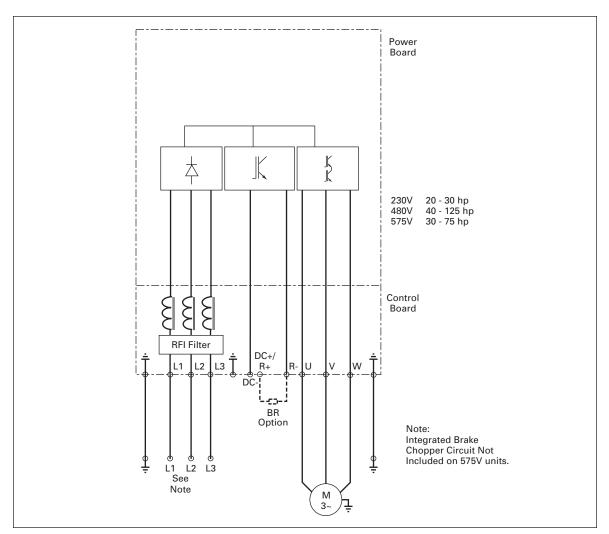
Figure 3-6: Principle Wiring Diagram of SVX9000/SPX9000 Power Unit, FR6, FR7 and FR8

Note: When using a 1-phase supply, for units rated for such, connect the input power to terminals L1 and L2. Consult Eaton for more information.
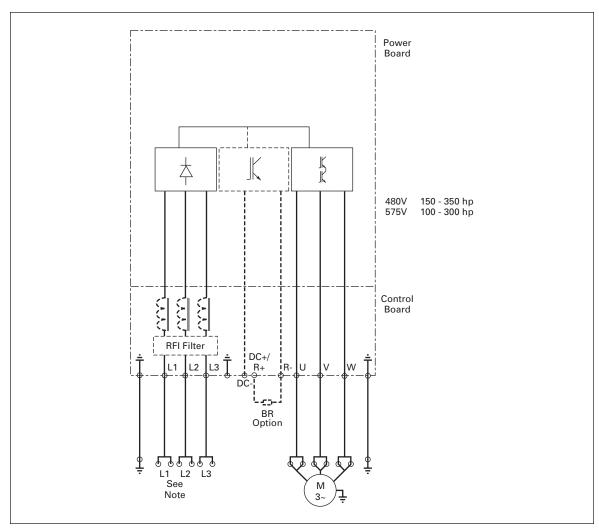
Figure 3-7: Principle Wiring Diagram of SVX9000/SPX9000 Power Unit, FR9 to FR10
The dotted lines refer to components present in FR9 but not in FR10.

Note: When using a 1-phase supply, for units rated for such, connect the input power to terminals L1 and L2. Consult Eaton for more information.

Power and Motor Wiring Terminal Photos

230V, 3/4 – 3 hp
480V, 1 – 5 hp

Frame Size: FR4
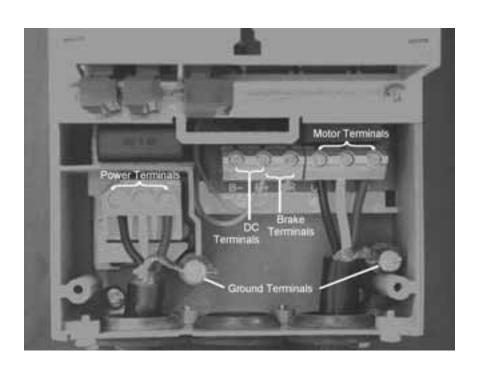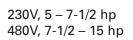
Figure 3-8: FR4 Power and Motor Wiring Terminals

230V, 5 – 7-1/2 hp
480V, 7-1/2 – 15 hp

Frame Size: FR5
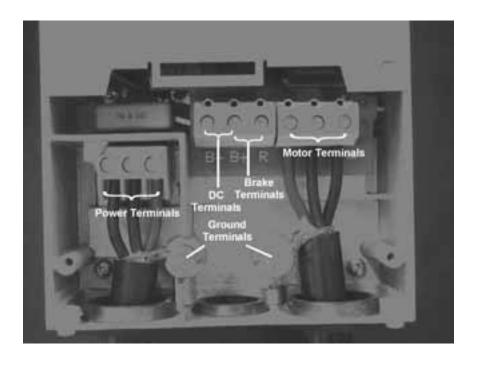
Figure 3-9: FR5 Power and Motor Wiring Terminals

230V, 10 – 15 hp
480V, 20 – 30 hp
575V, 2 – 25 hp

Frame Size: FR6
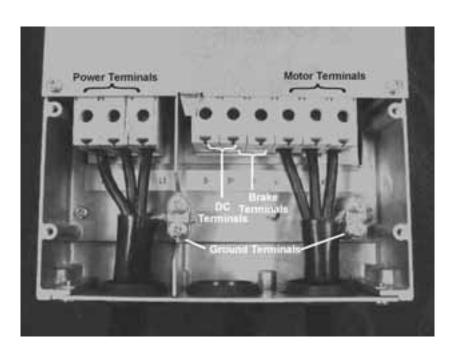
Figure 3-10: FR6 Power and Motor Wiring Terminals

230V, 20 – 30 hp
480V, 40 – 60 hp
575V, 30 – 40 hp

Frame Size: FR7
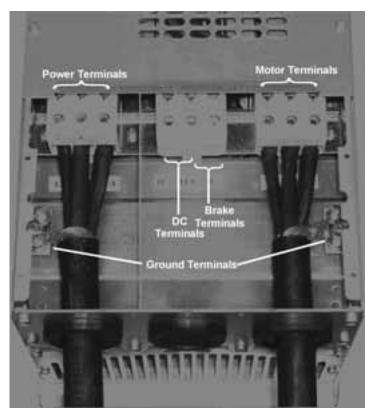
Figure 3-11: FR7 Power and Motor Wiring Terminals

Supplied only when Brake Chopper included with Drive.

480V, 75 – 125 hp
575V, 50 – 75 hp

Frame Size: FR8
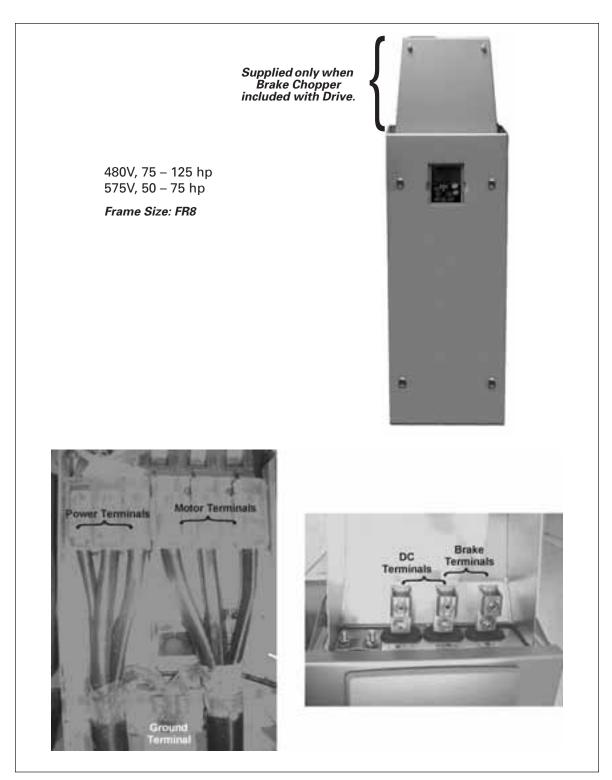
Figure 3-12: FR8 Power and Motor Wiring Terminals

480V, 150 – 200 hp
575V, 100 – 175 hp

Frame Size: FR9

Figure 3-13: FR9 Power and Motor Wiring Terminals

Checking the Cable and Motor Insulation

1. Check the motor cable insulation as follows:

    ●   Disconnect the motor cable from terminals U, V and W of the SVX9000/SPX9000 and from the motor.

    ●   Measure the insulation resistance of the motor cable between each phase conductor as well as between each phase conductor and the protective ground conductor.

    ●   The insulation resistance must be >1 MΩ.

2. Check the input power cable insulation as follows:

    ●   Disconnect the input power cable from terminals L1, L2 and L3 of the SVX9000/ SPX9000 and from the utility line feeder.

    ●   Measure the insulation resistance of the input power cable between each phase conductor as well as between each phase conductor and the protective ground conductor.

    ●   The insulation resistance must be >1 MΩ.

3. Check the motor insulation as follows:

    ●   Disconnect the motor cable from the motor and open any bridging connections in the motor connection box.

    ●   Measure the insulation resistance of each motor winding. The measurement voltage must equal at least the motor nominal voltage but not exceed 1000V.

    ●   The insulation resistance must be >1 MΩ.

Chapter 4 — Control Wiring

General Information

The control unit of the SVX9000/SPX9000 consists of the control board and various option boards that plug into the five slot connectors (A to E) of the control board.

Galvanic isolation of the control terminals is provided as follows:

- The control connections are isolated from power, and the GND terminals are permanently connected to ground.

- The digital inputs are galvanically isolated from the I/O ground.

- The relay outputs are double-isolated from each other at 300V AC.

Option Board General Information

The SVX9000/SPX9000 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. Option boards are available for normal analog and digital inputs and outputs, communication and additional application-specific hardware.

The SVX9000/SPX9000 factory installed standard option board configuration includes an A9 I/O board and an A2 relay output board, which are installed in slots A and B. For information on additional option boards, see the *9000X Series Drives Option Board User Manual*.
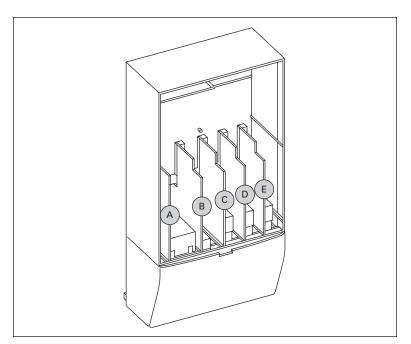
Figure 4-1: Option Board Slots

Control Wiring Guidelines

Wire the control terminals using the following guidelines:

- The control wires shall be at least AWG 20 (0.5 mm^2) shielded cables.

- The maximum wire size is AWG 14 (2.5 mm^2) for the relay terminals and AWG 16 (1.5 mm^2) for all other terminals.

- The tightening torques for the option board terminals are listed in **Table 4-1**.

Table 4-1: Tightening Torques of Terminals

Terminal Screw	Tightening Torque	
	in-lbs	Nm
Relay and thermistor terminals (M3 screw)	4.5	0.5
Other terminals (M2.6 screw)	2.2	0.25

Control Wiring Instructions

Table 4-2: Control Wiring Instructions

1. Unlock the bottom cover by turning the locking screw 90 degrees counterclockwise.	
2. Remove the bottom cover by rotating the cover towards you on the base hinges, then lifting the cover away from the base.	
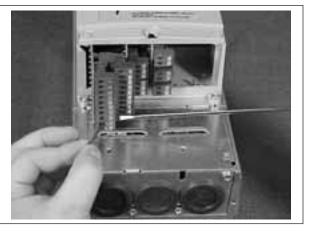
Table 4-2: Control Wiring Instructions (Continued)

3. Wire the control terminals following the details for the specific option boards shown on the following pages. **Note:** Note for ease of access, the option board terminal blocks can be unplugged for wiring.	

Control Wiring Details

Wiring Option Board A9
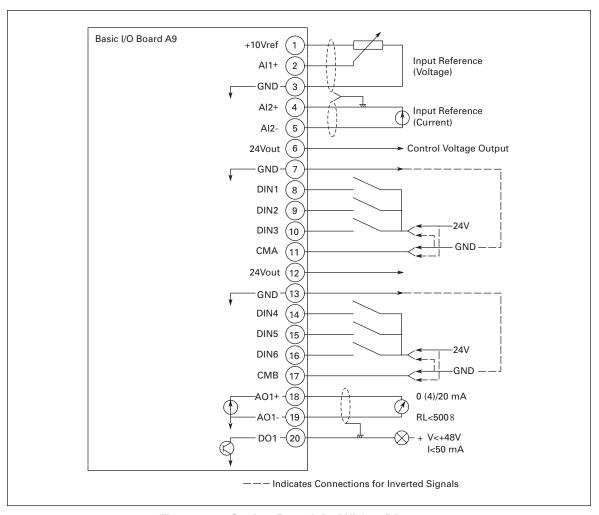
Figure 4-2: Option Board A9 Wiring Diagram

Table 4-3: Option Board A9 Terminal Descriptions

Terminal		Signal	Description and Parameter Reference
1	+10 V_{ref}	Reference voltage	Maximum current 10 mA
2	AI1+	Analog input, voltage	Default: 0 – +10V (R_i = 200 kΩ)
3	GND	Analog input common	-10V to +10V (joystick control) 0 – 20 mA (R_i = 250 Ω) *Select V or mA with jumper block X1* (**Figure 4-3**) Differential input if not connected to ground; allows ±20V differential mode voltage to GND
4	AI2+	Analog input	Default: 0 – 20 mA (R_i = 250 Ω)
5	GND/AI2-	Analog input common	0 – +10V (R_i = 200 kΩ) -10V to +10V (joystick control) *Select V or mA with jumper block X2* (**Figure 4-3**) Differential input if not connected to ground; allows ±20V differential mode voltage to GND
6	24 V_{out}	24V control voltage (bi-directional)	±15%, 250 mA (all boards total); 150 mA (max. current from single board); Can be used as external power backup for the control (and fieldbus); Galvanically connected to terminal #12
7	GND	I/O ground	Ground for reference and controls; Galvanically connected to terminals #13, 19
8	DIA1	Digital input 1	R_i = min. 5 kΩ
9	DIA2	Digital input 2	
10	DIA3	Digital input 3	
11	CMA	Digital input common A for DIN1, DIN2 and DIN3	Must be connected to GND or 24V of I/O terminal or to external 24V or GND. Selection with jumper block X3. (**Figure 4-3**)
12	24 V_{out}	24V control voltage (bi-directional)	Same as terminal #6; Galvanically connected to terminal #6
13	GND	I/O ground	Same as terminal #7; Galvanically connected to terminals #7 & 19
14	DIB4	Digital input 4	R_i = min. 5 kΩ
15	DIB5	Digital input 5	
16	DIB6	Digital input 6	
17	CMB	Digital input common B for DIN4, DIN5 and DIN6	Must be connected to GND or 24V of I/O terminal or to external 24V or GND. Select with jumper block X3. (**Figure 4-3**)
18	A01+	Analog signal (+output)	Output signal range: 0 – 10V default Current: 0(4) – 20 mA, RL max 500 Ω or Voltage: 0 – 10V, RL >1 kΩ Selection with jumper block X6. (**Figure 4-3**)
19	A01-	Analog output common	Maximum V_{in} = 48V DC; Galvanically connected to terminals #7, 13
20	DO1	Digital output1	Open collector, Maximum current = 50 mA

October 2007
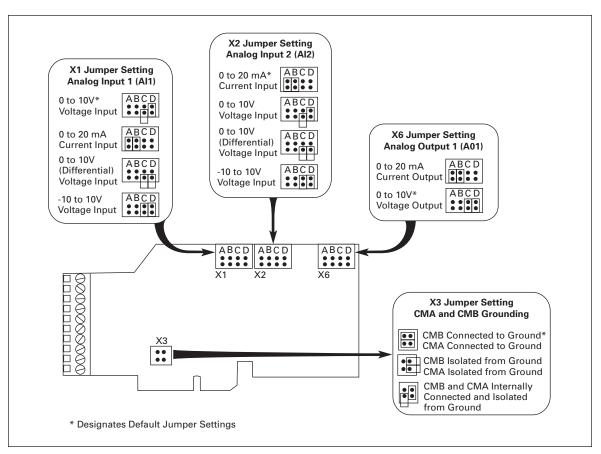
Figure 4-3: Option Board A9 Jumper Location and Settings

Wiring Option Board A2
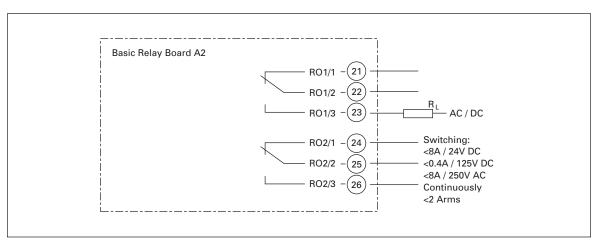
Figure 4-4: Option Board A2 Wiring Diagram

Table 4-4: Option Board A2 Terminal Descriptions

Terminal		Signal	Technical Information
21	RO1/1	Normally Closed (NC)	Switching Capacity: 24V DC / 8A 250V AC / 8A
22	RO1/2	Common	
23	RO1/3	Normally Open (NO)	125V DC / 0.4A Min Switching Load: 5V/10 mA Continuous Capacity: <2 Arms
24	RO2/1	Normally Closed (NC)	Switching Capacity: 24V DC / 8A 250V AC / 8A
25	RO2/2	Common	
26	RO2/3	Normally Open (NO)	125V DC / 0.4A Min Switching Load: 5V/10 mA Continuous Capacity: <2 Arms
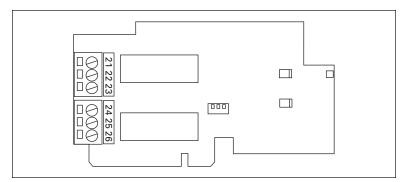
Figure 4-5: Option Board A2 Terminal Locations

Inverting the Digital Input Signal

The active signal level depends on which potential the common inputs CMA and CMB (terminals 11 and 17) are connected to. The alternatives are either +24V or ground (0V). See **Figure 4-6**.

The 24V control voltage and the ground for the digital inputs and the common inputs (CMA, CMB) can be sourced from either the internal 24V supply or an external supply.
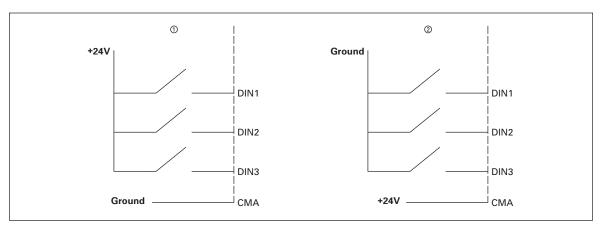
Figure 4-6: Positive/Negative Logic

[1] Positive logic (+24V is the active signal) = the input is active when the switch is closed.
[2] Negative logic (0V is the active signal) = the input is active when the switch is closed.

Chapter 5 — Menu Information

Keypad Operation
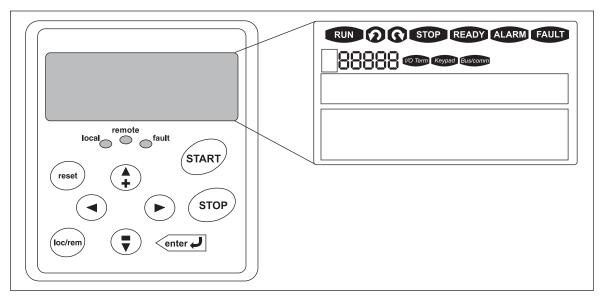
Figure 5-1: Keypad and Display

Table 5-1: LCD Status Indicators

Indicator	Description
RUN	**Run** Indicates that the SVX9000/SPX9000 is running and controlling the load. Blinks when a stop command has been given but the SVX9000/SPX9000 is still ramping down.
↺	**Counterclockwise Operation** The output phase rotation is BAC, corresponding to counterclockwise rotation of most motors.
↻	**Clockwise Operation** The output phase rotation is ABC, corresponding to clockwise rotation of most motors.
STOP	**Stop** Indicates that the SVX9000/SPX9000 is stopped and not controlling the load.
READY	**Ready** Indicates that the SVX9000/SPX9000 is ready to be started.
ALARM	**Alarm** Indicates that there is one or more active drive alarm(s).
FAULT	**Fault** Indicates that there is one or more active drive fault(s).
I/O Term	**I/O Terminal** Indicates that the I/O terminals have been chosen for control.
Keypad	**Keypad** Indicates that the keypad has been chosen for control.
Bus/comm	**Bus/Communications** Indicates that the communications bus control has been chosen for control.

Table 5-2: LED Status Indicators

Indicator	Description
local	**Local — Steady Illumination** Indicates that the SVX9000/SPX9000 is ready to be started and operated from the Local mode. **Local — Flashing** Indicates that the SVX9000/SPX9000 is ready for operating command to select Local or Remote operation.
remote	**Remote** Indicates that the SVX9000/SPX9000 is operating and controlling the load remotely.
fault	**Fault** Indicates that there is one or more active drive fault(s).

Table 5-3: Navigation Buttons

Button	Description
START	**Start** This button operates as the START button for normal operation when the "Keypad" is selected as the active control.
enter	**Enter** This button is used in the parameter edit mode to save the parameter setting and move to the next parameter … • to reset the Fault History if pressed while in the "Fault History" menu. • to confirm the acceptance of a change. • to change a virtual button status while in the "Button" menu. • to confirm the start-up list at the end of the Start-Up Wizard. • when the "Operate" menu is active, to exit the "Operate" submenu.
STOP	**Stop** This button has two integrated operations. The button operates as STOP button during normal operation … • motor STOP from the keypad, which is always active unless disabled by the "StopButtonActive" parameter. • used to reset the active faults.
reset	**Reset** Resets the active faults.
loc/rem	**Local / Remote** Switches between LOCAL and REMOTE control for start, speed reference and reverse functions. The control locations corresponding to local and remote can be selected within an application.

Table 5-3: Navigation Buttons (Continued)

Button	Description
◄	**Left Arrow** • navigation button, movement to left. • in parameter edit mode, exits mode, backs up one step. • cancels edited parameter (exit from a parameter edit mode). • When in "Operate" menu will move backward through menu. • At end of "Start-Up Wizard", repeats the "Start-Up Wizard" setup menu.
►	**Right Arrow** • navigation button, movement to right. • enter parameter group mode. • enter parameter mode from group mode. • When in "Operate" menu will move forward through menu.
▲+ ▼	**Up and Down Arrows** • move either up or down a menu list to select the desired menu item. • editing a parameter/password, while the active digit/character is scrolled. • increase/decrease the reference value of the selected parameter. • in the "Operate" menu, will cause the display of the current reference source and value and allow its change if the keypad is the active reference source. Used to set the password (if defined) when leaving the "Operate" menu. • scroll through the "Active Faults" menu when the SVX9000/SPX9000 is stopped.

Menu Navigation

Navigation Tips

- To navigate within one level of a menu, use the up and down arrows.

- To move deeper into the menu structure and back out, use the right and left arrows.

- To edit a parameter, navigate to show that parameter's value, and press the right arrow button to enter the edit mode. In edit mode, the parameter value will flash.

- When in edit mode, the parameter value can be changed by pressing the up or down arrow keys.

- When in edit mode, pressing the right arrow a second time will allow you to edit the parameter value digit by digit.

- To confirm the parameter change you must press the ENTER button. *The value will not change unless the ENTER button is pushed*.

- Some parameters can not be changed while the SVX9000/SPX9000 is running. The screen will display LOCKED if you attempt to edit these parameters while the drive is running. Stop the drive to edit these parameters. See the appropriate application manual for identification of these parameters specific to your chosen application.

Main Menu

The data on the control keypad are arranged in menus and submenus. The first menu level consists of M1 to M8 and is called the Main Menu. The structure of these menus and their submenus is illustrated in **Figure 5-2**. Some of the submenus will vary for each application choice.

Menu Navigation:

Up Arrow — The up arrow advances to the next menu item.
For example, pressing the up arrow once will advance from M1 to M2.

Down Arrow — The down arrow backs up to the previous menu item.
For example, pressing the down arrow once will back up from M2 to M1.

Right Arrow — The right arrow will advance to the next level in the menu.
For example, pressing the right arrow once will advance from M2 to R2.1.

Left Arrow — The left arrow will back up one level in the menu structure.
For example, pressing the left arrow once will back up from R2.1 to M2.

M1 Parameters
- G1.1
- . . .
- G1.x

M2 Keypad Control
- R2.1 Keypad Reference
- P2.2 Keypad Direction
- . . .
- P2.x Stop Button Active

M3 Active Faults
- A3.1 Active Fault 1
  - T3.1.1 Operation Days
  - . . .
  - T3.1.13 Zero Speed
- . . .
- A3.x Active Fault x

M4 Fault History
- H4.1 Most Recent Fault
  - T4.1.1 Operation Days
  - . . .
  - T4.1.13 Zero Speed
- . . .
- H4.1.x Oldest Saved Fault

M5 System Menu
- S5.1 Language
- S5.2 Application
- S5.3 Copy Parameters
- S5.4 Compare Parameters
- S5.5 Security
- S5.6 Keypad Settings
- S5.7 Hardware Settings
- S5.8 System Information

M6 Expander Boards
- G6.1 Slot A Board
- . . .
- G6.5 Slot E Board

M7 Monitor
- V7.1 Output Frequency - 0.00 Hz
- V7.2 Frequency Reference - 0.00 Hz
- . . .
- M7.1x Multimonitor
  - N7.1x.1

M8 Operate Mode
- O1 Output Frequency - 0.0 Hz
- O2 Freq Reference - 0.0 Hz
- . . .
- Ox   . . .

Figure 5-2: Main Menu Navigation

① Menu application dependent.

Parameter Menu (M1)

The Parameter Menu is a single or multi-level menu dependent upon the application in use, arranged by the parameter group items. **Figure 5-3** illustrates this for the Standard application. Parameters and parameter groups are explained in further detail in the appropriate application manual.

M1 Parameters Menu

G1.1 Basic Parameters
- P1.1.1 Minimum Frequency
- P1.1.2 Maximum Frequency
- . . .
- P1.1.16 Preset Speed 1

G1.2 Input Signals
- P1.2.1 Start/Stop Logic
- P1.2.2 DIN3 Function
- . . .
- P1.2.9 AI2 Signal Select

G1.3 Output Signals
- P1.3.1 A1out Signal
- P1.3.2 A1out Content
- . . .
- P1.3.17 A2out Scale

G1.4 Drive Control
- P1.4.1 Ramp 1 Shape
- P1.4.2 Ramp 2 Shape
- . . .
- P1.4.13 Flux Brake Current

G1.5 Skip Frequency
- P1.5.1 Skip F1 Low Limit
- P1.5.2 Skip F1 High Limit
- P1.5.3 PH Accel/Decel Ramp

G1.6 Motor Control
- P1.6.1 Motor Control Mode
- P1.6.2 V/Hz Optimization
- . . .
- P1.6.13 Identification

G1.7 Protections
- P1.7.1 4mA Input Fault
- P1.7.2 4mA Fault Frequency
- . . .
- P1.7.23 Slot Comm Fault Response

G1.8 Auto Restart
- P1.8.1 Wait Time
- P1.8.2 Trial Time
- . . .
- P1.8.10 Underload Tries

Figure 5-3: Parameter Menu Structure Example

Keypad Control Menu (M2)

In the Keypad Control Menu, you can set the frequency reference, choose the motor direction for keypad operation, and determine if the STOP button will be active at all times. See **Figure 5-4**.
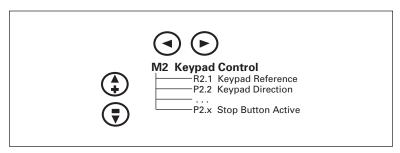
Figure 5-4: Keypad Control Menu

R2.1 **Keypad** **Reference**	Range: Min. Frequency — Max. Frequency Units: Hertz *KEYPAD REFERENCE* This displays and allows the operator to edit the keypad frequency reference. A change takes place immediately. This reference value will not influence the output frequency unless the keypad has been selected as the active control place.
P2.2 **Keypad** **Direction**	Range: Forward, Reverse Default: Forward *KEYPAD DIRECTION* This allows the operator to change the rotation direction of the motor. This setting will not influence the rotation direction of the motor unless the keypad has been selected as the active control place.
P2.3 ① **Stop Button** **Active**	Range: Yes, No Default: Yes *STOPBUTTONACTIVE* By default, pushing the STOP button will **always** stop the motor regardless of the selected control place. If this parameter is set to **No**, the **STOP** button will stop the motor only **when the keypad has been selected as the active control place**.

① This parameter number varies for different applications.

Active Faults Menu (M3)

When a fault occurs, the SVX9000/SPX9000 stops. The sequence indication F1, the fault code, a short description of the fault and the fault type symbol will appear on the display. In addition, the indication FAULT or ALARM is displayed and, in case of a FAULT, the red LED on the keypad starts to blink. If several faults occur simultaneously, the sequence of active faults can be browsed with the Browser buttons. See **Figure 5-5**.

The active faults memory can store the maximum of 10 faults in the sequential order of appearance. The fault remains active until it is cleared with either the STOP or RESET buttons or with a reset signal from the I/O terminal. Upon fault reset the display will be cleared and will return to the same state it was before the fault trip.
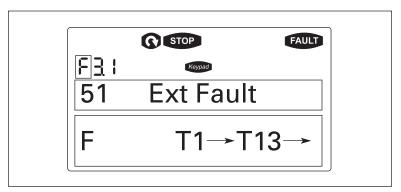
Figure 5-5: Active Fault Display Example

⚠ CAUTION

Remove any External Start signals or permissives before resetting the fault to prevent an unintentional restart of the SVX9000/SPX9000, which could result in personal injury or equipment damage.

Fault Type   Range: A, F, AR, FT

FAULT TYPE

There are four different types of faults. These faults and their definitions are given in **Table 5-4**.

Table 5-4: Fault Types

Fault Type	Fault Name	Description
A	Alarm	This type of fault is a sign of an unusual operating condition. It does not cause the drive to stop, nor does it require any special actions. The "A fault" remains in the display for about 30 seconds.
F	Fault	An "F fault" is a kind of fault that makes the drive stop. Actions need to be taken in order to restart the drive.
AR	Auto-Restart Fault	If an "AR fault" occurs the drive will also stop immediately. The fault is reset automatically and the drive tries to restart the motor. If the restart is not successful, a fault trip (FT) occurs.
FT	Fault Trip	If the drive is unable to restart the motor after an AR fault, an FT fault occurs. The effect of the "FT fault" is the same as that of the F fault — the drive is stopped.

Fault Code   Range: 1 – 54

Fault codes indicate the cause of the fault. A list of fault codes, their descriptions, and possible solutions can be found in **Appendix B — Fault and Warning Codes**.

Fault Time Data Record   Range: T.1 – T.13

In this menu, important data recorded at the time the fault is available. This feature is intended to help the user or the service person to determine the cause of fault. **Table 5-5** indicates the information that is recorded.

Table 5-5: Fault Time Data

Data	Units	Description
T.1 [1]	D	Counted operation days (Fault 43: Additional code)
T.2 [1]	hh:mm:ss (d)	Counted operation hours (Fault 43: Counted operation days)
T.3	Hz hh:mm:ss	Output frequency (Fault 43: Counted operation hours)
T.4	A	Motor current
T.5	V	Motor voltage
T.6	%	Motor power
T.7	%	Motor torque
T.8	V	DC bus voltage
T.9	°C	Unit temperature
T.10	—	Run status
T.11	—	Direction
T.12	—	Warnings
T.13	—	Zero speed

[1] Real time record.

If real time is set, T.1 and T.2 will appear as follows:

T.1	yyyy-mm-dd	Counted operation days (Fault 43: Additional code)
T.2	hh:mm:ss.sss	Counted operation hours (Fault 43: Counted operation days)

Fault History Menu (M4)

All faults are stored in the Fault History Menu, which can be viewed by using the Browser buttons. Additionally, the Fault time data record pages are accessible for each fault as in the Active Faults Menu described above. See **Figure 5-6**.

The SVX9000/SPX9000's memory can store a maximum of 30 faults, in the order of appearance. If there are 30 uncleared faults in the memory, the next occurring fault will erase the oldest fault from the memory.
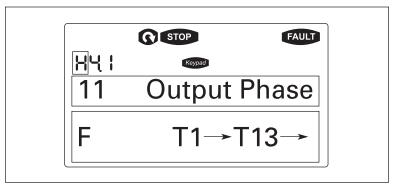
Figure 5-6: Sample Fault History Display

Note: Pressing the ENTER button for 3 seconds will clear the entire fault history.

System Menu (M5)

The controls associated with the general use of the drive, such as application selection, customized parameter sets or information about the hardware and software are located in the System Menu. Password protection can be activated by parameter **S5.5.1**.

Descriptions of the system menu parameters are illustrated in **Figure 5-7**.
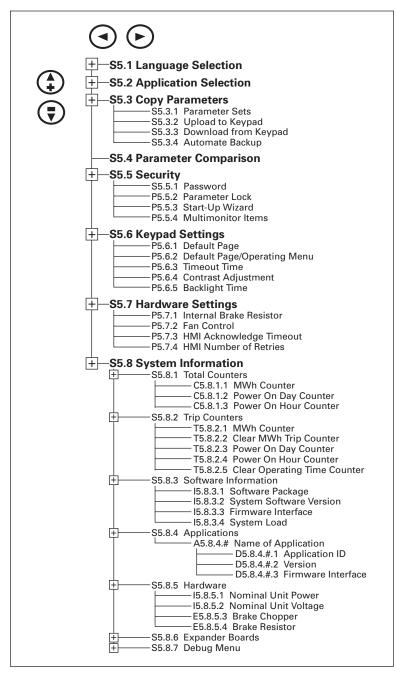
Figure 5-7: System Menu Structure

System Menu Parameters

S5.1 **Language** **Selection**	Range: English, Spanish, French, Portuguese Default: English *LANGUAGE* This parameter offers the ability to control the SVX9000/SPX9000 through the keypad in the language of your choice. Available languages are: English, Spanish, French and Portuguese.
S5.2 **Application** **Selection**	Default: Basic *APPLICATION* This parameter sets the active application. When changing applications, you will be asked if you want the parameters of the new application to be uploaded to the keypad. If you wish to load the new application parameters, push the ENTER button. Pushing any other button saves the parameters of the previously used application in the keypad.

System Menu Copy Parameter Options (S5.3)

The parameter copy function is used when the operator wants to copy one or all parameter groups from one drive to another. All the parameter groups are first uploaded to the keypad, then the keypad is connected to another drive and then the parameter groups are downloaded to it (or possibly back to the same drive).

Note: Before any parameters can successfully be copied from one drive to another, the drive must be stopped when the parameters are downloaded to it.

S5.3.1 **Parameter** **Sets**	*PARAMETER SETS* This parameter allows you to reload the factory default parameter values, and to store and load two customized parameter sets.
S5.3.2 **Upload to** **Keypad**	*UP TO KEYPAD* This function uploads all existing parameter groups to the keypad.
S5.3.3 **Download** **from Keypad**	Range: 0 – 3 Default: 0 (All parameters) *DOWN FROM KEYPAD* This function downloads one or all parameter groups from the keypad to the drive. 0 All parameters 1 All, no motor 2 Application parameters
S5.3.4 **Automatic** **Backup**	Range: Yes, No Default: Yes *AUTO.BACKUP* This parameter activates and deactivates the parameter backup function. When the Parameter backup function is activated, the keypad makes a copy of the parameters and settings in the currently active application. When applications are changed, you will be asked if you wish the parameters of the **new** application to be uploaded to the keypad. For this to happen, push the ENTER button. If you wish to keep the copy of the parameters of the **previously used** application saved in the keypad push any other button. **Note**: Parameters saved in the parameter settings of S5.3.1 will be deleted when applications are changed. If you want to transfer the parameters from one application to another you have to upload them to the keypad first.

System Menu Parameter Comparison Options (S5.4)

S5.4 Parameter Comparison

PARAMETER COMPARISON

With the Parameter Comparison function, you can compare the actual parameter values to the values of your customized parameter sets and those loaded to the control keypad.

The actual parameter values are first compared to those of the customized parameter Set1. If no differences are detected, a "0" is displayed on the lowermost line of the keypad.

If any of the parameter values differ from those of the Set1 parameters, the number of the deviations is displayed together with symbol P (e.g. P1 ➔ P5 = five deviating values).

By pressing the right arrow button once again you will see both the actual value and the value it was compared to. In this display, the value on the Description line (in the middle) is the default value, and the one on the value line (lowermost line) is the edited value. You can also edit the actual value by pushing the Right Arrow button.

Actual values can also be compared to Set2, Factory Settings and the Keypad Set values.

Security Menu Parameter Options (S5.5)

Note: The Security submenu is protected with a password. Store the password in a safe place.

S5.5.1 Password

Range: 0 – 65535   Default: 0

PASSWORD

The application selection can be protected against unauthorized changes with the Password function. When the password function is enabled, the user will be prompted to enter a password before application changes, parameter value changes, or password changes.

By default, the password function is not in use. If you want to activate the password, change the value of this parameter to any number between 1 and 65535. The password will be activated after the Timeout time (***Timeout Time***) has expired.

To deactivate the password, reset the parameter value to 0.

P5.5.2 Parameter Lock

Range: ChangeEnable, ChangeDisabl   Default: ChangeDisabl

PARAMETER LOCK

This function allows the user to prohibit changes to the parameters. If the parameter lock is activated the text *LOCKED** will appear on the display if you try to edit a parameter value.

Note: This function does not prevent unauthorized editing of parameter values.

P5.5.3 Start-Up Wizard

Range: Yes, No   Default: No

START-UP WIZARD

The Start-Up Wizard facilitates commissioning the SVX9000/SPX9000. If selected active, the Start-Up Wizard prompts the operator for the language and application desired and then advances through the start-up parameter list. After completion it allows the user to repeat the Start-Up Wizard or return to the default page, the Operate Menu. The Start-Up Wizard in always active for the initial power up of the SVX9000/SPX9000.

P5.5.4 Multimonitor Items

Range: ChangeEnable, ChangeDisabl   Default: ChangeEnable

MULTIMON.ITEMS

The keypad display can display three actual monitored values at the same time. This parameter determines if the operator is allowed to replace the values being monitored with other values.

Keypad Settings (S5.6)

There are five parameters (*Default Page* to *Backlight Time*) associated with the keypad operation:

P5.6.1 **Default Page**	Default: 0

DEFAULT PAGE
This parameter sets the view to which the display automatically moves as the *Timeout Time* expires or when the keypad power is switched on. If the Default Page value is 0 this function is not activated, i.e. the last displayed page remains on the keypad display.

P5.6.2
Default Page
in the
Operating
Menu

DEFAULT PAGE/OM
Here you can set the location in the Operating menu to which the display automatically moves as the set *Timeout Time* expires, or when the keypad power is switched on. See setting of *Default Page* parameter above.

P5.6.3
Timeout Time

Range: 0 – 65,535   Default: 30
Units: Seconds
TIMEOUT TIME
The *Timeout Time* setting defines the time after which the keypad display returns to the *Default Page*.
Note: If the *Default Page* value is 0 the *Timeout Time* setting has no effect.

P5.6.4
Contrast
Adjustment

CONTRAST ADJUSTMENT
If the display is not clear, you can adjust the keypad contrast with this parameter.

P5.6.5
Backlight
Time

Range: 1 – 65,535 or Forever   Default: 10
Units: Minutes
BACKLIGHT TIME
This parameter determines how long the backlight stays on before going out. You can select any time between 1 and 65,535 minutes or "Forever".

Hardware Settings (S5.7)

The Hardware Settings submenu (S5.7) provides parameters for setting information on Internal brake resistor connection, Fan control, Keypad acknowledge timeout and Keypad retries.

P5.7.1 **Internal Brake** **Resistor** **Connection**	Range: Connected – Not Connected Default: Connected *INTERNBRAKERES* With this function you tell the SVX9000/SPX9000 whether the internal brake resistor is connected or not. If your drive has an internal brake resistor, the default value of this parameter is "Connected". However, if it is necessary to increase braking capacity by installing an external brake resistor, or if the internal brake resistor is disconnected, it is advisable to change the value of this function to "Not Connected" in order to avoid unnecessary fault trips. **Note**: The brake resistor is available as an option for all drives. It can be installed internally in frame sizes FR4 to FR6.
5.7.2 **Fan Control**	Range: Continuous, Temperature, First Start and Default: Continuous Calc Temp *FAN CONTROL* This function allows you to control the SVX9000/SPX9000's cooling fan. You can set the fan to run: 1 Continuous — fan runs continuously. 2 Temperature — based on the temperature of the unit. The fan is switched on automatically when the heatsink temperature reaches 60°C. The fan receives a stop command when the heatsink temperture falls to 55°C. The fan runs for about a minute after receiving the stop command or switching on the power, as well as after changing the value from "Continuous" to "Temperature". 3 First Start — after power up the fan is stopped until the run command is given and then fan runs continuously. This is mainly made for common DC-bus systems to prevent cooling fans to load charging resistors on power up moment. 4 Calc Temp — starting of cooling fan is based on calculated IGBT-temperature. When IGBT temp = 40°C, fan starts and when temp falls down to 30°C, fan stops. **Note**: The fan runs continuously, regardless of this setting, when the SVX9000/SPX9000 is in RUN state.

P5.7.3	Range: 200 – 5,000	Default: 200

Keypad Acknowledge Timeout

Units: mseconds

KEYPAD ACK TIMEOUT

This function allows the user to change the timeout of the Keypad acknowledgement time.

Note: If the SVX9000/SPX9000 has been connected to a PC with a serial cable, the default values of **Keypad Acknowledge Timeout** and **Number of Retries to Receive Keypad Acknowledgement** must not be changed.

If the SVX9000/SPX9000 has been connected to a PC via a modem and there is delay in transferring messages, the value of **Keypad Acknowledge Timeout** must be set according to the delay as follows:

Example:
- Transfer delay between the SVX9000/SPX9000 and the PC is found to be = 600 ms
- The value of Keypad Acknowledge Timeout is set to 1200 ms (2 x 600, sending delay + receiving delay)
- The corresponding setting is then entered in the [Misc] section of the file 9000XDrive.ini:

  Retries = 5

  AckTimeOut = 1200

  TimeOut = 5000

It must also be considered that intervals shorter than the **Keypad Acknowledge Timeout** time cannot be used in SVX9000/SPX9000 drive monitoring.

P5.7.4
Number of Retries to Receive Keypad Acknowledge-ment

Range: 1 – 10   Default: 5

KEYPAD RETRY

With this parameter you can set the number of times the drive will try to receive an acknowledgement when it has not been received within the acknowledgement time (**Keypad Acknowledge Timeout**) or if the received acknowledgement is faulty.

System Information (S5.8)

This section contains hardware and software information as well as operation information.

S5.8.1
Total Counters

TOTAL COUNTERS

In the **Total Counters** page you will find information related to the SVX9000/SPX9000 operating times, i.e. the total numbers of MWh, operating days and operating hours. See **Table 5-6**.

Unlike the counters for the **Trip Counters**, these counters cannot be reset.

Note: The Power On time counters, days and hours, operate whenever power is applied to the SVX9000/SPX9000.

Table 5-6: Total Counters

Number	Name	Description
C5.8.1.1	MWh counter	Megawatt hours total operation time counter
C5.8.1.2	Power On day counter	Number of days the SVX9000/SPX9000 has been supplied with power
C5.8.1.3	Power On hour counter	Number of hours the SVX9000/SPX9000 has been supplied with power

**S5.8.2
Trip Counters**

TRIP COUNTERS

The **Trip Counters** are counters whose values can be reset to zero. The resettable counters are shown in **Table 5-7**.

Table 5-7: Trip Counters

Number	Name	Description
T5.8.2.1	MWh counter	Megawatts hours since last reset
P5.8.2.2	Clear MWh counter	Resets megawatts hours counter
T5.8.2.3	Power On day counter	Number of days the SVX9000/SPX9000 has been run since the last reset
T5.8.2.4	Power On hour counter	Number of hours the SVX9000/SPX9000 has been run since the last reset
P5.8.2.5	Clr Optime cntr	Resets the operating day and hour counters

Note: The **Trip Counters** operate only when the motor is running.

**S5.8.3
Software
Information**

SOFTWARE

The Software information page includes information on the following software related topics:

Table 5-8: Software Information

Number	Name	Description
I5.8.3.1	Software package	SVX00031V003
I5.8.3.2	System software version	11.53.6536
I5.8.3.3	Firmware interface	4.37
I5.8.3.4	System load	G9.1

**S5.8.4
Application
Information**

APPLICATIONS

The Application information page includes information on not only the application currently in use but also all other applications loaded into the SVX9000/SPX9000. The information available is shown in **Table 5-9**. Note that the "x" in the table refers to the sequential number of the application in the list.

Table 5-9: Application Information

Name	Content
A4.8.4.x	Application name
D4.8.4.x.1	Application ID
D4.8.4.x.2	Version
D4.8.4.x.3	Firmware interface

**S5.8.5
Hardware
Information**

HARDWARE

The Hardware information page provides information on the following hardware-related topics:

Table 5-10: Hardware Information

Number	Content
I5.8.5.1	Nominal power of the unit
I5.8.5.2	Nominal voltage of the unit
E5.8.5.3	Brake chopper
E5.8.5.4	Brake resistor

**S5.8.6
Expander
Board
Information**

EXPANDER BOARDS

This parameter and its sub-items provide information about the basic and option boards plugged into the control board as shown in **Table 5-11**. Note that the "x" in the table refers to the sequential number of the slot, with slot A being "1" and slot E being "5".

Table 5-11: Expander Board Information

Number	Content
E5.8.6.x	Slot "x" board identification
E5.8.6.x.1	Operating state
E5.8.6.x.2	Software version

**S5.8.7
Debug Menu**

DEBUG

This menu is meant for advanced users and application designers. Contact the factory for any assistance needed.

Expander Board Menu (M6)

The Expander Board Menu makes it possible for the user to:

● to see what expander boards are connected to the control board and

● to access and edit the parameters associated with the expander board.
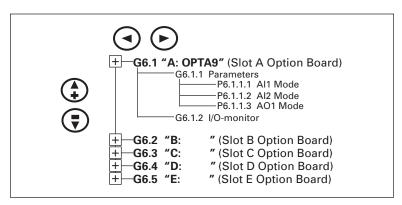
Figure 5-8: Expander Board Menu Structure

Example of Expander Board Parameters for Option Board A9

P6.1.1.1 **AI1 Mode**	Range: 1 – 5	Default: 3

AI1 MODE

Analog Input 1 input options:
1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V
5 -10 – +10VP

P6.1.1.2 **AI2 Mode**	Range: 1 – 5	Default: 1

AI2 MODE

Analog Input 2 input options:
1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V
5 -10 – +10VP

P6.1.1.3 **AO1 Mode**	Range: 1 – 4	Default: 1

AO1 MODE

Analog Output 1 output options:
1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V

Monitoring Menu (M7)

The Monitoring Menu items are meant for viewing parameter values during operation. Monitored values are updated every 0.3 sec. Monitored items are identified by item numbers V7.1 to V1.xx, where "xx" varies by application. **Table 5-12** provides an example of the monitored values for the **Standard** application.

Monitored parameters are not editable from this menu (See Parameter Menu [M1] to change parameter values).

Table 5-12: Monitoring Menu Items — Standard Application Example

Code	Signal Name	Unit	Description
V7.1	Output Frequency	Hz	Output frequency
V7.2	Frequency reference	Hz	Frequency reference setting
V7.3	Motor speed	rpm	Calculated motor speed
V7.4	Motor current	A	Measured motor current
V7.5	Motor torque	%	Calculated torque based on nominal motor torque
V7.6	Motor power	%	Calculated power based on nominal motor power
V7.7	Motor voltage	V	Calculated motor voltage
V7.8	DC bus voltage	V	Measured DC-bus voltage
V7.9	Unit temperature	°C	Heatsink temperature
V7.10	Calculated motor temperature	°C	Calculated motor temperature based on the motor nameplate information and the calculated motor load
V7.11	Analog Input 1	V	Voltage input at Terminals AI1+ and GND
V7.12	Analog Input 2	mA	Current input at Terminals AI2+ and AI2-
V7.13	DIN1, DIN2, DIN3	—	Digital input status (**Figure 5-9**)
V7.14	DIN4, DIN5,DIN6	—	Digital input status (**Figure 5-10**)
V7.15	DO1, RO2, RO3	—	Digital and relay output status (**Figure 5-11**)
V7.16	Analog I$_{out}$	mA	Current output at Terminals AO1+ and AO1-

```
V1.13
DIN1, DIN2, DIN3
OFF   ON    OFF
```
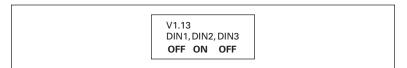
Figure 5-9: Digital Inputs — DIN1, DIN2, DIN3 Status

```
V1.14
DIN4, DIN5, DIN6
ON    OFF   OFF
```
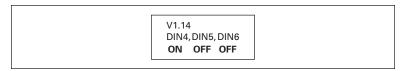
Figure 5-10: Digital Inputs — DIN4, DIN5, DIN6 Status

```
V1.15
DO1,  RO1,  RO2
OFF   OFF   ON
```
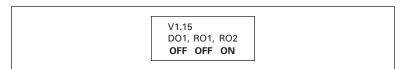
Figure 5-11: Digital and Relay Outputs — DO1, RO1, RO2 Status

Multimonitor (V7.17)

This parameter allows the viewing and selection (if allowed by System menu item, P5.5.4) of three simultaneously monitored items from the Monitored Menu Items shown in **Table 5-12**. Use the right arrow key to select the item to be modified and then the up or down arrow keys to select the new item. Press the ENTER key to accept the change.

Operate Menu (M8)

The Operate Menu provides a easy to use method of viewing key numerical Monitoring Menu items. Some applications also support the setting of reference values in this menu. The items displayed vary by application. **Table 5-13** is an example for the Standard application.

Table 5-13: Operate Menu Items — Standard Application Example

Code	Signal Name	Unit	Description
O.1	Output Frequency	Hz	Output frequency
O.2	FreqReference	Hz	Frequency reference
O.3	Motor Speed	rpm	Calculated motor speed
O.4	Motor Current	A	Measured motor current
O.5	Motor Torque	%	Calculated torque based on nominal motor torque
O.6	Motor Power	%	Calculated power based on nominal motor power
O.7	Motor Voltage	V	Calculated motor voltage
O.8	DC-Bus Voltage	V	Measured DC-bus voltage
O.9	Unit Temperature	°C	Heatsink temperature
O.10	MotorTemperature	%	Calculated motor temperature based on the motor nameplate information and the calculated motor load
R1	Keypad Reference	Hz	Keypad frequency reference setting

The menu is navigated by using the left and right arrow buttons. If a reference level is available for setting, the up and down arrow buttons adjust the value. To exit the Operate Menu to access the other menus, depress the ENTER button for 2 seconds. While in the other menus, if there is no keypad activity, the display will return to the Operate Menu after 30 seconds. **Figure 5-12** illustrates the Operate Menu button function.
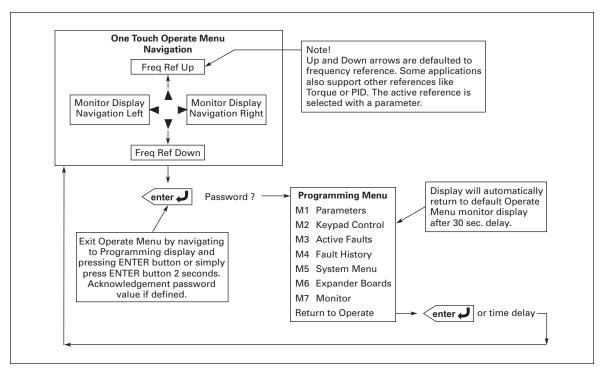
Figure 5-12: Operate Menu Navigation

Start-Up Wizard

Upon initial power up, the **Start-Up Wizard** guides the commissioner through the basic SVX9000/SPX9000 setup. The **Start-Up Wizard** may be set to function upon an application change by setting parameter P5.5.3.

Upon power up, the display will read:
"Startup Wizard"
"Press enter"

Upon pressing ENTER, the choice for the language to be used followed by the application desired are presented. The lists are navigated by using the right arrow and up and down arrow buttons. A selection is confirmed by pressing ENTER. After these two selections, the following text appears:
"Setup starts"
"Press enter"

When ENTER is pressed the setup parameter list is presented. The parameter value will be blinking allowing setting by the arrow buttons. The value is confirmed using the ENTER button, after which the next parameter in the list will be displayed.

After the last setup parameter is presented, the following text is displayed:
"Repeat setup?"
"Press ➔"

If the left arrow is pressed the Start-Up Wizard restarts. If the ENTER button is pressed the following is displayed:
"Setup done"

After this, the display returns to the default page, normally the Operate Menu.

Chapter 6 — Start-Up

Safety Precautions

Before start-up, observe the warnings and safety instructions provided throughout this manual.

⚠ WARNING

1   Internal components and circuit boards (except the isolated I/O terminals) are at utility potential when the SVX9000/SPX9000 is connected to the line. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it.

2   When the SVX9000/SPX9000 is connected to the utility, the motor connections U (T1), V (T2), W (T3) and DC-bus/brake resistor connections B–, B+ and R– are live even if the motor is not running.

3   Do not make any connections when the AF drive is connected to the utility line.

4   Do not open the cover of the AF drive immediately after disconnecting power to the unit, because components within the drive remain at a dangerous voltage potential for some time. Wait at least five minutes after the cooling fan has stopped and the keypad or cover indicators are dark before opening the SVX9000/SPX9000 cover.

5   The control I/O terminals are isolated from the utility potential, but relay outputs and other I/Os may have dangerous external voltages connected even if power is disconnected from the SVX9000/SPX9000.

6   Before connecting to the utility, make sure that the cover of the drive is closed.

Overview

The SVX9000/SPX9000 Control can be used to operate induction motors using the applications included in the system software delivered with the drive. Higher performance permanent magnet (PM) synchronous motors and other functions of the frequency converter (FC) are accomplished by loading special applications with the 9000XLoad software tool. The following sections describe how to commission the drive for motor control in all applications. See the All-in-One or special application manual for additional startup information or details on the parameters. Parameters are available (visible) based on the application selected, the type of control (SVX or SPX), the option boards installed in the control and the version of the system software loaded in the control. In general, the SVX controls are limited to V/Hz and open loop speed control of induction motors while the SPX control will work with any application and option board. Before starting the commissioning process, select the type of control, option boards, and size of the drive to meet the needs of the application and check that the latest system software is loaded. Open loop or sensorless control means motor control is accomplished by the standard drive unit without added speed/position feedback devices and associated option cards. Vector control means the drive can differentiate between torque producing and magnetizing current when reading motor phase currents. The "rotor flux oriented, current vector control" allows the AC drive to control an induction motor in the same manner as a separately excited DC motor.

Open Loop Vector Control Operations

The SVX9000/SPX9000 Control normally operates an induction motor in V/Hz or open loop vector control (speed control) mode. By default, the ID run is designed to automatically configure parameters for the programmable volts per Hertz (V/f) curve and make a stator resistance measurement for a standard induction motor. If the ID run does not give the proper performance, manual tuning of the control is described in later sections.

Frequency Controlled Application

For pumps and fans the application is usually frequency controlled and there is no need for high torque on low speed. A straight V/f curve ("linear" V/Hz ratio type) is all that is required for proper operation. Since pumps and fans are variable torque, selecting "Squared" for V/Hz ratio type will give some energy savings. Compensation for measured stator resistance voltage drop will improve performance and selecting "Auto Torque Boost" will help start the motor if necessary. The SLX/SVX controls will operate a PM motor open loop but manual tuning of the V/f curve is required.

Speed Controlled Application

When an application is speed controlled and high torque at low speed is needed, it is often necessary to complete the ID run; select auto torque boost to help start the motor and set the drive to speed control mode to compensate for the slip of the induction motor.

Closed Loop Vector Control Operations

Closed loop vector mode provides the best performance for speed and torque control; especially in low speed, high torque applications, including full torque at zero speed. The SPX is required for closed loop control with a speed or position feedback device. The closed loop ID run is similar to the open loop mode ID run.

PM Motor Control Operations

The SPX control can be used to control a synchronous PM motor open loop, or closed loop with a resolver or absolute encoder. Best low speed, high torque performance is achieved with a position feedback device. The High Performance Multi-purpose application has a selection for PM motor control. The PM motor Encoder ID run determines the zero position of the rotor and stores it to a parameter for use when the load is connected.

Sequence of Operation to Commission an Induction Motor

1. Read and follow all safety warnings and cautions in this manual.

2. At installation ensure:

   - That the SVX9000/SPX9000 and motor are connected to ground.

   - That the utility and motor cables are in accordance with the installation and connection instructions as detailed in **Chapter 3 — Power Wiring**.

   - That the control cables are located as far as possible from the power cables as detailed in **Chapter 4 — Control Wiring** and **Table 3-1**. That control cable shields are connected to protective ground. That no wires make contact with any electrical components in the SVX9000/SPX9000.

   - That the common input of each digital input group is connected to ground or +24V of the I/O terminal supply or an external supply as detailed here and **Figure 4-6**.

3. Check the quality of the cooling air as detailed in **Chapter 2 — Mounting**.

4. Check that moisture has not condensed inside the SVX9000/SPX9000.

5. Check that all START/STOP switches connected to the I/O terminals are in the STOP state.

6. Connect the SVX9000/SPX9000 to the utility and switch the power on. For the initial power up you will enter the **Start-Up Wizard**, which will guide you through application selection and basic parameter setup. See the **Start-Up Wizard** section at the end of **Chapter 5 — Menu Information** for more information. After completing the **Start-Up Wizard**, proceed to step 8. If this is not the initial power up, the keypad will default to the Operate Menu. Depress the ENTER button for 2 seconds to enter the Parameter Menu. Proceed to step 7.

7. Ensure that the Group 1 parameters match the application by setting — at minimum, the following parameters to match the motor nameplate:

- Nominal voltage of the motor.
- Nominal nameplate frequency of the motor.
- Nominal nameplate full load speed of the motor.
- Motor nominal current.
- Motor power factor.
- Motor type (Select PM motor in Group 6 of special app)

8. Perform either Test A or Test B without the motor connected to the SVX9000/SPX9000.

   Test A — Control from the Control Panel

   - Apply input power to the SVX9000/SPX9000.
   - Press the keypad START button.
   - If not in the Operate Menu, go to the Monitoring Menu and check that the output frequency follows the keypad reference.
   - Press the keypad STOP button.

   Test B — Control from the I/O Terminals

   - Apply input supply power to the SVX9000/SPX9000.
   - Change control from the keypad to the I/O terminals using the LOCAL/REMOTE button.
   - Start the drive by closing the START/STOP input on DIN1.
   - Change the frequency reference setting on AI1.
   - If not in the Operate Menu, go to the Monitoring Menu and check that the output frequency follows the frequency reference.
   - Stop the drive by opening the START/STOP input on DIN1.

9. Disconnect all power to the SVX9000/SPX9000. Wait until the cooling fan on the unit stops and the indicators on the panel are not lit. If no keypad is present, check the indicators in the control panel cover. Wait at least five more minutes for the DC bus to discharge. Connect the motor to the SVX9000/SPX9000. If possible, perform a startup test or ID run with the motor connected to the SVX9000/SPX9000 but not connected to the process. If the SVX9000 must be tested with the motor connected to the process, perform it under no-load conditions.

10. Repeat test 8A or 8B to check operation of the motor without the process or load. Note for proper motor current, voltage and direction of shaft rotation. If an encoder card is installed, set encoder parameters in the expander board menu and monitor frequency and speed from the encoder board. Frequency should match output frequency of the drive with a positive value for forward direction. If encoder frequency is opposite; change motor phase order, encoder connection or select "invert" on the expander board menu. For many pump or fan applications, no tuning is required. If further tuning is necessary, perform the tuning while the motor is disconnected from the process.

11. Perform ID Run. Setting the identification parameter to the appropriate value Par/group P1.6.16 followed by a start command within 20 seconds activates automatic identification. (See test 8A or 8B for start command.) Upon completion, cancellation by a stop command or if timely start is not received, the parameter will reset to its default setting. Possible ID run selections are as follows:

   ● OL V/f Ratio — The drive is run at zero speed to identify the motor parameters. (Earlier system software version.)

   ● OL V/f +Boost — The drive is run at zero speed to identify the motor parameters and automatic torque boost is turned on. (Earlier system software version.)

   ● Identification without motor run — The drive is run at zero speed to identify the motor parameters.

   ● Identification with motor run — The drive is run at 2/3 rated speed to identify the motor parameters. (No load on motor.)

   ● Encoder ID run — Identifies the shaft zero position when using PM motor with absolute encoder or resolver feedback.

12. When ID Run is complete as shown by a stop indication on the keypad, reset the drive with a stop command according to Test 8A or 8B. Set the motor control mode to OL Speed Control, CL Speed Control if appropriate for the application and repeat Test 8A or 8B.

13. If necessary, skip to the next section to perform manual tuning functions before connecting the motor to the process.

14. Disconnect all power to the SVX9000/SPX9000. Wait until the cooling fan on the unit stops and the indicators on the panel are not lit. If no keypad is present, check the indicators in the control panel cover. Wait at least five more minutes for the DC bus to discharge. Connect the motor to the driven load making sure mechanical system requirements are met. Make sure that the driven load can be run safely and that no hazard exists to any personnel. Repeat test 8A or 8B.

Manual Tuning of the SVX9000/SPX9000

Proper tuning of the open loop speed control will give better torque control accuracy for improved motor performance. The aim of tuning is to get the motor model as close to the actual motor as possible through proper setting of parameters. Open loop tuning consists of three functions, 1) V/f curve tuning, 2) stator resistance measurement, and 3) compensation for slip.
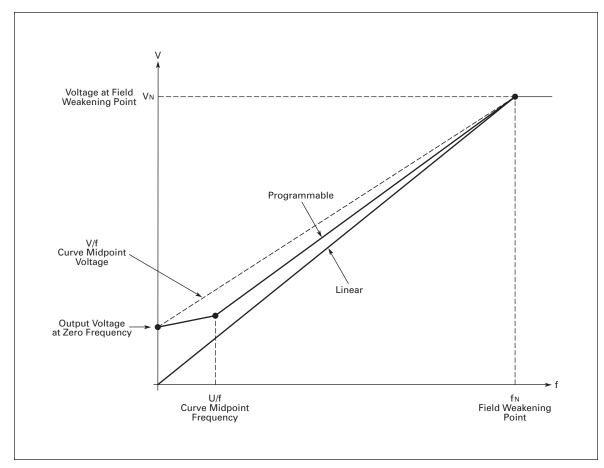
Figure 6-1: Open Loop Tuning

V/f- Curve Manual Tuning

When tuning the V/f — curve manually (not using identification run) the motor shaft must be unloaded and the motor control mode set to frequency control (P1.6.1). The following parameters are adjusted to tune the V/f curve:

Parameters

V/f ratio selection	P1.6.3
Field weakening point	P1.6.4
Voltage at field weakening point	P1.6.5
V/f curve midpoint frequency	P1.6.6
V/f curve midpoint voltage	P1.6.7
Output voltage at zero frequency	P1.6.8

When using a linear V/f curve with increased zero frequency voltage ensure that the motor current does not increase too much between 3 – 7 Hz.

Tuning Steps

Set the motor nameplate values.

Nominal voltage of motor	P1.1.6
Nominal frequency of motor	P1.1.7
Nominal speed of motor	P1.1.8
Nominal current of motor	P1.1.9
Motor Power Factor (Cos Phi)	P1.1.10

Run the motor unloaded at 2/3 rated speed using a frequency reference. Read the motor current from the monitoring menu (V7.4) or use 9000XDrive for monitoring. This current is the motor magnetizing current. This value should match a nameplate magnetizing current value if given.

If the motor will only be run in closed loop, skip to section on closed loop vector control tuning.

Change the V/f- curve ratio selection to programmable-mode = 2 (P1.6.3).

Run motor with zero frequency reference and increase motor zero point voltage (P1.6.8) until motor current is approximately same as the motor magnetizing current. (If motor is only in the low frequency area for short periods, it is possible to use up to 80% of rated current).

Set then the midpoint voltage (P1.6.7) to 1.4142*P1.6.8 ($\sqrt{2}$ * Zero Point Voltage) and midpoint frequency (P1.6.6) to value P1.6.8/100%*P1.1.7. ([ZeroPoint Voltage/100%]*Nominal frequency of motor.)

$$P1.6.7 = \sqrt{2} * P1.6.8 \qquad P1.6.6 = \frac{P1.6.8}{100} * P1.1.7$$

Hint for the 9000X Drive user:

When zero point voltage is set correctly, run motor with slow ramp (~20 s) to 1/2 of rated frequency. Show output frequency and motor current in the 9000XDrive monitoring window. If midpoint parameters are set correctly, motor current should be stable during acceleration. (Picture 2: heavy solid line).

If there is a peak in the monitored motor current, (heavy dashed in picture 2.) check what the output frequency is at the max current point, and set this value for midpoint frequency (P1.6.6). Then readjust midpoint voltage for a stable current performance during acceleration.
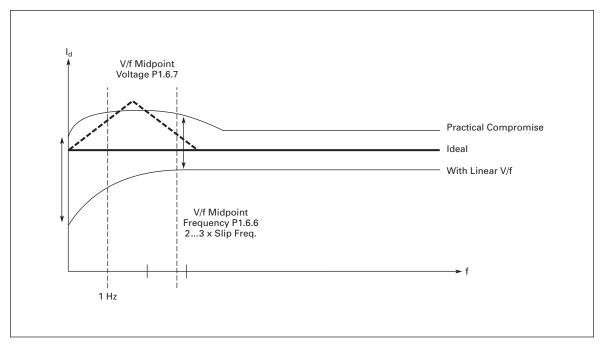
Figure 6-2: Motor Current after V/f-Curve Tuning

Stator Resistance Measurement Using Dc-brake at Start

1. Define the DC-brake current (=motor nominal current) (P1.4.8).

2. Set the DC-brake time at start to 2 seconds (P1.4.11).

3. Give start command.

The drive will correct the stator impedance to improve the motor torque calculation. This also improves slip compensation accuracy. (Stator resistance voltage loss compensation, see picture 3.)

If the DC-brake time at start is set back to zero, the calculated stator impedance value goes back to default if the drive's power is switched off. (Identification will retain all values in memory.)
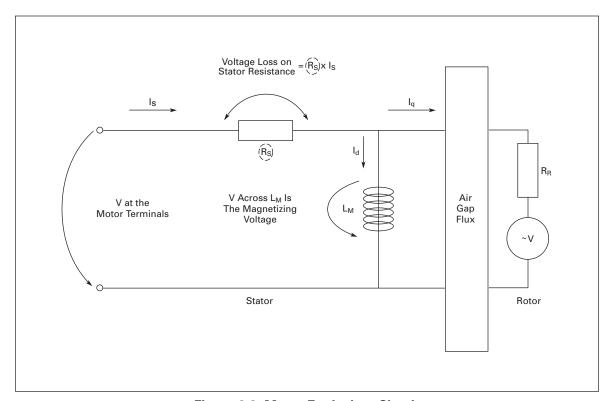
Figure 6-3: Motor Equivalent Circuit

Change the motor control mode to the speed control (P1.6.1 = 1)

Change the V/f-optimization (Auto Torque Boost) to on if more torque is needed on low frequencies (P1.6.2). Note, this will increase motor voltage while loading motor, check motor current draw.

Note: In high torque — low speed applications — it is likely that the motor will overheat. If the motor has to run a prolonged time under these conditions, special attention must be paid to cooling the motor.

Slip Compensation In Open Loop

The drive uses motor torque and motor nominal RPM to compensate slip. If motor nominal RPM is 1710 -> nominal slip is 90 RPM. And when motor torque is 50% slip is 45 RPM. To keep reference speed drive must increase output frequency by:

$$\frac{50\% * 90 \text{ RPM}}{1500 \text{ RPM}} * 50{,}00 \text{ Hz} = 1{,}50 \text{ Hz}$$
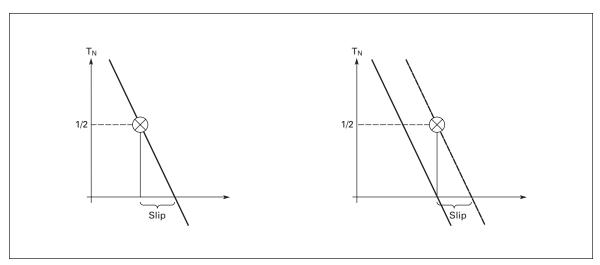
Figure 6-4: Left: OL Speed Control Off. Right: OL Speed Control ON.

Closed Loop Vector Control Manual Tuning (SPX9000 Only)

For some non-standard motors the auto-tune is not sufficient. Closed lop control mode is used, when enhanced performance near zero speed and better steady stats and dynamic speed accuracy at higher speeds are needed.

Tuning Steps

Set the motor nameplate values.

Nominal voltage of motor	P1.1.6
Nominal frequency of motor	P1.1.7
Nominal speed of motor	P1.1.8
Nominal current of motor	P1.1.9
Motor Power Factor (Cos Phi)	P1.1.10

Check encoder Pulse/Revolution rate and set this value to expander menu P6.3.1.1. Parameter is only visible if OPTA4 or OPTA5 is installed to slot C.

Set motor control mode to open loop frequency control (P1.6.1 = 0).

Run the motor unloaded at 2/3 rated speed using a frequency reference. Read the motor current from the monitoring menu (V1.4) or use 9000X Drive for monitoring. This current is the motor magnetizing current. This value should match a nameplate magnetizing current value if given.

Check the expander board menu (monitoring page V6.3.2.1), that the encoder frequency is approximately the same as the output frequency. Check also, that the direction is correct. If the encoder frequency direction is opposite the output frequency (negative value), change the motor phase order to encoder connection. The expander board menu also has a parameter to invert the signal if rewiring is not an option.

Set motor control mode to closed loop (P1.6.1 = 3 or 4).

Set the motor magnetizing current P1.6.17.1 (measured in step 4).

Fine Tuning

Tune parameter P1.6.17.6 (Slip Adjust) to get the motor voltage slightly above the linear V/f-curve when motor is loaded and slightly below when motor is generating.

Using the linear V/f-curve (P1.6.3 = 0), run the motor in frequency control mode (P1.6.1 = 0) at about 2/3 of the motor nominal frequency and check motor voltage (V7.7).

At 40 Hz, voltage should be 40/60*460V = 307V.

Run the motor in closed loop control mode with same reference and check the motor voltage. Adjust P1.6.17.6 (Slip Adjust) so that motor voltage is slightly above the linear V/f-curve. If motor voltage is low, decrease the value of Slip Adjust (P1.6.17.6).
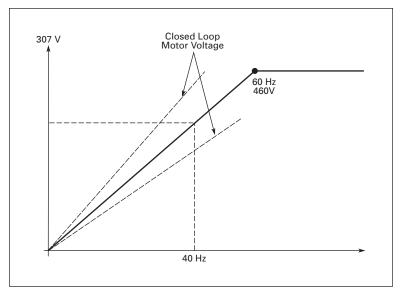
Figure 6-5: Closed Loop Motor Voltage

Adjust the following parameters for optimum performance in closed loop mode:

Fine Tuning Parameters

613   Speed control P gain

Sets the gain for the speed controller in % per Hz. 100 means nominal torque with 1 Hz frequency error.

614   Speed control I time

Sets the integral time constant for the speed controller. Too short integration time makes the control unstable.

620   Load drooping

Setting a proper value to the LoadDrooping parameter enables the load drooping. This function causes the speed to decrease as the load torque increases. At rapid load changes this gives a smoother torque response, when a part of the required power is taken from the system inertia. This operation causes a constant, torque-dependent steady-state error in speed response.

626   Acceleration compensation

Sets the inertia compensation to improve speed response during acceleration and deceleration. The time is defined as acceleration time to nominal speed with nominal torque. This parameter is active also in advanced open loop mode.

627   Magnetizing current at start

628   Magnetizing time at start

These parameters are certain type of DC-brake in start. With these parameters it is possible to shorten the time needed to fully magnetize the motor, especially when motor is big.

615 Zero speed time at start

After giving the start command the drive will remain at zero speed for the time defined by this parameter. The ramp is released to follow the set frequency/speed reference after this time has elapsed.

616 Zero speed time at stop

The drive will remain at zero speed with controllers active for the time defined by this parameter after reaching the zero speed when a stop command is given. This parameter has no effect, if the selected stop function (P1.4.7) is coasting.

621 Start-up torque

This parameter selects the start-up torque.

Torque Memory is used in crane applications. Start-up Torque FWD/REV can be used in other applications to help the speed controller.

0 = Not Used
1 = TorqMemory
2 = Torque Ref
3 = Torq.Fwd/Rev

633 Start-up torque, forward

Sets the start-up torque for forward direction, if selected with par. 1.6.17.12.

634 Start-up torque, reverse

Sets the start-up torque for reverse direction, if selected with par. 1.6.17.13.

107 Current limit

This parameter determines the maximum motor current from the frequency converter. The parameter value range differs from size to size. On closed loop control mode this limits torque (= torque producing current).

For example, if motor magnetizing current is 2.0 A and current limit is 1.0 A, total motor current can be:

I (Total Current)

I_q (Torq. Producing Current) = 1.0 A

I_d (Magnetising Current) = 2.0 A

$$I^2 = I_d{}^2 + I_q{}^2$$
$$I = \sqrt{I_d{}^2 + I_q{}^2}$$

$\longrightarrow$ I = 2.24 A
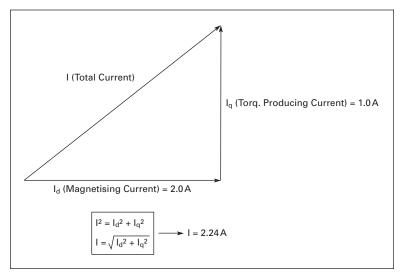
Figure 6-6: Closed Loop Current Limit

October 2007

Appendix A — Technical Data

General

Figure A-1 shows a block diagram of the SVX9000/SPX9000 drive. The SVX9000/SPX9000 physically consists of two sections, the Power Unit and the Control Unit. The three-phase **AC Choke** with the **DC-Link Capacitor** form a LC filter which together with the **Rectifier** produce the DC voltage for the **IGBT Inverter** block. The **AC Choke** smooths the disturbances from the utility into the SVX9000/SPX9000 as well as the high frequency disturbances caused by the SVX9000/SPX9000 on the utility line. It also improves the input current waveform to the SVX9000/SPX9000. The **IGBT Inverter** produces a symmetrical three-phase pulse width modulated adjustable frequency AC voltage to the motor.

The **Motor and Application Control** block contains a microprocessor with customized software. The microprocessor controls the motor based on **Measured Signals**, parameter value settings and commands from the **Control I/O Block** and the **Control Module**. The **Motor and Application Control** block commands the **Motor Control ASIC** which calculates the IGBT switching positions. **Gate Drivers** amplify these signals for driving the **IGBT Inverter**.

The **Control Keypad** is a link between the user and the SVX9000/SPX9000. With the **Control Keypad** the user can set parameter values, read status information and issue control commands. The **Control Keypad** is removable and can be mounted externally and connected with the appropriate cable. Instead of the **Control Keypad**, a PC can be used to control the SVX9000/SPX9000 by cable connecting it where the **Control Keypad** is normally connected or through an option board.

The **Control I/O Block** is isolated from line potential and may be connected to or isolated from ground by the choice of the control I/O board which is used. OPTA8 is isolated ground, OPTA1 and OPTA9 are not.

Input and Output EMC-Filters are not required for the functionality of the SVX9000/SPX9000. They are only needed for compliance with the EU EMC directive as detailed in the following section.
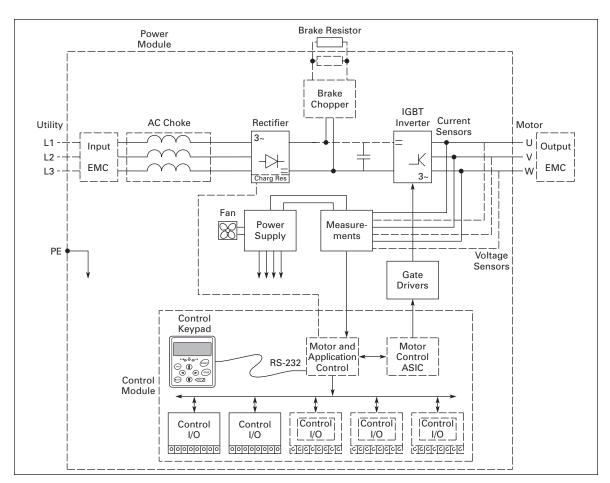
Figure A-1: SVX9000/SPX9000 Block Diagram

Specifications

Table A-1: SVX9000/SPX9000 Drive Specifications

Description	Specification
Power Connections	
Input Voltage (V_{in})	208 – 240V +10%/-15% 380 – 500V +10%/-15% 525 – 690V +10%/-15%
Input Frequency (f_{in})	50/60 Hz (variation up to 45 – 66 Hz)
Connection to Utility Power	Once per minute or less (typical operation)
Maximum Symmetrical Supply Current	208 – 240V, 100 kAIC 380 – 500V, 100 kAIC 525 – 690V, 100 kAIC
Motor Connections	
Output Voltage	0 to V_{in}
Continuous Output Current	Ambient temperature max. +122°F (+50°C), overload 1.5 x I_L (1 min. out of 10 min.)
Starting Current	200% for 2 seconds
Output Frequency	0 to 320 Hz
Frequency Resolution	0.01 Hz

Table A-1: SVX9000/SPX9000 Drive Specifications (Continued)

Description	Specification
Control Characteristics	
Control Method	SVX Frequency Control (V/f) SVX Open Loop Sensorless Vector SPX Open Loop Sensorless Vector Control SPX Closed Loop Control

Switching Frequency	Adjustable with Parameter 2.6.9
	208 – 230V: 3/4 – 15 hp: 1 to 16 kHz; default 10 kHz
	             20 – 30 hp: 1 to 10 kHz; default 3.6 kHz
	380 – 500V: 1 – 30 hp: 1 to 16 kHz; default 10 kHz
	             40 – 200 hp: 1 to 10 kHz; default 3.6 kHz
	525 – 690V All Sizes: 1 to 6 kHz; default 1.5 kHz

Frequency Reference	Analog Input: Resolution 0.1% (10-bit), accuracy ±1% Panel Reference: Resolution 0.01 Hz
Field Weakening Point	30 to 320 Hz
Acceleration Time	0.1 to 3000 sec.
Deceleration Time	0.1 to 3000 sec.
Braking Torque	DC brake: 15% to 150% x T_n (without brake option)
Environment	
Ambient Operating Temperature	14°F (-10°C), no frost to 122°F (+50°C)
Storage Temperature	-40°F (-40°C) to 158°F (70°C)
Relative Humidity	0 to 95% RH, non-condensing, 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 3300 ft. (1000m); 1% derating for each 330 ft. (100m) above 3300 ft. (1000m); max. 10000 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 1 G 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 available all ratings NEMA 12/IP54 available all ratings
Standards	
EMC (at default settings)	Immunity: Fulfils all EMC immunity requirements Emissions: EN 61800-3
Safety	UL 508C
Product	IEC 61800-2
Control Connections	
Analog Input Voltage	0 to 10V, R – 200 kΩ differential (-10 to 10V joystick control) Resolution 0.1%; accuracy ±1%
Analog Input Current	0(4) to 20 mA; R_i – 250Ω differential
Digital Inputs (6)	Positive or negative logic; 18 to 24V DC
Auxiliary Voltage	+24V ±15%, max. 250 mA
Output Reference Voltage	+10V +3%, max. load 10 mA

Table A-1: SVX9000/SPX9000 Drive Specifications (Continued)

Description	Specification
Control Connections (Continued)	
Analog Output	0(4) to 20 mA; R_L max. 500Ω; Resolution 10 bit; Accuracy ±2% or 0 to 10 V, R_L 1 kΩ, select with jumper
Digital Outputs	Open collector output, 50 mA/48V
Relay Outputs	3 programmable change-over relay outputs Switching capacity: 24V DC / 8A, 250V AC / 8A, 125V DC / 0.4A Minimum switching load: 5V/10 mA Continuous capacity: < 2 A_{rms}
Protections	
Overcurrent Protection	Yes
Undervoltage Protection	Yes
Ground (Earth) Fault	In case of a ground fault in the motor or motor cables, only the SVX9000/SPX9000 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 of the +24V and +10V Reference Voltages	Yes

Power Ratings

Table A-2: Output Power Ratings — 230V I_H

Catalog Number [1][2]	Frame Size	Three-Phase Input	
		Horsepower	Current
SVXF07Ax-2A_1	FR4	3/4	3.7
SVX001Ax-2A_1		1	4.8
SVXF15Ax-2A_1		1-1/2	6.6
SVX002Ax-2A_1		2	7.8
SVX003Ax-2A_1		3	11.0
SVX005Ax-2A_1	FR5	5	17.5
SVX007Ax-2A_1		7-1/2	25.
SVX010Ax-2A_1	FR6	10	31.
SVX015Ax-2A_1		15	48.
SVX020Ax-2A_1	FR7	20	61.
SVX025Ax-2A_1		25	75.
SVX030Ax-2A_1		30	88.

[1] Insert a **1** for NEMA Type 1 or a **2** for NEMA Type 12 in place of the **x** in the Catalog Number.

[2] For SPX drives change SVX prefix to SPX.

October 2007

Table A-3: Output Power Ratings — 480V I_H

Catalog Number [1][2]	Frame Size	Three-Phase Input	
		Horsepower	Current
SVX001x-4A_1 SVXF15x-4A_1 SVX002x-4A_1 SVX003x-4A_1 SVX005x-4A_1	FR4	1 1-1/2 2 3 5	2.2 3.3 4.3 5.6 7.6
SVX007x-4A_1 SVX010x-4A_1 SVX015x-4A_1	FR5	7-1/2 10 15	12. 16. 23.
SVX020x-4A_1 SVX025x-4A_1 SVX030x-4A_1	FR6	20 25 30	31. 38. 46.
SVX040x-4A_1 SVX050x-4A_1 SVX060x-4A_1	FR7	40 50 60	61. 72. 87.
SVX075x-4A_1 SVX100x-4A_1 SVX125x-4A_1	FR8	75 100 125	105. 140. 170.
SVX150x-4A_1 SVX200x-4A_1	FR9	150 200	205. 245.

[1] Insert a **1** for NEMA Type 1 or a **2** for NEMA Type 12 in place of the **x** in the Catalog Number.

[2] For SPX drives change SVX prefix to SPX.

Table A-4: Output Power Ratings — 480V SPX FR10 – FR14

Catalog Number	Frame Size [3]	hp (I_H)	Current (I_H)	hp (I_L)	Current (I_L)
SPX250A0-4A2N1 SPX300A0-4A2N1 SPX350A0-4A2N1	FR10	250 300 350	330 385 460	300 — 400	385 460 520
SPX400A0-4A2N1 SPX500A0-4A2N1 SPX550A0-4A2N1	FR11	400 500 —	520 590 650	500 — 600	590 650 730
SPX600A0-4A2N1 SPX650A0-4A2N1 SPX700A0-4A2N1	FR12	600 — 700	730 820 920	— 700 800	820 920 1030
SPX800A0-4A2N1 SPX900A0-4A2N1 SPXH10A0-4A2N1	FR13	800 900 1000	1030 1150 1300	900 1000 1200	1150 1300 1450
SPXH12A0-4A2N1 SPXH16A0-4A2N1 SPXH19A0-4A2N1	FR14	1200 1600 1900	1600 1940 2300	1500 1800 2200	1770 2150 2700

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

Table A-5: Output Power Ratings — 575V I$_H$

Catalog Number [1]	Frame Size	Three-Phase Input	
		Horsepower	Current
SVX002A1-5A4N1	FR6	2	3.33
SVX003A1-5A4N1		3	4.5
SVX004A1-5A4N1		—	5.5
SVX005A1-5A4N1		5	7.5
SVX007A1-5A4N1		7-1/2	10.
SVX010A1-5A4N1		10	13.5
SVX015A1-5A4N1		15	18.
SVX020A1-5A4N1		20	22.
SVX025A1-5A4N1		25	27.
SVX030A1-5A4N1	FR7	30	34.
SVX040A1-5A4N1		40	41.
SVX050A1-5A4N1	FR8	50	52.
SVX060A1-5A4N1		60	62.
SVX075A1-5A4N1		75	80.
SVX100A1-5A4N1	FR9	100	100.
SVX125A1-5A4N1		125	125.
SVX150A1-5A4N1		150	144.
SVX175A1-5A4N1		—	170.

[1] For SPX drives change SVX prefix to SPX.

Table A-6: Output Power Ratings — 575V SPX FR10 – FR14

Catalog Number	Frame Size [2]	hp (I$_H$)	Current (I$_H$)	hp (I$_L$)	Current (I$_L$)
SPX200A0-5A2N1	FR10	200	208	250	261
SPX250A0-5A2N1		250	261	300	325
SPX300A0-5A2N1		300	325	400	385
SPX400A0-5A2N1	FR11	400	385	450	460
SPX450A0-5A2N1		450	460	500	502
SPX500A0-5A2N1		500	502	—	590
SPX550A0-5A2N1	FR12	—	590	600	650
SPX600A0-5A2N1		600	650	700	750
SPX700A0-5A2N1		700	750	800	820
SPX800A0-5A2N1	FR13	800	820	900	920
SPX900A0-5A2N1		900	920	1000	1030
SPXH10A0-5A2N1		1000	1030	1250	1180
SPXH13A0-5A2N1	FR14	1350	1300	1500	1500
SPXH15A0-5A2N1		1500	1500	2000	1900
SPXH20A0-5A2N1		2000	1900	2300	2250

[2] FR10 – FR14 includes a 3% line reactor but it is not integral to chassis.

Power Loss and Switching Frequency

In some situations it may be desirable to change the switching frequency of the SVX9000/SPX9000 for some reason (typically e.g. to reduce the motor noise). Raising the switching frequency above the factory default level increases the drive power loss and increases the cooling requirements, **Figures A-2** through **A-7** illustrate the power loss increase for the different SVX9000/SPX9000 models. When operating above the default switching frequency the SVX9000/SPX9000 output current rating should be derated by the ratio of the increased power loss to the nominal power loss.

Example:

The user of a 30 hp I_H, 61A, 480V SVX9000/SPX9000 wishes to increase the switching frequency from the factory default value of 10 kHz to 15 kHz to reduce motor noise. From **Figure A-4** the loss at the factory default switching frequency of 10 kHz is 1240 watts. The loss at 15 kHz from **Figure A-4** is 1340 watts.

$$\mathrm{Re}\,rate = 61 \times \frac{1240}{1340} = 56A$$

Thus at the increased switching frequency the maximum load allowed is reduced to 56A to avoid overheating the SVX9000/SPX9000.
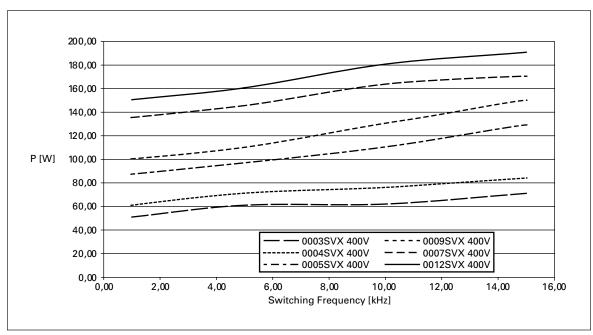
**Figure A-2: Power Loss as Function of Switching Frequency —
3/4 – 3 hp 230V, 1 – 5 hp 480V**
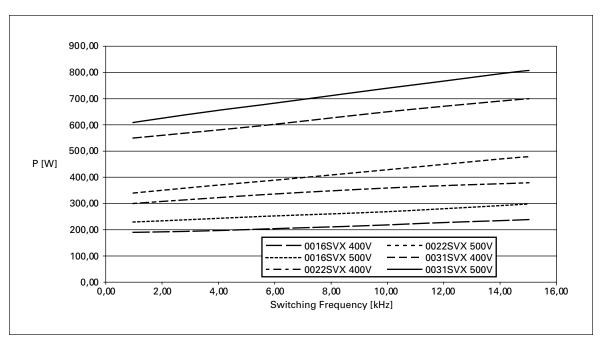
**Figure A-3: Power Loss as Function of Switching Frequency —
5 – 7-1/2 hp 230V, 7-1/2 – 15 hp 480V**
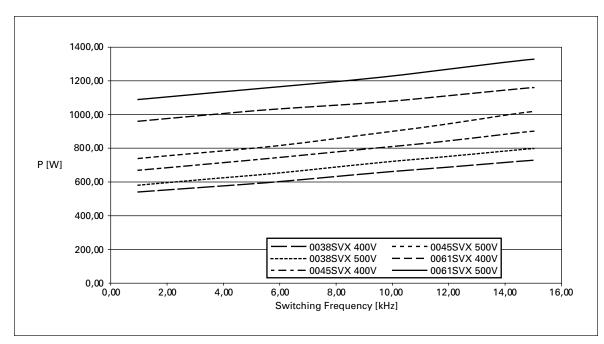
**Figure A-4: Power Loss as Function of Switching Frequency —
10 – 15 hp 230V, 20 – 30 hp 480V**
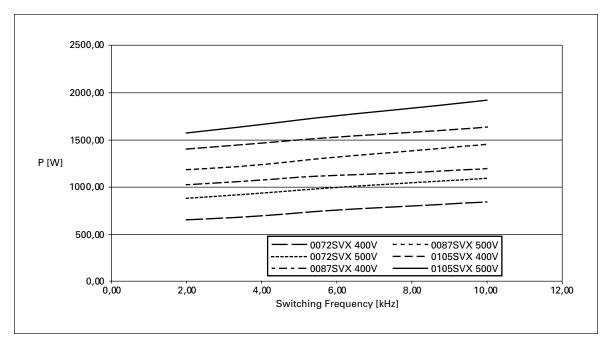
**Figure A-5: Power Loss as Function of Switching Frequency —
20 – 30 hp 230V, 40 – 60 hp 480V**
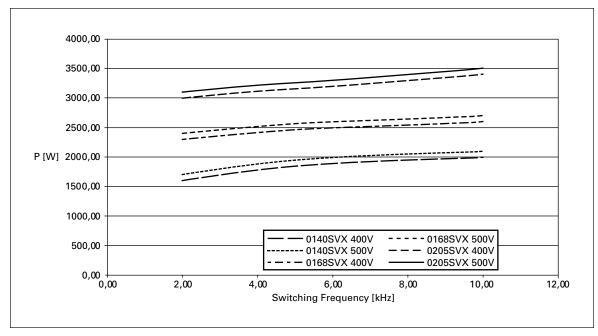
**Figure A-6: Power Loss as Function of Switching Frequency —
75 – 125 hp 480V**
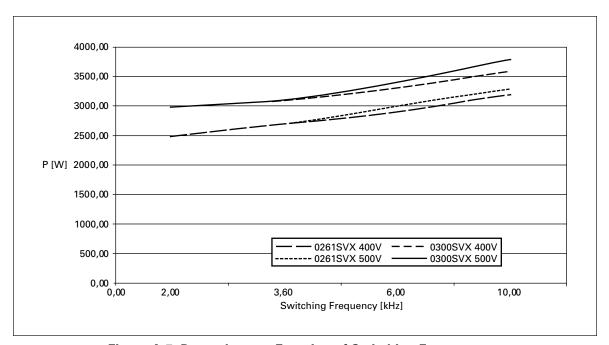
**Figure A-7: Power Loss as Function of Switching Frequency —
150 – 200 hp 480V**

October 2007

Dimensions
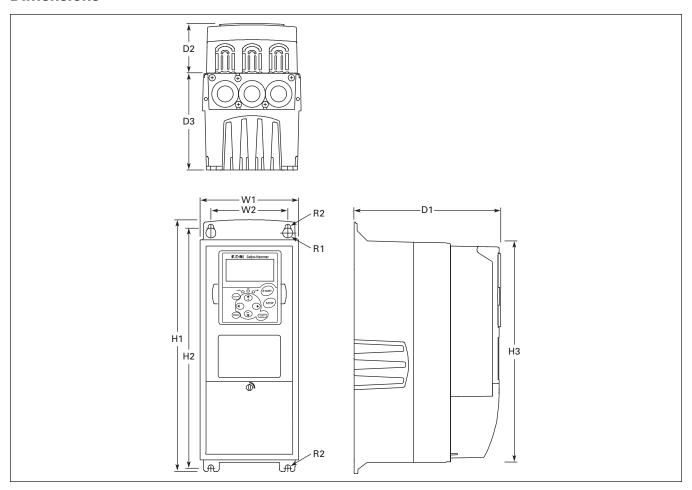
Figure A-8: NEMA Type 1 Enclosure Dimensions

Table A-7: NEMA Type 1/Type 12 Enclosure Dimensions

Frame Size	Voltage	hp (I_H)	Approximate Dimensions in Inches (mm)										Weight Lbs. (kg)
			H1	H2	H3	D1	D2	D3	W1	W2	R1 dia.	R2 dia.	
FR4	230V	3/4 – 3	12.9 (327)	12.3 (312)	11.5 (292)	7.5 (190)	2.5 (64)	5.0 (126)	5.0 (128)	3.9 (100)	0.5 (13)	0.3 (7)	11 (5)
	480V	1 – 5											
FR5	230V	5 – 7-1/2	16.5 (419)	16.0 (406)	15.3 (389)	8.4 (214)	2.7 (68)	5.8 (148)	5.6 (143)	3.9 (100)	0.5 (13)	0.3 (7)	17.9 (8.1)
	480V	7-1/2 – 15											
FR6	230V	10 – 15	22.0 (558)	21.3 (541)	20.4 (519)	9.3 (237)	2.7 (68)	6.7 (171)	7.7 (195)	5.8 (148)	0.7 (18)	0.4 (9)	40.8 (18.5)
	480V	20 – 30											
	575V	2 – 25											
FR7	230V	20 – 30	24.8 (630)	24.2 (614)	23.3 (591)	10.1 (257)	2.7 (68)	7.5 (189)	9.3 (237)	7.5 (190)	0.7 (18)	0.4 (9)	77.2 (35)
	480V	40 – 60											
	575V	30 – 40											
FR8	480V	75 – 125	29.7 (755)	28.8 (732)	28.4 (721)	12.3 (312)	1.3 (34)	11.0 (279)	11.2 (285)	10.0 (255)	0.7 (18)	0.4 (9)	127.8 (58)
	575V	50 – 75											
FR9	480V	150 – 200	45.3 (1150)	44.1 (1120)	45.3 (1150)	14.3 (362)	5.4 (137)	8.8 (224)	18.9 (480)	15.7 (400)	0.7 (18)	0.4 (9)	321.9 (146)
	575V	100 – 150											
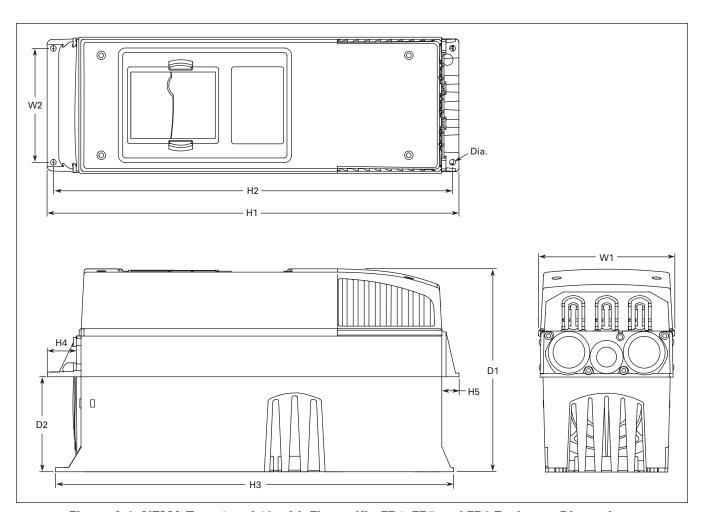
Figure A-9: NEMA Type 1 and 12 with Flange Kit, FR4, FR5 and FR6 Enclosure Dimensions

Table A-8: FR4, FR5 and FR6 with Flange Kit Enclosure Dimensions

Frame Size	Voltage	Approximate Dimensions in Inches (mm)									
		W1	W2	H1	H2	H3	H4	H5	D1	D2	Dia.
FR4	230V	5.0 (128)	4.45 (113)	13.27 (337)	12.8 (325)	12.9 (327)	1.18 (30)	.87 (22)	7.5 (190)	3.0 (77)	.27 (7)
	480V										
FR5	230V	5.67 (144)	4.7 (120)	17.0 (434)	16.5 (420)	16.5 (419)	1.4 (36)	.7 (18)	8.42 (214)	3.93 (100)	.27 (7)
	480V										
FR6	230V	7.67 (195)	6.7 (170)	22.0 (560)	21.6 (549)	21.9 (558)	1.18 (30)	.79 (20)	9.33 (237)	4.17 (106)	.25 (6.5)
	480V										
	575V										
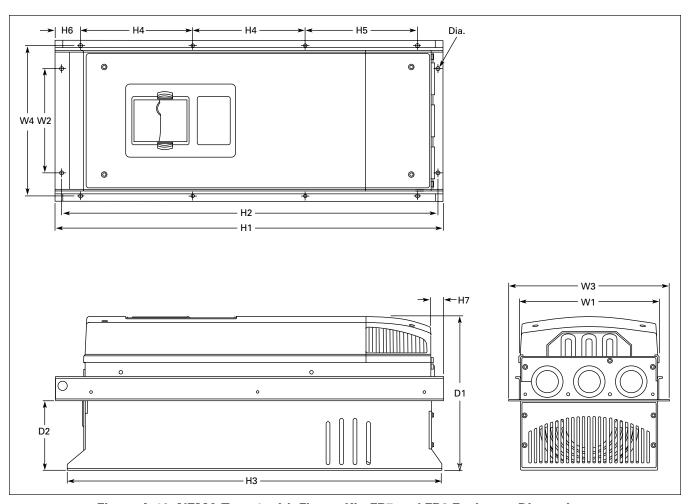
Figure A-10: NEMA Type 1 with Flange Kit, FR7 and FR8 Enclosure Dimensions

Table A-9: FR7 and FR8 with Flange Kit Enclosure Dimensions

Frame Size	Voltage	Approximate Dimensions in Inches (mm)													
		W1	W2	W3	W4	H1	H2	H3	H4	H5	H6	H7	D1	D2	Dia.
FR7	230V	9.33 (237)	6.8 (175)	10.62 (270)	10 (253)	25.6 (652)	24.8 (632)	24.8 (630)	7.42 (188.5)	7.42 (188.5)	.9 (23)	.78 (20)	10.1 (257)	4.6 (117)	.25 (5.5)
	480V														
	575V														
FR8	480V	11.22 (285)	—	13.97 (355)	13 (330)	32.75 (832)	—	29.33 (745)	10.15 (258)	10.43 (265)	1.7 (43)	2.24 (57)	11.3 (288)	4.33 (110)	.35 (9)
	575V														
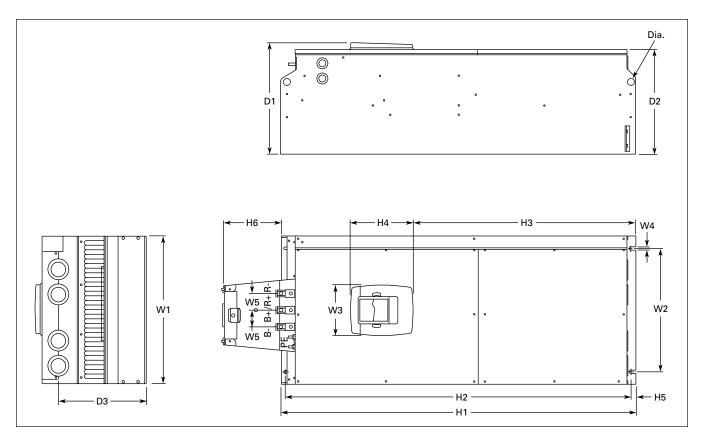
Figure A-11: FR9 Enclosure Dimensions

Table A-10: FR9 Enclosure Dimensions

Frame Size	Voltage	Approximate Dimensions in Inches (mm)														
		W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	H6 [1]	D1	D2	D3	Dia.
FR9	480V	18.8 (480)	15.75 (400)	6.5 (165)	.35 (9)	2.12 (54)	45.27 (1150)	44 (1120)	28.3 (721)	8 (205)	.62 (16)	7.4 (188)	14.25 (362)	13.38 (340)	11.22 (285)	.82 (21)
	575V															

[1] Brake resistor terminal box (H6) included when brake chopper ordered.
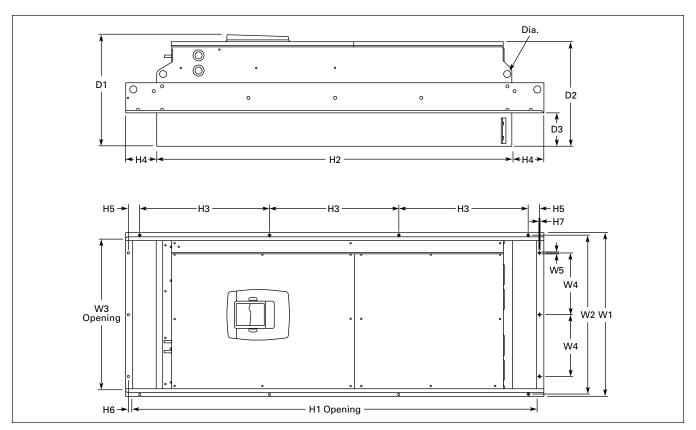
Figure A-12: FR9 with Flange Kit Enclosure Dimensions

Table A-11: FR9 with Flange Kit Enclosure Dimensions

Frame Size	Voltage	Approximate Dimensions in Inches (mm)															
		W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	H6	H7	D1	D2	D3	Dia.
FR9	480V	20.9 (530)	20 (510)	19.1 (485)	7.9 (200)	.22 (5.5)	51.7 (1312)	45.3 (1150)	16.5 (420)	3.9 (100)	1.4 (35)	.35 (9)	.08 (2)	24.9 (362)	13.4 (340)	4.3 (109)	.8 (21)
	575V																

Power Unit — SPX9000 FR10 – FR14
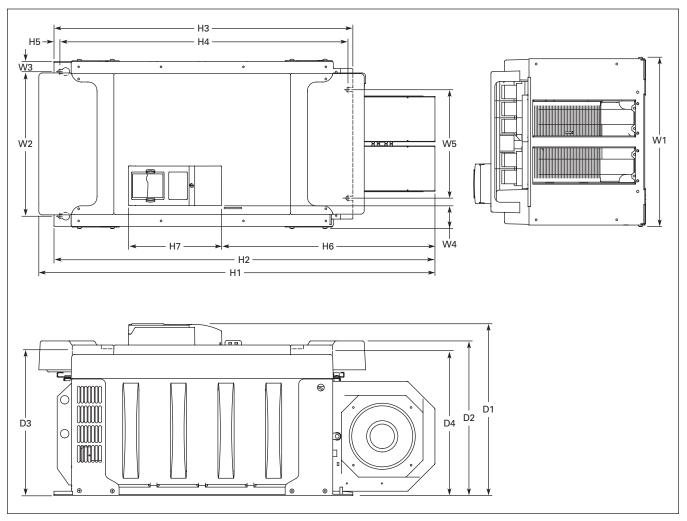
Figure A-13: SPX9000 Dimensions, FR10 Open Chassis

Table A-12: Dimensions for SPX9000, FR10 Open Chassis

Frame Size	Voltage	hp (I_H)	Approximate Dimensions in Inches (mm)								
			W1	W2	W3	W4	W5	H1	H2	H3	H4
FR10	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)
	575V	200 – 300									

Table A-12: Dimensions for SPX9000, FR10 Open Chassis (Continued)

Frame Size	Voltage	hp (I_H)	Approximate Dimensions in Inches (mm)							Weight Lbs. (kg)
			H5	H6	H7	D1	D2	D3	D4	
FR10	480V	250 – 350	.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: SPX9000 FR12 is built of two FR10 modules.

Shown without terminal cover
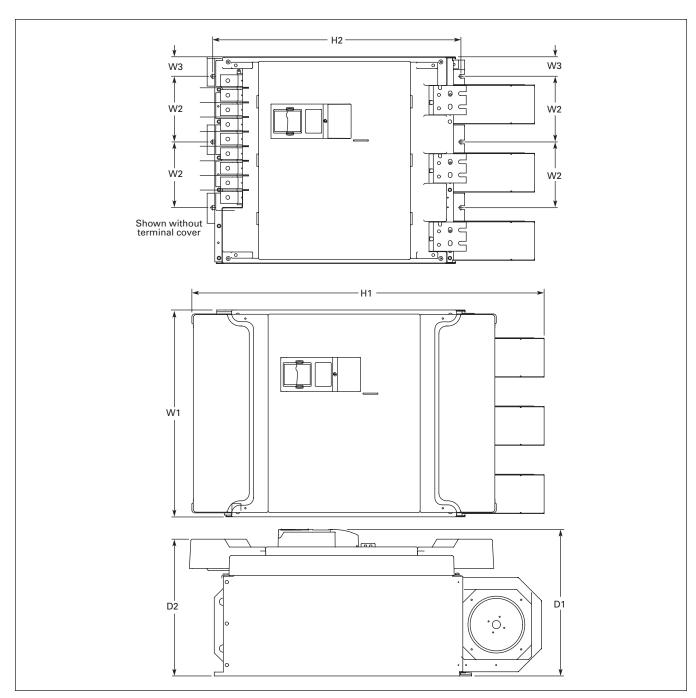
Figure A-14: SPX9000 Dimensions, FR11 Open Chassis

Table A-13: Dimensions for SPX9000, FR11 Open Chassis

Frame Size	Voltage	hp (I_H)	Approximate Dimensions in Inches (mm)							Weight Lbs. (kg)
			W1	W2	W3	H1	H2	D1	D2	
FR11	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								
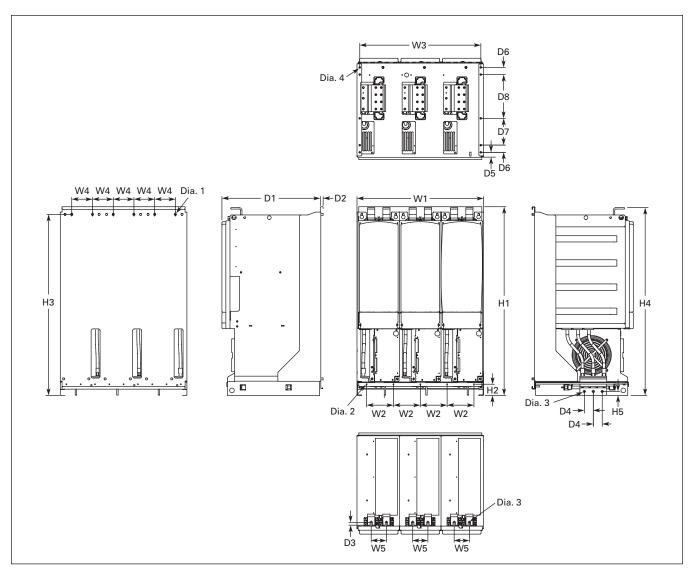
Figure A-15: SPX9000 Dimensions, FR13 Open Chassis Inverter

Table A-14: Dimensions for SPX9000, FR13 Open Chassis Inverter

Frame Size	Approximate Dimensions in Inches (mm)									
	W1	W2	W3	W4	W5	H1	H2	H3	H4	H5
FR13	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)	.79 (20)

Table A-14: Dimensions for SPX9000, FR13 Open Chassis Inverter (Continued)

Frame Size	Approximate Dimensions in Inches (mm)								Dia. 1	Dia. 2	Dia. 3	Dia. 4	Weight Lbs. (kg)
	D1	D2	D3	D4	D5	D6	D7	D8					
FR13	21.77 (553)	.51 (13)	.63 (16)	1.97 (50)	1.06 (27)	1.57 (40)	5.91 (150)	9.64 (244.8)	.35x.59 (9x15)	.18 (4.6)	.51 (13)	.37 (9.5)	683 (310)

Note: 9000X FR14 is built of two FR13 modules.

Note: FR13 is built from an inverter module and a converter module.
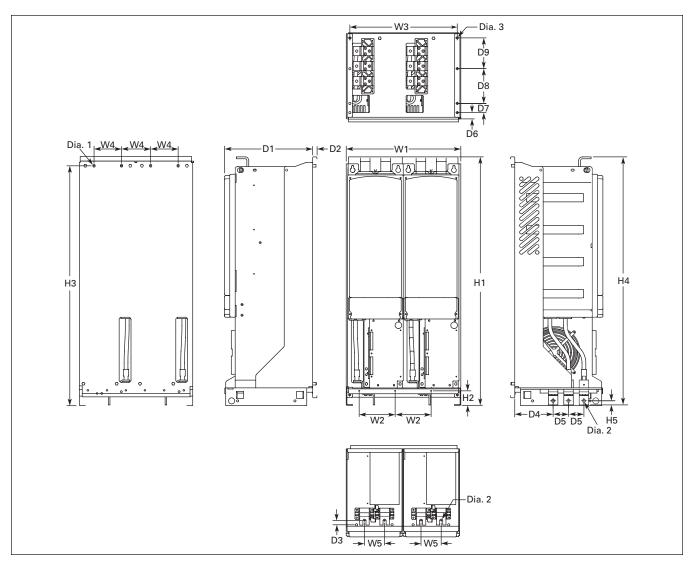
Figure A-16: SPX9000 Dimensions, FR13 Open Chassis Converter

Table A-15: FR13 — Number of Input Units

480V	hp	Input Modules	690V	hp	Input Modules
SPX800A0-4A2N1	800	2	SPX800A0-5A2N1 SPX900A0-5A2N1 SPXH10A0-5A2N1	800 900 1000	2 2 2

Table A-16: Dimensions for SPX9000, FR13 Open Chassis Converter

Frame Size	Approximate Dimensions in Inches (mm)											
	W1	W2	W3	W4	W5	H1	H2	H3	H4	H5	D1	D2
FR13	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)	.69 (17.5)	14.69 (373)	.51 (13)

Table A-16: Dimensions for SPX9000, FR13 Open Chassis Converter (Continued)

Frame Size	Approximate Dimensions in Inches (mm)										Weight Lbs. (kg)
	D3	D4	D5	D6	D7	D8	D9	Dia. 1	Dia. 2	Dia. 3	
FR13	.73 (18.5)	6.42 (163)	2.56 (65)	1.06 (27)	1.57 (40)	5.91 (150)	5.24 (133)	.35x.59 (9x15)	.51 (13)	.37 (9.5)	295 (134)
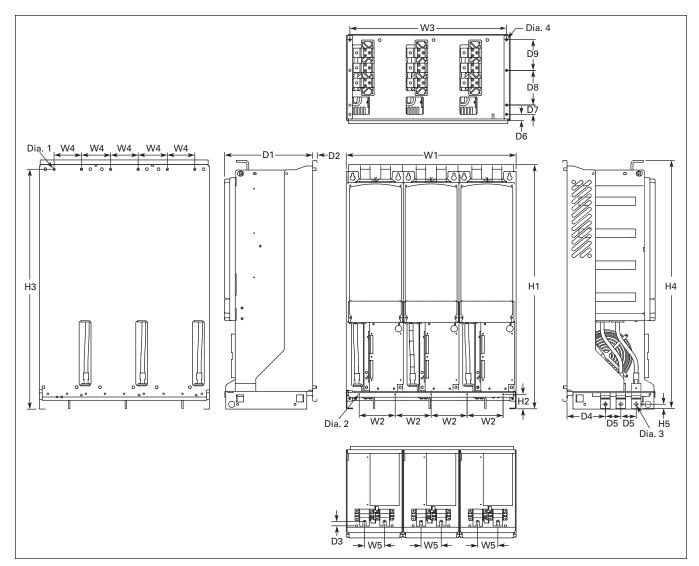
Figure A-17: SPX9000 Dimensions, FR13 Open Chassis Converter — 900/1000 hp 480V

Table A-17: FR13 — Number of Input Units

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

Table A-18: Dimensions for SPX9000, FR13 Open Chassis Converter — 900/1000 hp 480V

Frame Size	Approximate Dimensions in Inches (mm)												
	W1	**W2**	**W3**	**W4**	**W5**	**H1**	**H2**	**H3**	**H4**	**H5**	**D1**	**D2**	**D3**
FR13	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)	.69 (17.5)	14.69 (373)	.51 (13)	.73 (18.5)

Table A-18: Dimensions for SPX9000, FR13 Open Chassis Converter — 900/1000 hp 480V (Continued)

Frame Size	Approximate Dimensions in Inches (mm)										Weight Lbs. (kg)
	D4	**D5**	**D6**	**D7**	**D8**	**D9**	**Dia. 1**	**Dia. 2**	**Dia. 3**	**Dia. 4**	
FR13	6.42 (163)	2.56 (65)	1.06 (27)	1.57 (40)	5.91 (150)	5.24 (133)	.35x.59 (9x15)	.18 (4.6)	.51 (13)	.37 (9.5)	443 (201)

AC Choke — CHK0650
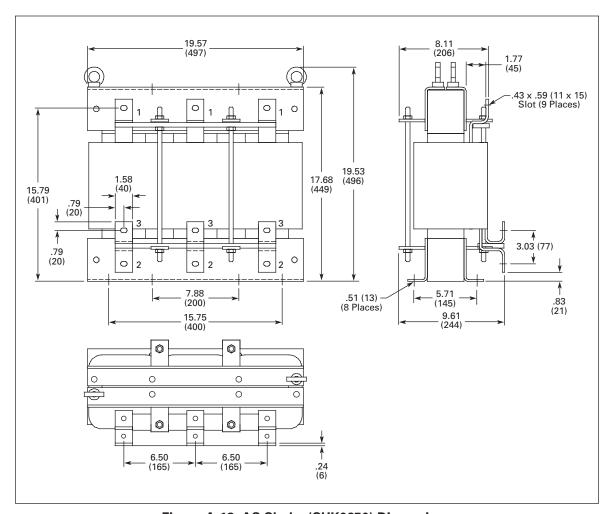
Figure A-18: AC Choke (CHK0650) Dimensions
Approximate Dimensions in Inches (mm)

AC Choke — CHK0520

Figure A-19: AC Choke (CHK0520) Dimensions
Approximate Dimensions in Inches (mm)

October 2007

AC Choke — CHK0400
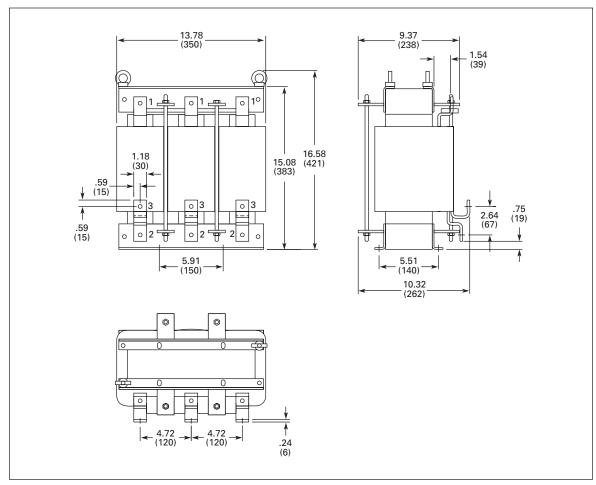
Figure A-20: AC Choke (CHK0400) Dimensions
Approximate Dimensions in Inches (mm)

AC Choke — CHK0261
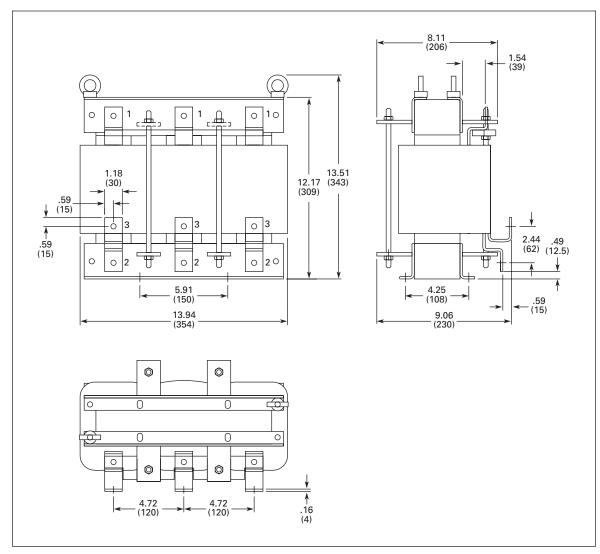
Figure A-21: AC Choke (CHK0261) Dimensions
Approximate Dimensions in Inches (mm)

Control Unit — SPX9000 FR10 – FR14
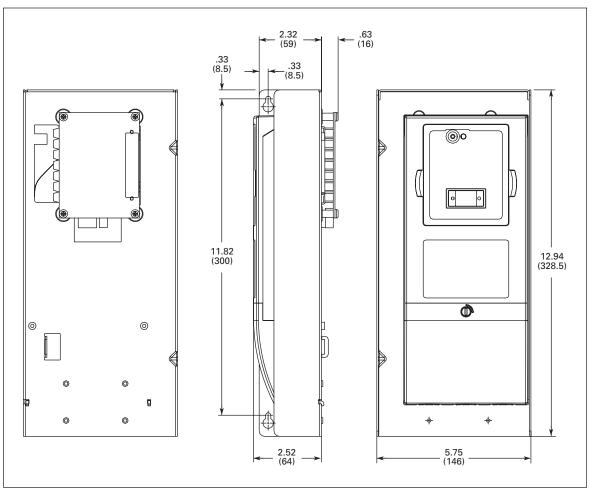
Figure A-22: Control Unit Dimensions
Approximate Dimensions in Inches (mm)
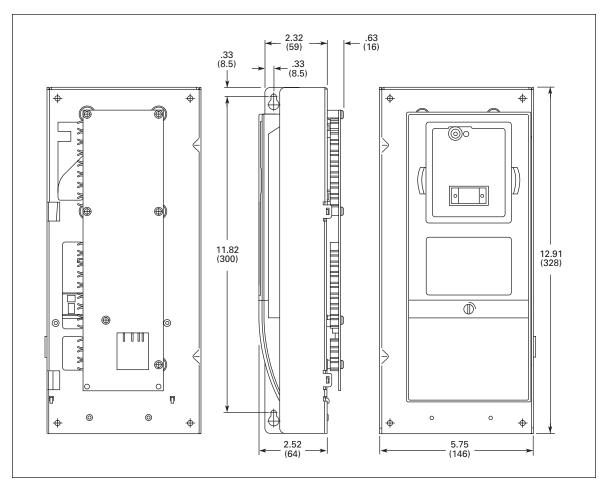
Figure A-23: Control Unit with Star-Coupler Board, FR12 or FR14 Only
Approximate Dimensions in Inches (mm)

EMC Capability

General

For products used within the European Community (EC), the Electro Magnetic Compatibility (EMC) directive states that the electrical equipment must not disturb the environment and must be immune to other Electro Magnetic Disturbances in the environment.

The design intent was to develop a family of drives, which is user friendly and cost effective, while fulfilling the user's needs. EMC compliance was a major consideration from the outset of the design.

The SVX9000/SPX9000 drive series is targeted at the world market. To ensure maximum flexibility, yet meet the EMC needs of different regions, all drives meet the highest immunity levels, while emission levels meet the requirements noted in the following section.

EMC Classification

The SVX9000/SPX9000 drive series are EMC classification H capable.

Class H

SVX9000/SPX9000 drives have been designed to fulfill the requirements of the product standard EN 61800-3+A11 for the 1st environment restricted distribution and the 2nd environment.

The emission levels correspond to the requirements of EN 61000-6-4.

SVX9000/SPX9000 series drives fulfill all applicable EMC immunity requirements (standards EN 61000-6-1, EN 61000-6-2 and EN 61800-3+A11).

Declaration of Conformity

The Manufacturer's Declarations of Conformity assuring the compliance of the SVX9000/SPX9000 drives with the European Community (EC) EMC-directives is available upon request.

Warranty and Liability Information

Eaton Electrical Inc. warrants the product delivered in the Cutler-Hammer shipping package to be free from defects in material and workmanship, under normal use and service, for twenty four (24) months from date of manufacturing. Products that fail during this period will be repaired or replaced at Eaton's discretion, with the same or a functionally equivalent product, provided the original purchaser (A) returns the failed product, and (B) provides proof of original date of purchase. This warranty does not apply, in the judgment of Eaton, to damage caused during shipment, handling, storage, or accidental misuse. The original purchaser of the product must obtain a Cutler-Hammer Return Material Authorization (RMA) number prior to returning any defective product. (When purchased through an Authorized Distributor, the Distributor should supply an RMA number to their customer.)

The maximum liability of this warranty is limited to the purchase price of the product. In no event, regardless of cause, shall Eaton Electrical Inc. be liable (a) for penalties or penalty clauses of any description, or (b) for certification not otherwise specifically provided herein and/or indemnification of purchaser or others for costs, damages or expenses, each arising out of or related to the product or services of any order or (c) for any damages resulting from loss of profits, use of products or for any incidental indirect or consequential damages, even if advised of the possibility of such damages.

Appendix B — Fault and Warning Codes

The faults with one asterisk are "Fault" only. The faults with two asterisks can be programmed for different actions based on the chosen application. See the appropriate application manual for specific application details.

Table B-1: Fault Codes

Fault Code	Fault	Possible Cause	Solution
1	Overcurrent	The SVX9000/SPX9000 has detected a high current ($>4xI_n$) in its output due to: • sudden heavy load increase • short in the motor • short in the cables to the motor • unsuitable motor	Check loading. Check motor. Check cables.
2	Overvoltage	The DC-link voltage has exceeded its high limit due to: • too short a deceleration time • high voltage levels or surges in the utility supply	Make the deceleration time longer. Use a chopper and brake resistor (standard on some models, available as an option on others). Correct utility supply voltage (level is too high). Add input impedance to limit surges.
3**	Ground (Earth) Fault	Current sensing indicates that the sum of motor phase currents is not zero. • insulation failure in motor or motor cables	Check the motor and motor cables.
5	Charging Switch	The charging switch was open when the START command was been given due to: • faulty operation • component failure	Reset the fault and restart. Should the fault re-occur, contact your Cutler-Hammer distributor.
6	Emergency stop	An Emergency stop signal was received from one of the digital inputs	Determine the reason for the Emergency stop and remedy it.
7	Saturation trip	• defective component • motor or motor cable short	Cannot be reset from the keypad. Switch off power. If this fault appears simultaneously with Fault 1, check the motor and motor cables. IF THE PROBLEM IS <u>NOT</u> IN THE MOTOR OR ITS CABLES, DO NOT RE-CONNECT POWER! Contact your Cutler-Hammer distributor.
8	System fault	• component failure • faulty operation **Note**: exceptional fault data record, see the Active Fault Menu and Fault Time Data Record for more information	Reset the fault and restart. Should the fault reoccur, contact your Cutler-Hammer distributor.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
9**	Undervoltage	DC-link voltage is less than the minimum safe operating voltage limit. • most probable cause: too low a supply voltage • SVX9000/SPX9000 internal fault	If there was a supply voltage loss or dip, reset the fault and restart the SVX9000/SPX9000. Check the supply voltage. If it was within specification at the time of the fault, an internal failure has occurred. Contact your Eaton distributor.
10**	Input line supervision	Input line phase is low or missing.	Check the utility supply voltage, cables and connections.
11**	Output phase supervision	Current sensing indicates that there is no current in one motor phase.	Check the motor cables, connections and motor.
12	Brake chopper supervision	• no brake resistor installed • brake resistor is open • brake chopper failure	Check the brake resistor. If the resistor is ok, the chopper is faulty. Contact your Eaton distributor.
13	SVX9000/SPX9000 undertemperature	Heatsink temperature is under 14°F (-10°C)	Provide supplemental heating or relocate the SVX9000/SPX9000 to a warmer location.
14	SVX9000/SPX9000 overtemperature	Heatsink temperature is over 194°F (90°C).	An overtemperature warning is issued when the heatsink temperature exceeds 185°F (85°C), a fault occurs at 194°F (90°C). Check for the correct amount and unrestricted flow of cooling air. Check the heatsink for dust or dirt buildup. Check the highest ambient temperature level. Make sure that the switching frequency is not set too high in relation to ambient temperature and motor load.
15**	Motor stalled	• motor or load mechanical failure • load is too high • stall parameter settings incorrect	Check motor, mechanical system and load level. Confirm the stall parameter settings.
16**	Motor overtemperature	• motor is overloaded • motor overheating has been detected by the SVX9000/SPX9000 motor temperature model	Decrease the motor load. If no motor overload exists, check the temperature model parameters.
17**	Motor underload	• mechanical or load problems • underload parameter settings incorrect	Check the motor. Check for a loose belt, broken coupling or load problems. Confirm the underload parameter settings.
22	EEPROM checksum fault	Parameter save fault • faulty operation • component failure	Upon reset of this fault, the SVX9000/SPX9000 will automatically reload the parameter default settings. Check all parameter settings after reset. If the fault reoccurs, contact your Eaton distributor.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
24*	Counter fault	Values displayed on the counters are incorrect	
25	Microprocessor watchdog fault	• faulty operation • component failure	Reset the fault and restart. Should the fault reoccur, contact your Eaton distributor.
26	Startup prevented	Startup of the drive has been prevented	Check Start Enable/Interlock settings.
29**	Thermistor fault	The thermistor input of an option board has detected a high motor temperature	Check the motor cooling and the motor loading. Check the thermistor connection. (If the thermistor input of an option board is not being used, it must be short-circuited).
31	IGBT temperature (hardware)	IGBT Inverter Bridge overtemperature protection has detected a high short-term overload current	Check loading. Check motor size.
32	Fan cooling	The SVX9000/SPX9000 cooling fan did not start when commanded	Contact your Eaton distributor.
34	CAN bus communication	Sent message not acknowledged	Ensure that there is another device on the bus with the appropriate configuration.
36	Control unit	The control unit cannot control the power unit and vice-versa	Change the control unit.
37*	Device change (same type)	• option board changed • different power rating of drive	Reset. **Note:** No Fault Time Data Record is made.
38*	Device added (same type)	• option board added • drive of different power rating added	Reset. **Note:** No Fault Time Data Record is made.
39*	Device removed	• option board removed • drive removed	Reset. **Note:** No Fault Time Data Record is made.
40	Device unknown	Unknown option board or drive	Contact your Eaton distributor.
41	IGBT temperature	IGBT Inverter Bridge overtemperature protection has detected a high short-term overload current	Check loading. Check motor size.
42**	Brake resistor overtemperature	Brake resistor overtemperature protection has detected excessive braking	Set the deceleration time longer. Use an external brake resistor.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
43	Encoder fault	**Note**: exceptional fault data record, see the Active Fault Menu and Fault Time Data Record for more information. Additional codes: **1** = Encoder 1 channel A is missing **2** = Encoder 1 channel B is missing **3** = Both encoder 1 channels are missing **4** = Encoder reversed	Check encoder channel connections. Check the encoder board.
44*	Device change (different type)	• option board changed • different power rating of drive	Reset. **Note:** No Fault Time Data Record is made. **Note:** Application parameter values restored to default.
45*	Device added (different type)	• option board added • drive of different power rating added	Reset. **Note:** No Fault Time Data Record is made. **Note:** Application parameter values restored to default.
50**	Analog input I_{in} < 4 mA (for the signal range 4 to 20 mA)	Current at the analog input is < 4 mA. • control cable is broken or loose • signal source has failed	Check the current loop, signal source and wiring.
51	External fault	Digital input set as an external fault input has been triggered	Check source of trigger.
52	Keypad communication fault	The connection between the control keypad and the SVX9000/SPX9000 has been lost	Check the keypad connection and keypad cable.
53	Communication bus fault	The data connection between the communication bus master and the communication bus board has failed	Check installation. If installation is correct contact your Eaton distributor.
54	Slot fault	Defective option board or slot	Check that the board is properly installed and seated in slot. If the installation is correct, contact your Eaton distributor.
56	PT100 board temperature fault	Temperature limit values set for the PT100 board parameters have been exceeded	Determine the cause of the high temperature.

Appendix C — Troubleshooting Charts Using Fault Codes

F1 — Overcurrent
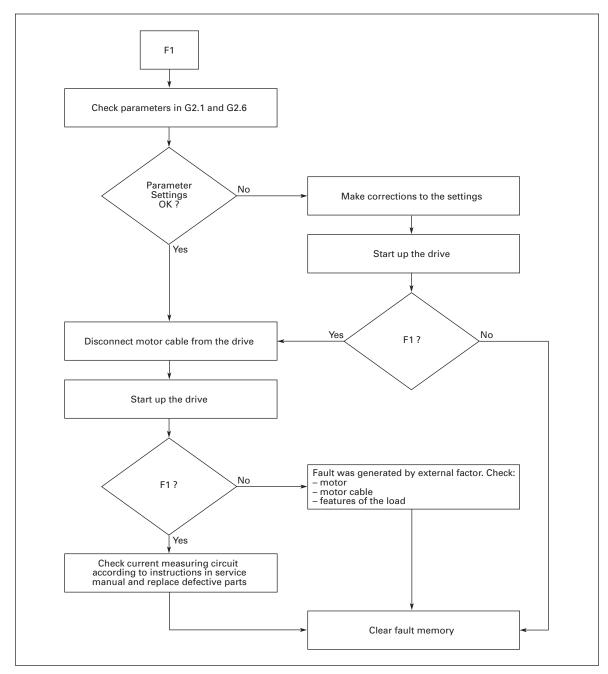
Figure C-1: F1 — Overcurrent

F2 — Overvoltage

```
                          ┌───────┐
                          │  F2   │
                          └───┬───┘
                              │
                              ▼
               Check parameters in G2.1, G2.4 and G2.6.
                  Notice the break chopper if used,
                      check parameter P6.3.3.
                              │
                              ▼
                          ╱─────────╲
                         ╱ Parameter ╲   No      ┌──────────────────────────────┐
                        ⟨   Settings   ⟩─────────▶│ Make corrections to the settings │
                         ╲   OK ?    ╱            └──────────────────────────────┘
                          ╲─────────╱
                              │ Yes
                              ▼
               ┌──────────────────────────────┐
               │  Measure voltage in DC-bus.   │
               │ Compare measured voltage to   │
               │   monitored value V1.8.       │
               └──────────────┬───────────────┘
                              │
                              ▼
                          ╱─────────╲          ┌─────────────────────────────────────┐
                         ╱ Measure   ╲  Yes     │ Fault was generated by external factor:│
                        ⟨  value =     ⟩─────────▶│ – line voltage >+10%                 │
                         ╲Monitored   ╱          │ – voltage spikes on line            │
                          ╲ value ?  ╱           │ – feature of load                   │
                          ╲─────────╱            │ – declaration time too short for    │
                              │ No               │   system inertia                    │
                              ▼                  │ – break resistor too small          │
               ┌──────────────────────────────┐ └──────────────────┬──────────────────┘
               │ Check current measuring circuit│                    │
               │ according to instructions in   │                    ▼
               │ service manual. Replace defective│ ┌────────────────────────────────┐
               │ parts as recommended in the    │ │   Make corrective measures to    │
               │ spare parts lists.             │ │ quality of line power, setting the│
               └──────────────┬───────────────┘  │deceleration time versus system inertia│
                              │                   └────────────────┬───────────────┘
                              │                                    │
                              ▼                                    ▼
                          ┌──────────────────────────────────────────┐
                          │           Clear fault memory             │
                          └──────────────────────────────────────────┘
```

Note: Overvoltage triplimit is
911V in 380-500V units.

Figure C-2: F2 — Overvoltage

F3 — Earth Fault

Figure C-3: F3 — Earth Fault

F5 — Charging Switch

```
                    ┌─────────┐
                    │   F5    │
                    └────┬────┘
                         │
                         ▼
          ┌──────────────────────────────┐
          │ Reset the fault and start up  │
          │          the unit             │
          └──────────────┬───────────────┘
                         │
                         ▼
                    ╱─────────╲
                   ╱           ╲      No
                  ╱   F5 ?      ╲──────────┐
                  ╲             ╱          │
                   ╲           ╱           │
                    ╲─────────╱            │
                         │ Yes            │
                         ▼                 │
          ┌──────────────────────────────┐│
          │ Test and/or replace the       ││
          │ control board with functional ││
          │ one by following instructions ││
          │ in service manual. Replace    ││
          │ defective parts as            ││
          │ recommended in spare parts    ││
          │ lists.                        ││
          └──────────────┬───────────────┘│
                         │                 │
                         ▼                 │
          ┌──────────────────────────────┐│
          │ Set values of parameters to   ││
          │ comply with nature of         ││
          │ application                   ││
          └──────────────┬───────────────┘│
                         │                 │
                         ▼                 │
          ┌──────────────────────────────┐│
          │     Clear fault memory        │◄┘
          └──────────────────────────────┘
```
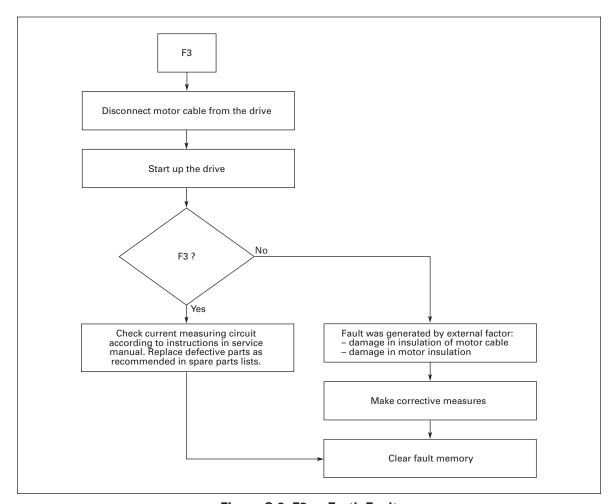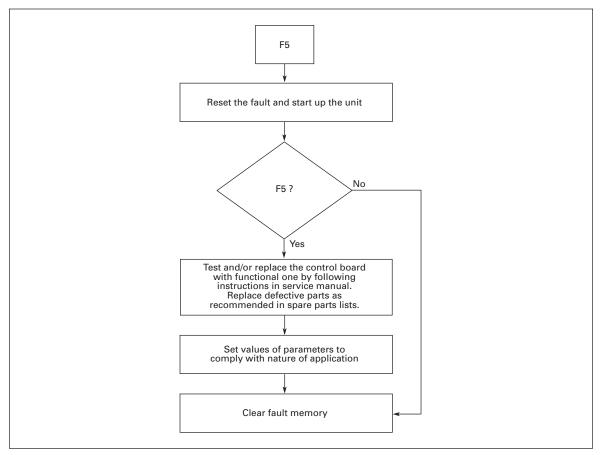
Figure C-4: F5 — Charging Switch

F6 — Emergency Stop
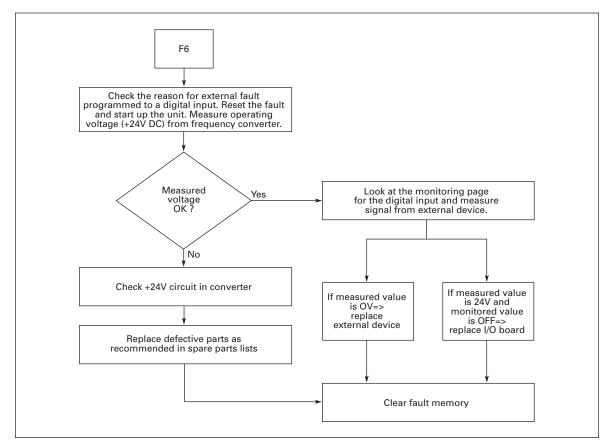
Figure C-5: F6 — Emergency Stop

F7 — Saturation Trip

Figure C-6: F7 — Saturation Trip

October 2007

F8 — System Fault

```
                    ┌──────────┐
                    │    F8    │
                    └────┬─────┘
                         │
                         ▼
        ┌────────────────────────────────────┐
        │   Reset the fault and start up the unit   │
        └────────────────┬───────────────────┘
                         │
                         ▼
               ╱◆╲
         No  ╱      ╲
      ◄─────    F8 ?    
             ╲      ╱
               ╲  ╱
                │ Yes
                ▼
        ┌────────────────────────────────────┐
        │      Check subfault code (1-7)       │
        └────────────────┬───────────────────┘
                         │
                         ▼
        ┌────────────────────────────────────┐
        │  Check control box with 9000X service │
        │       tool software according to       │
        │       instructions in service manual   │
        │        and change defective parts      │
        └────────────────┬───────────────────┘
                         │
                         ▼
        ┌────────────────────────────────────┐
        │          Clear fault memory          │
        └────────────────────────────────────┘
```
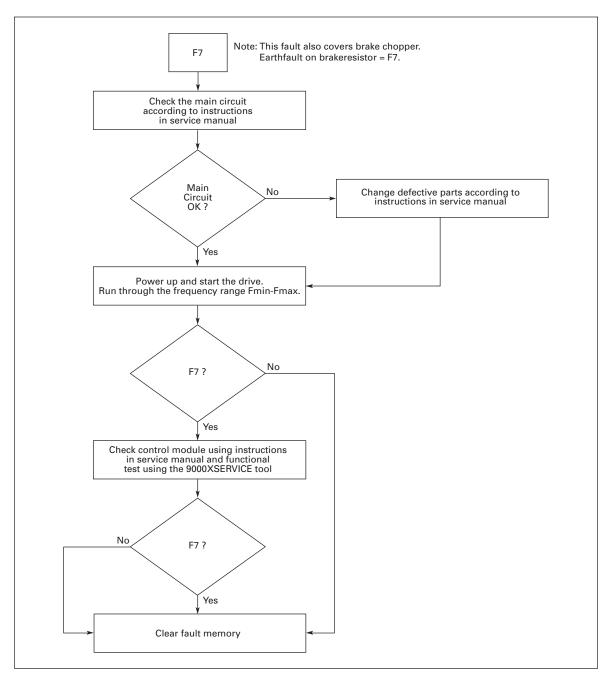
Note: Subfault codes:
1 = feedback fault
2 = Asic fault
3 = Asic fault
4 = Asic fault
5 = vacon bus problem
6 = charging relay fault
7 = charging relay fault
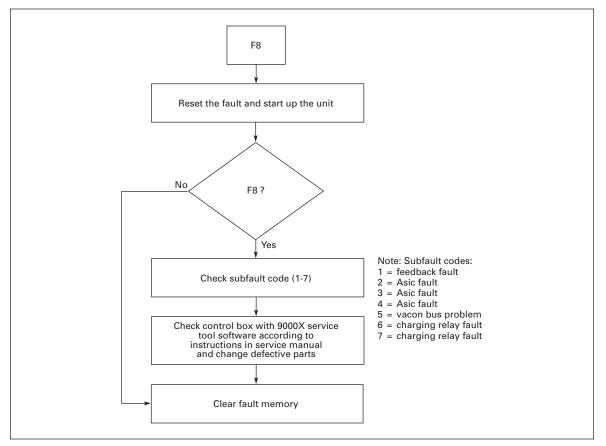
Figure C-7: F8 — System Fault

F9 — Undervoltage

F9

↓

Check parameters in G2.1 and G2.6

↓

Parameter Settings OK ? —No→ Set values of parameters to comply with nature of application

↓ Yes

Measure voltage in DC-bus. Compare actual voltage to monitored value V1.8.

↓

Measured value = Monitored value ? —Yes→ Fault was generated by either:

External factor: – line dips
– features of the load
– blown input fuses

Internal factor: – faulty rectifier

↓ No

Check the voltage measuring circuit and rectifier according to instructions in service manual. Replace defective parts as recommended and listed in spare parts lists.

Make corrections to parameter settings

↓

Clear fault memory

Figure C-8: F9 — Undervoltage

F10 — Input Line Supervision

Figure C-9: F10 — Input Line Supervision

F11 — Output Phase Supervision


```
                        ┌──────────┐
                        │   F11    │
                        └────┬─────┘
                             │
                             ▼
        ┌────────────────────────────────────────────┐
        │  Check connections in power transmission    │
        │  line from drive to motor                   │
        └────────────────────┬───────────────────────┘
                             │
                             ▼
                    ◇ Connections      No    ┌──────────────────────────────┐
                    ◇   OK ?       ─────────▶│  Make corrective measures to  │
                    ◇                         │  circuit from the drive to     │
                             │                │  motor                         │
                            Yes               └───────────────┬───────────────┘
                             ▼                                │
        ┌────────────────────────────────┐                  │
        │  Check operation of the current│                  │
        │  measuring circuit according to│                  │
        │  instructions in service manual│                  │
        └────────────────┬───────────────┘                  │
                         │                                    │
                         ▼                                    │
        ┌────────────────────────────────┐                  │
        │  Replace defective parts as    │                  │
        │  recommended and listed in     │                  │
        │  spare parts lists             │                  │
        └────────────────┬───────────────┘                  │
                         │                                    ▼
                         └──────────────▶┌──────────────────────────────┐
                                          │      Clear fault memory       │
                                          └──────────────────────────────┘
```
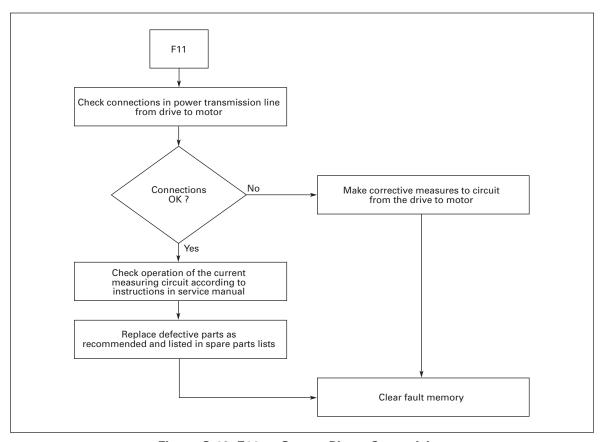
Figure C-10: F11 — Output Phase Supervision

F12 — Brake Chopper Supervision


```
                        ┌──────────┐
                        │   F12    │
                        └────┬─────┘
                             ▼
          ┌────────────────────────────────┐
          │ Check brake resistor and connections │   Note: Earthfault on brakeresistor = F7
          │    in brake chopper circuit     │
          └────────────────┬───────────────┘
                           ▼
                    ◇ Circuit        No    ┌──────────────────────────────┐
                      OK ?     ────────────▶│ Make corrective measures. Check the │
                    ◇                        │ dimensioning of the braking resistor. │
                     │                       └──────────────┬───────────────┘
                    Yes                                     ▼
          ┌────────────────────────┐          Yes      ◇ F12 ?      No
          │ Check conditions of brake │ ◀───────────────◇
          │ chopper according to instructions │
          │    in service manual    │
          └───────────┬────────────┘
                      ▼
               ◇ Brake chopper    No
                 OK ?        ──────────────┐
               ◇                            │
                │                           │
               Yes                          ▼
     ┌──────────────────────┐   ┌──────────────────────┐
     │ Replace power board   │   │ Replace defective parts │
     │ according to instructions │ │ according to instructions │
     │   in service manual   │   │    in service manual   │
     └───────────┬──────────┘   └───────────┬──────────┘
                 │                           ▼
                 │              ┌──────────────────────┐
                 └─────────────▶│   Clear fault memory  │◀──────
                                └──────────────────────┘
```

Figure C-11: F12 — Brake Chopper Supervision

F13 — Frequency Converter Under Temperature
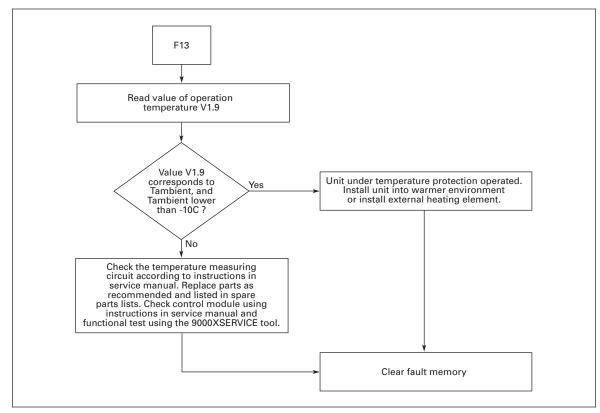
Figure C-12: F13 — Frequency Converter Under Temperature

F14 — Frequency Converter Over Temperature
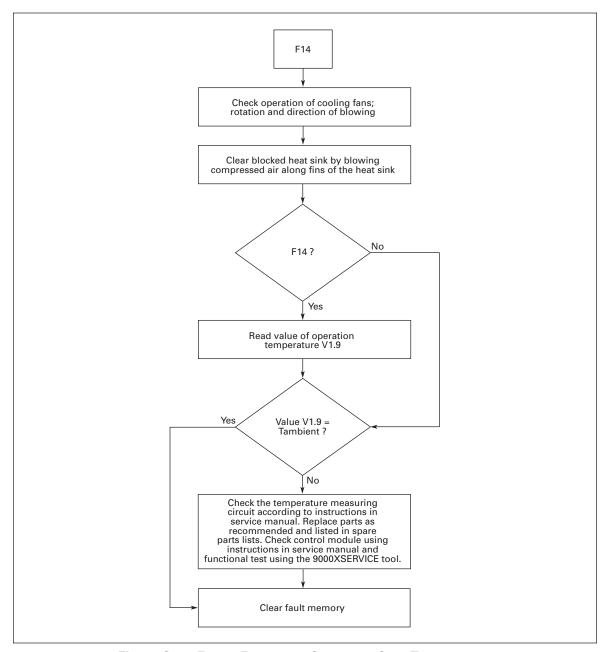
Figure C-13: F14 — Frequency Converter Over Temperature

F15 — Motor Stalled

```
                              ┌─────────┐
                              │   F15   │
                              └────┬────┘
                                   │
                    ┌──────────────┴──────────────┐
                    │  Check parameters in G2.7 and│
                    │    make corrections to match │
                    │  with requirements of        │
                    │        application           │
                    └──────────────┬──────────────┘
                                   │
                              ◇─────┴─────◇         No
                            <    F15 ?    >──────────────┐
                              ◇─────┬─────◇              │
                                   │ Yes                 │
                    ┌──────────────┴──────────────┐      │
                    │ Check mechanical load of the │      │
                    │  application versus rating of│      │
                    │    the motor and the drive   │      │
                    └──────────────┬──────────────┘      │
                                   │                     │
                    ┌──────────────┴──────────────┐      │
                    │  Measure actual motor current│      │
                    │  and compare it to V1.4      │      │
                    │          reading             │      │
                    └──────────────┬──────────────┘      │
                                   │                     │
  ┌────────────────────────┐      ◇──┴──◇               │
  │ Combination of the      │ Yes <Measured>            │
  │ rating for motor and    │◄────<current =>           │
  │ drive do not match with │     <Monitored>           │
  │ mechanical load         │     <current?>            │
  └───────────┬────────────┘      ◇──┬──◇               │
              │                      │ No                │
              │            ┌─────────┴─────────┐         │
              │            │ Check current     │         │
              │            │ measuring circuit │         │
              │            │ according to      │         │
              │            │ instructions in   │         │
              │            │ service manual    │         │
              │            │ and replace       │         │
              │            │ defective parts   │         │
              │            │ as recommended in │         │
              │            │ spare parts lists │         │
              │            └─────────┬─────────┘         │
              │                      │                   │
              └──────────►┌──────────┴──────────┐◄───────┘
                          │  Clear fault memory  │
                          └──────────────────────┘
```

Figure C-14: F15 — Motor Stalled

October 2007

F16 — Motor Over Temperature

```
                              ┌─────────┐
                              │   F16   │
                              └────┬────┘
                                   │
              ┌────────────────────▼────────────────────┐
              │  Motor overheating has been detected by  │
              │  frequency converter temperature model.  │
              │       Measure temperature of motor.      │
              └────────────────────┬────────────────────┘
                                   │
                            ◇ Temperature higher ◇   Yes    ┌──────────────────────────────┐
                            ◇ than thermal capability ◇────▶│       Motor overloaded.       │
                            ◇   of the motor ?     ◇        │     Decrease load or provide   │
                                   │                        │ additional cooling to motor if needed. │
                                   │ No                     └──────────────┬───────────────┘
              ┌────────────────────▼────────────────────┐                 │
              │        Correct the parameters for        │◀────────────┐   │
              │       thermal protection in G2.7         │             │   │
              └────────────────────┬────────────────────┘             │   │
                                   │                                   │   │
                        No   ◇    F16 ?    ◇                           │   │
                    ◀───────◇               ◇                          │   │
                    │              │                                   │   │
                    │              │ Yes                               │   │
                    │  ┌───────────▼─────────────┐                     │   │
                    │  │  Measure actual motor current │◀──────────────┘   │
                    │  │    and compare it to V1.4     │◀──────────────────┘
                    │  └───────────┬─────────────┘
                    │              │
                    │       ◇ Measured (I) = ◇   Yes
                    │       ◇ Monitored (I) ? ◇───────┘
                    │              │
                    │              │ No
                    │  ┌───────────▼─────────────┐
                    │  │  Check current measurement │
                    │  │   according to instructions │
                    │  │     in service manual      │
                    │  └───────────┬─────────────┘
                    │              │
                    │  ┌───────────▼─────────────┐
                    │  │  Replace parts recommended │
                    │  └───────────┬─────────────┘
                    │              │
                    │  ┌───────────▼─────────────┐
                    └─▶│     Clear fault memory    │
                       └─────────────────────────┘
```

Figure C-15: F16 — Motor Over Temperature

F17 — Motor Under Load

```
                        ┌──────────┐
                        │   F17    │
                        └────┬─────┘
                             │
                             ▼
              ┌────────────────────────────────┐
         ┌───▶│ Check settings of parameters in │◀──┐
         │    │   G2.7 and set values according │   │
         │    │    to requirements of application│   │
         │    └────────────────┬───────────────┘   │
         │                     │                    │
         │                     ▼                    │
         │    ┌────────────────────────────────┐   │
         │    │ Measure motor current and compare│   │
         │    │      result to value V1.4        │   │
         │    └────────────────┬───────────────┘   │
         │                     │                    │
         │                     ▼                    │
         │                  ╱──────╲         Yes    │
         │                 ╱ (I) Measured=╲─────────┘
         │                 ╲ (I) Monitored?╱
         │                  ╲──────╱
         │                     │ No
         │                     ▼
         │    ┌────────────────────────────────┐
         │    │ Check the current measuring circuit│
         │    │  according to instructions in service│
         │    │    manual. Replace defective parts │
         │    │  as recommended in spare parts lists.│
         │    └────────────────┬───────────────┘
         │                     │
         │                     ▼
         │    ┌────────────────────────────────┐
         │    │       Clear fault memory         │
         │    └────────────────────────────────┘
```
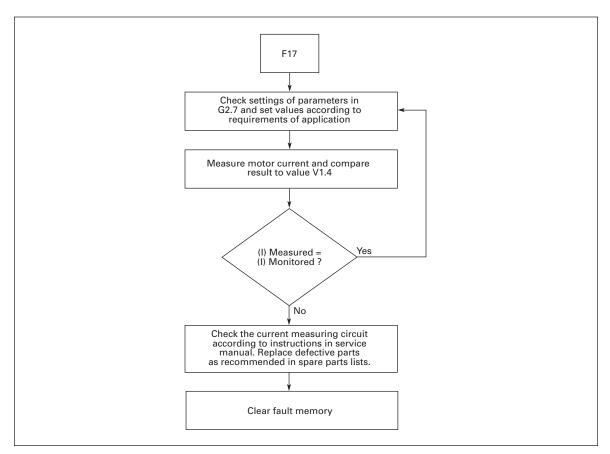
Figure C-16: F17 — Motor Under Load

October 2007

F22 — Param Fault
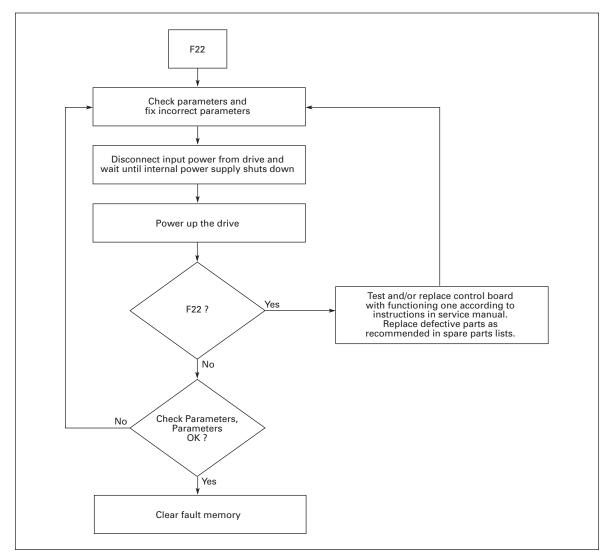
Figure C-17: F22 — Param Fault

F24 — Counter Fault

```
┌──────────┐
│   F24    │
└────┬─────┘
     │
     ▼
┌────────────────────────────────┐
│  Reset fault and start up the unit  │
└────────────┬───────────────────┘
             │
             ▼
┌────────────────────────────────┐
│       Clear fault memory       │
└────────────────────────────────┘
```
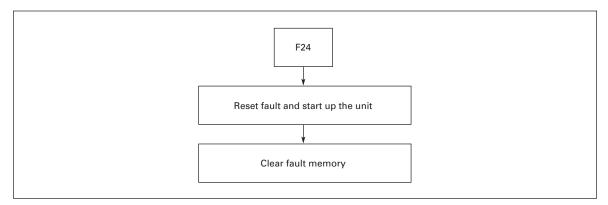
Figure C-18: F24 — Counter Fault

F25 — Microprocessor Watchdog Fault

```
┌──────────┐
│   F25    │
└────┬─────┘
     │
     ▼
┌────────────────────────────────┐
│          Reset the fault,          │
│  check the parameters and start up the unit  │
└────────────┬───────────────────┘
             │
             ▼
┌────────────────────────────────┐
│  Test and/or replace the control board  │
│   with functioning one according to    │
│     instructions in service manual.    │
│        Replace defective parts as       │
│    recommended in spare parts lists.    │
└────────────┬───────────────────┘
             │
             ▼
┌────────────────────────────────┐
│       Clear fault memory       │
└────────────────────────────────┘
```
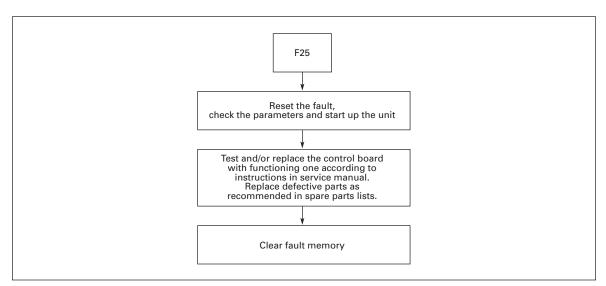
Figure C-19: F25 — Microprocessor Watchdog Fault

October 2007

F31 — IGBT Temperature (Hardware)
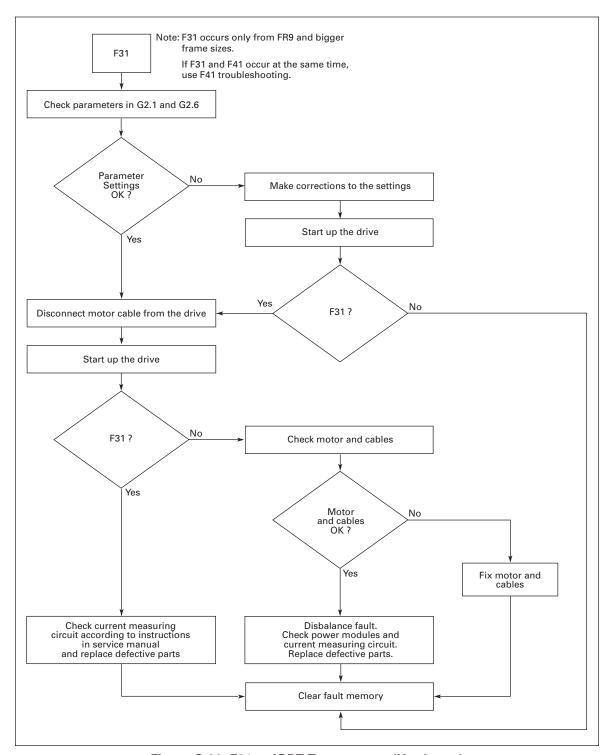
Figure C-20: F31 — IGBT Temperature (Hardware)

F32 — Fan Cooling

```
         ┌──────┐   Note: This fault is for FR8.
         │ F32  │
         └──────┘
            │
            ▼
   ┌────────────────────┐
   │ Check fan inverter │
   └────────────────────┘
            │
            ▼
         ╱╲
        ╱  ╲        No      ┌─────────────────────┐
       ╱ Fan ╲ ──────────▶  │  Replace fan inverter │
       ╲Inverter╱           └─────────────────────┘
        ╲ OK ? ╱                      │
         ╲  ╱                         ▼
          ╲╱              ┌─────────────────────┐
           │ Yes          │     Check the fan    │
           │              └─────────────────────┘
           │                        │
           │                        ▼
           │                     ╱╲
           │                    ╱  ╲     No    ┌─────────────┐
           │                   ╱Fan OK╲ ─────▶ │ Replace fan │
           │                   ╲  ?  ╱         └─────────────┘
           │                    ╲  ╱                 │
           │                     ╲╱                  │
           │                      │ Yes              │
           │                      ▼                  │
           │        ┌──────────────────────────────┐
           └───────▶│   Check control module using  │◀─┘
                    │  instructions in service manual│
                    │   and functional test using   │
                    │      the 9000XSERVICE tool     │
                    └──────────────────────────────┘
                                  │
                                  ▼
                    ┌──────────────────────────────┐
                    │       Clear fault memory       │
                    └──────────────────────────────┘
```
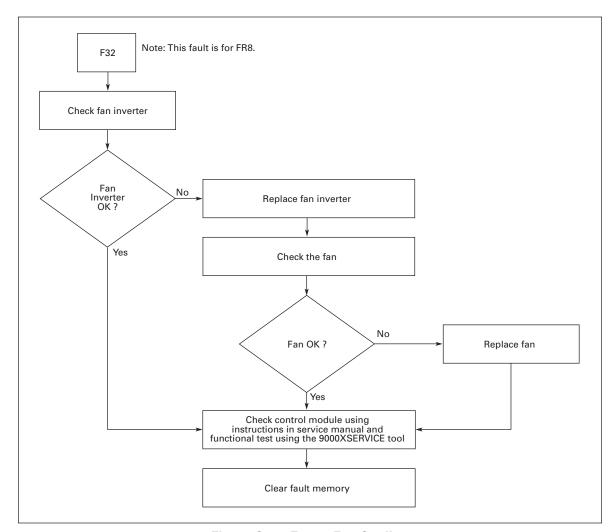
Figure C-21: F32 — Fan Cooling

For more information visit: **www.eaton.com**

F36 — Control Unit
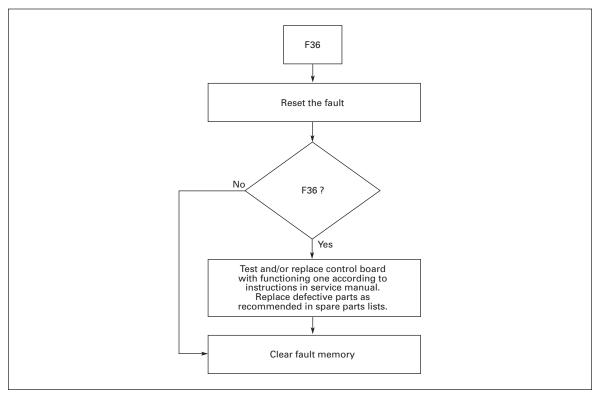
Figure C-22: F36 — Control Unit

F37 — Device Change
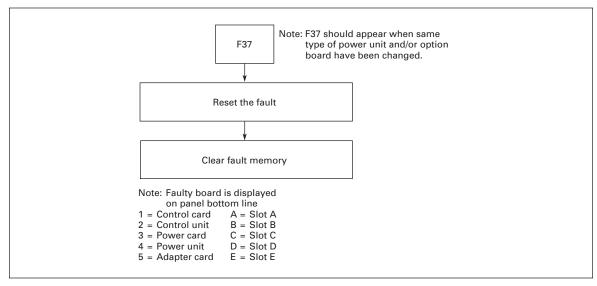
Figure C-23: F37 — Device Change (Indication Only)

F38 — Device Added

F38

Note: F38 should appear when same type
of option board has been added.

Reset the fault

Clear fault memory

Note: Faulty board is displayed
      on panel bottom line
1 = Control card   A = Slot A
2 = Control unit   B = Slot B
5 = Adapter card   C = Slot C
                      D = Slot D
                      E = Slot E
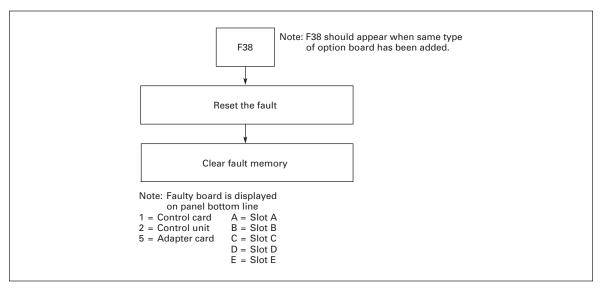
Figure C-24: F38 — Device Added (Indication Only)

F39 — Device Removed

F39

Note: F39 should appear when an option
board has been removed.

Reset the fault

Clear fault memory

Note: Faulty board is displayed
      on panel bottom line
A = Slot A
B = Slot B
C = Slot C
D = Slot D
E = Slot E
5 = Adapter card
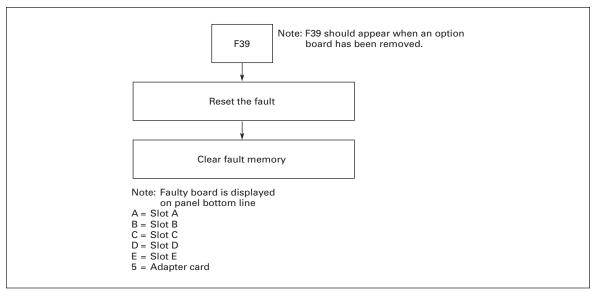
Figure C-25: F39 — Device Removed (Indication Only)

F40 — Device Unknown

```
                    ┌──────────┐     Note: F40 should appear if installed
                    │   F40    │           power board, control board
                    └────┬─────┘           and/or option board are faulty.
                         │
                         ▼
        ┌────────────────────────────────────────┐
        │ Disconnect input power from drive and    │
        │ wait until internal power supply shuts down│
        └────────────────────┬───────────────────┘
                             │
                             ▼
        ┌────────────────────────────────────────┐
        │         Power up the unit                 │
        └────────────────────┬───────────────────┘
                             │
                             ▼
                          ╱─────╲              No
                        ╱  F40 ?  ╲ ──────────────┐
                        ╲         ╱               │
                          ╲─────╱                 │
                             │ Yes                │
                             ▼                    │
        ┌────────────────────────────────────────┐│
        │ Faulty board is displayed on panel bottom line ││
        └────────────────────┬───────────────────┘│
                             │                    │
                             ▼                    │
        ┌────────────────────────────────────────┐│
        │ Change the faulty board and reset the fault ││
        └────────────────────┬───────────────────┘│
                             │                    │
                             ▼                    ▼
        ┌────────────────────────────────────────┐
        │         Clear fault memory               │
        └────────────────────────────────────────┘
```

Note: Faulty board is displayed
     on panel bottom line
1 = Control card   A = Slot A
2 = Control unit   B = Slot B
3 = Power card   C = Slot C
4 = Power unit   D = Slot D
5 = Adapter card   E = Slot E

Figure C-26: F40 — Device Unknown

F41 — IGBT Temperature

Figure C-27: F41 — IGBT Temperature

F42 — Brake Resistor Over Temperature
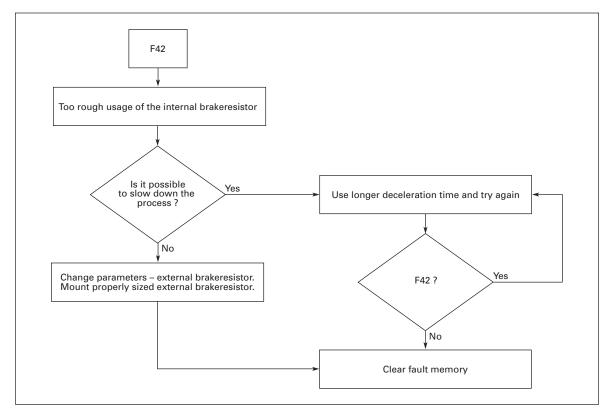
Figure C-28: F42 — Brake Resistor Over Temperature

F44 — DevParChange

Figure box contents:

F44

Note: F44 should appear when different
type power unit and/or option
board have been changed.

Use old parameters ? — Yes → Copy parameters to keypad or upload parameters from drive to PC and save them to file

Use old parameters ? — No → Reset the fault

Copy parameters → Reset the fault → Download parameters to drive → Check parameters

Reset the fault → Check parameters

Check parameters → Disconnect input power form drive and wait until internal power supply shuts down → Power up the drive → Check parameters → Clear fault memory

Note: Faulty board is displayed
    on panel bottom line
A = Slot A
B = Slot B
C = Slot C
D = Slot D
E = Slot E
4 = Power unit

Figure C-29: F44 — DevParChange

F45 — DevParAdded
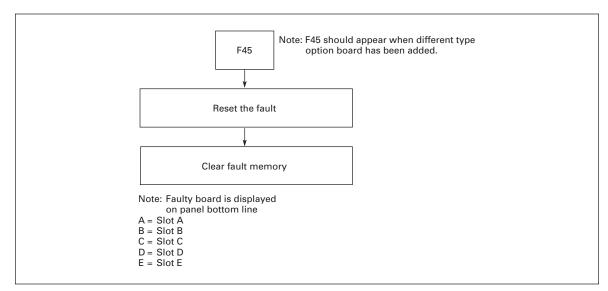
Figure C-30: F45 — DevParAdded

F50 — Analog Input I_{in} < 4 mA

```
                        ┌─────────┐
                        │   F50   │
                        └─────────┘
                             │
                             ▼
              ┌──────────────────────────────┐
              │   Check value on monitoring   │
              │ page corresponding to the input│
              └──────────────────────────────┘
                             │
                             ▼
              ┌──────────────────────────────┐
              │      Measure mA signal of      │
              │    the measurement device      │
              └──────────────────────────────┘
                             │
                             ▼
                      ╱─────────────╲
                     ╱  Measured value = ╲        No
                     ╲  Monitored value ? ╱────────────┐
                      ╲─────────────╱                   │
                             │                          │
                            Yes                         │
                             ▼                          │
                      ╱─────────────╲                   │
                     ╱               ╲      No   ┌──────────────────────────────┐
                     ╲   I<4mA ?      ╱─────────▶│ Test input on the option board,│
                      ╲─────────────╱            │ if faulty replace option board │
                             │                   │     with functioning one        │
                            Yes                  └──────────────────────────────┘
                             │                          │
                             │                          ▼
              ┌──────────────────────────────┐  ┌──────────────────────────────┐
              │ Make corrections to external  │  │  Test and/or replace control   │
              │          circuit               │  │  board with functioning one    │
              └──────────────────────────────┘  │  according to instructions in   │
                             │                   │  service manual. Replace        │
                             │                   │  defective parts as recommended │
                             │                   │      in spare parts lists.      │
                             │                   └──────────────────────────────┘
                             │                          │
                             │                          ▼
                             │                   ┌──────────────────────────────┐
                             └──────────────────▶│       Clear fault memory        │
                                                 └──────────────────────────────┘
```

Figure C-31: F50 — Analog Input I_{in} < 4 mA

F51 — External Fault

```
                        ┌──────────┐
                        │   F51    │
                        └────┬─────┘
                             │
              ┌──────────────▼──────────────────┐
              │ Set parameters to match with     │
              │ application                      │
              └──────────────┬──────────────────┘
                             │
              ┌──────────────▼──────────────────┐
              │ Read status of programming input │
              │ from corresponding monitoring page│
              └──────────────┬──────────────────┘
                             │
                      ◇ Actual status =
                        Monitored status ?  ──Yes──► External reason for activating the fault
                             │ No                              │
              ┌──────────────▼──────────────────┐   ┌──────────────────────────────────┐
              │ Check I/O option board, replace  │   │ Make corrections to the external  │
              │ if necessary                     │   │ devices                          │
              └──────────────┬──────────────────┘   └──────────────┬───────────────────┘
              ┌──────────────▼──────────────────┐                  │
              │ Test and/or replace control board│                 │
              │ with functioning one according to│                 │
              │ instructions in service manual.  │                 │
              │ Replace defective parts as       │                 │
              │ recommended in spare parts lists.│                 │
              └──────────────┬──────────────────┘                  │
                             └────────────►┌──────────────────────▼─────┐
                                           │    Clear fault memory       │
                                           └─────────────────────────────┘
```

Figure C-32: F51 — External Fault

F52 — Keypad Communication Fault
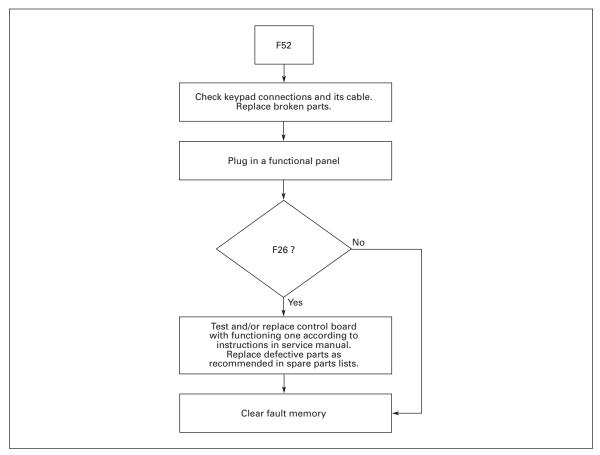
Figure C-33: F52 — Keypad Communication Fault

October 2007

Appendix D — Spare Parts

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 (see **Figure D-1**).

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.
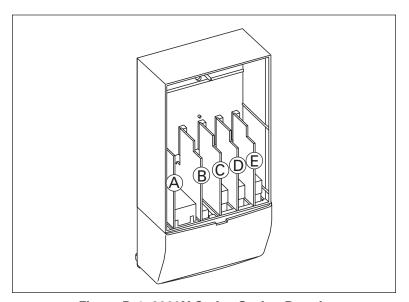
Figure D-1: 9000X Series Option Boards

Table D-1: Option Board Kits

Option Kit Description ②	Allowed Slot Locations ①	Field Installed Catalog Number	Factory Installed Option Designator	9000X Ready Programs						
				Basic	Local/ Remote	Standard	MSS	PID	Multi-P.	PFC
Standard I/O Cards (See Figure D-1)										
2 RO (NC/NO)	B	**OPTA2**	—	X	X	X	X	X	X	X
6 DI, 1 DO, 2 AI, 1AO, 1 +10V DC ref, 2 ext +24V DC/ EXT +24V DC	A	**OPTA9**	—	X	X	X	X	X	X	X
Extended I/O Card Options										
2 RO, Therm	B	**OPTA3**	A3	—	X	X	X	X	X	X
Encoder low volt +5V/15V24V	C	**OPTA4**	A4	—	X	X	X	X	X	X
Encoder high volt +15V/24V	C	**OPTA5**	A5	—	X	X	X	X	X	X
Double encoder — SPX Only	C	**OPTA7**	A7	X	X	X	X	X	X	X
6 DI, 1 DO, 2 AI, 1 AO	A	**OPTA8**	A8	—	X	X	X	X	X	X
3 DI (Encoder 10 – 24V), Out +15V/+24V, 2 DO (pulse+direction) — SPX Only	C	**OPTAE**	AE	X	X	X	X	X	X	X

① Option card must be installed in one of the slots listed for that card. Slot indicated in Bold is the preferred location.
② AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

Table D-1: Option Board Kits (Continued)

Option Kit Description [2]	Allowed Slot Locations [1]	Field Installed Catalog Number	Factory Installed Option Designator	9000X Ready Programs						
				Basic	Local/ Remote	Standard	MSS	PID	Multi-P.	PFC
Extended I/O Card Options (Continued)										
6 DI, 1 ext +24V DC/EXT +24V DC	B, C, **D**, E	**OPTB1**	**B1**	—	—	—	—	—	X	X
1 RO (NC/NO), 1 RO (NO), 1 Therm	B, C, **D**, E	**OPTB2**	**B2**	—	—	—	—	—	X	X
1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24V DC/ EXT +24V DC	B, C, **D**, E	**OPTB4**	**B4**	—	X	X	X	X	X	X
3 RO (NO)	B, C, **D**, E	**OPTB5**	**B5**	—	—	—	—	—	X	X
1 ext +24V DC/EXT +24V DC, 3 Pt100	B, C, **D**, E	**OPTB8**	**B8**	—	—	—	—	—	—	—
1 RO (NO), 5 DI 42 – 240V AC Input	B,C, **D**, E	**OPTB9**	**B9**	—	—	—	—	—	X	X
SPI, Absolute Encoder	C	**OPTBB**	**BB**	—	—	—	—	—	—	—
Communication Cards [3]										
Modbus	D, **E**	**OPTC2**	**C2**	X	X	X	X	X	X	X
Johnson Controls N2	D, **E**	**OPTC2**	**CA**	—	—	—	—	—	—	—
Modbus TCP	D, **E**	**OPTCI**	**CI**	X	X	X	X	X	X	X
BACnet	D, **E**	**OPTCJ**	**CJ**	X	X	X	X	X	X	X
Ethernet IP	D, **E**	**OPTCK**	**CK**	X	X	X	X	X	X	X
Profibus DP	D, **E**	**OPTC3**	**C3**	X	X	X	X	X	X	X
LonWorks	D, **E**	**OPTC4**	**C4**	X	X	X	X	X	X	X
Profibus DP (D9 Connector)	D, **E**	**OPTC5**	**C5**	X	X	X	X	X	X	X
CanOpen (Slave)	D, **E**	**OPTC6**	**C6**	X	X	X	X	X	X	X
DeviceNet	D, **E**	**OPTC7**	**C7**	X	X	X	X	X	X	X
Modbus (D9 Type Connector)	D, **E**	**OPTC8**	**C8**	X	X	X	X	X	X	X
Adapter — SPX Only	D, **E**	**OPTD1**	**D1**	X	X	X	X	X	X	X
Adapter — SPX Only	D, **E**	**OPTD2**	**D2**	X	X	X	X	X	X	X
RS-232 with D9 Connection	D, **E**	**OPTD3**	**D3**	X	X	X	X	X	X	X
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**	—	—	—	—	—	—	—	—

[1] Option card must be installed in one of the slots listed for that card. Slot indicated in Bold is the preferred location.

[2] AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output

[3] OPTC2 is a multi-protocol option card.

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.

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 120Ω, and specific line delay of nominal 5 nS/m. 120Ω 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 2-wire twisted shielded cable with 2-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud.

Drive Options

Control Panel Options

Table D-2: Control Panel Factory Options

Description	Factory Installed Option Code	Field Installed NEMA Type 1 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 9000X 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 9000X 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
9000XDrive — A PC-based tool for controlling and monitoring of the 9000X. 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 9000X Drive option to avoid damage to the drive or computer. The same cable can be used for downloading specialized applications to the drive.	—	SVDRIVECABLE

![Eaton logo] | **Cutler-Hammer**

October 2007

Spare Units & Replacement Parts for 9000X Drives

Table D-3: 9000X Spare Units

Description	Catalog Number
Control Unit – Includes the control board, blue base housing, installed 9000X software program and blue flip cover. Does not include any OPT boards or keypad. See **Figure D-1** and **Table D-1** (**Page D-1**) for standard and option boards and keypad.	**CSBS0000000000** (for SVX) **CPBS0000000000** (for SPX)

208 – 240V

Table D-4: Replacement Parts — 9000X Drives, 208 – 240V

Frame:	4					5			6		7			8			Catalog Number
hp (I$_H$):	3/4	1	1-1/2	2	3	5 ①	5	7-1/2	10	15	20	25	30	40	50	60	
Control Board																	
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**VB00252** (for SVX)
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**VB00561** (for SPX)
Power Boards																	
	1																VB00308-0004-2
		1															VB00308-0007-2
			1														VB00308-0008-2
				1													VB00310-0011-2
					1												VB00310-0012-2
						1											VB00313-0017-2
							1										VB00313-0025-2
								1									VB00313-0031-2
									1								VB00316-0048-2
										1							VB00316-0061-2
											1						VB00319-0075-2
												1					VB00319-0088-2
													1				VB00319-0114-2
														1			VB00322-0140-2
															1		VB00322-0170-2
																1	VB00322-0205-2
Electrolytic Capacitors																	
	2	2	2														PP01000
				2	2												PP01001
						2	2										PP01002
								2									PP01003
									2	2							PP01004
											2	2	2	4	4		PP01005
																4	PP01099

① 5 hp I$_L$ only; has no corresponding I$_H$ rated hp rating.

Table D-4: Replacement Parts — 9000X Drives, 208 – 240V (Continued)

Frame: 4					5			6		7			8			Catalog Number
3/4	1	1-1/2	2	3	5①	5	7-1/2	10	15	20	25	30	40	50	60	
Cooling Fans																
1	1	1	1	1												PP01060
					1	1	1									PP01061
								1	1							PP01062
										1	1	1				PP01063
													1	1	1	PP01123 ②
1	1	1	1	1												PP01086
					1	1	1	1	1							PP01088
										1	1	1				PP01049
													1	2	2	CP01180
													1	1	1	PP08037
IGBT Modules																
1	1															CP01304
		1														CP01305
			1	1	1											CP01306
						1										CP01307
							1									CP01308
								1								PP01022
									1							PP01023
										1						PP01024
											1					PP01025
												1				PP01029
													1			PP01026
														1	1	PP01027
Choppers/Rectifiers																
								1								CP01367
									1							CP01368
Diode/Thyristor Modules																
										3	3	3				PP01035
													3	3	3	CP01268
Rectifying Boards																
										1	1	1				VB00242
													1	1	1	VB00227

① 5 hp I_L only; has no corresponding I_H rated hp rating.
② PP00061 capacitor not included in main fan; please order separately.

Eaton | Cutler-Hammer

October 2007

FR4 – FR9, 380 – 500V

Table D-5: Replacement Parts — FR4 – FR9 9000X Drives, 380 – 500V

Frame:	4						5			6			7			8			9		Catalog Number
hp (I_H):	1	1-1/2	2	3	5	7-1/2 ①	7-1/2	10	15	20	25	30	40	50	60	75	100	125	150	200	
Control Board																					
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**VB00252** (for SVX)
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**VB00561** (for SPX)
Power Boards																					
	1																				VB00208-0003-5
		1																			VB00208-0004-5
			1																		VB00208-0005-5
				1																	VB00208-0007-5
					1																VB00208-0009-5
						1															VB00210-0012-5
							1														VB00213-0016-5
								1													VB00213-0022-5
									1												VB00213-0031-5
										1											VB00216-0038-5
											1										VB00216-0045-5
												1									VB00216-0061-5
													1								VB00219-0072-5
														1							VB00219-0087-5
															1						VB00219-0105-5
																1					VB00236-0140-5
																	1				VB00236-0168-5
																		1			VB00236-0205-5
Electrolytic Capacitors																					
	2	2	2	2																	PP01000
					2	2															PP01001
							2	2													PP01002
									2												PP01003
										2	2	2									PP01004
													2	2	2	4	4	4	8	8	PP01005
Cooling Fans																					
	1	1	1	1	1	1															PP01060
							1	1	1												PP01061
										1	1	1									PP01062
													1	1	1						PP01063
																1	1	1			PP01123 ②
																			1	1	PP01080 ③

① I_L only; has no corresponding I_H rated hp rating.
② PP00061 capacitor not included in main fan; please order separately.
③ PP00011 capacitor not included in main fan; please order separately.

EAT•N | Cutler-Hammer

Table D-5: Replacement Parts — FR4 – FR9 9000X Drives, 380 – 500V (Continued)

Frame: 4						5			6			7			8			9		Catalog Number
hp (I$_H$): 1	1-1/2	2	3	5	7-1/2①	7-1/2	10	15	20	25	30	40	50	60	75	100	125	150	200	
Cooling Fans (Continued)																				
1	1	1	1	1	1															PP01086
						1	1	1												PP01088
									1	1	1	1	1	1						PP01049
															1	1	1			CP01180
																		1②	2	PP01068
																		1	1	PP09051
IGBT Modules																				
1	1	1																		CP01304
			1	1																CP01305
					1	1														CP01306
							1													CP01307
								1												CP01308
									1	1										PP01022
											1									PP01023
												1								PP01024
													1							PP01025
														1						PP01029
															1					PP01026
																1	1			PP01027
Chopper/Rectifiers																				
									1	1										CP01367
											1									CP01368
Diode/Thyristor Modules																				
												3	3	3						PP01035
															3	3	3			CP01268
																		3	3	PP01037
Rectifying Boards																				
												1	1	1						VB00242
															1	1	1			VB00227
																		1	1	VB00459
Rectifying Module Sub-assembly																				
																		1	1	FR09810
Power Module Sub-assemblies																				
																		1		FR09-150-4-ANS③
																			1	FR09-200-4-ANS③

① I$_L$ only; has no corresponding I$_H$ rated hp rating.
② For FR9 NEMA Type 12 you need two PP01068 internal fans.
③ See **Table D-9** for details.

For more information visit: **www.eaton.com**

October 2007

FR10 – FR12, 380 – 500

Table D-6: Replacement Parts — FR10 – FR12 9000X Drives, 380 – 500V

Frame:	10			11			12			Catalog Number
hp (I_H):	250	300	350	400	500	550	600	650	700	
Control Board										
	1	1	1	1	1	1	1	1	1	VB00561
Shunt Boards										
	6									VB00537
		6								VB00497
			6				12	12	12	VB00498
				9						VB00538
					9					VB00513
						9				VB00514
Driver Boards										
				3	3	3				VB00489
	1	1	1				2	2	2	VB00487
Driver Adapter Board										
	1	1	1				2	2	2	VB00330
ASIC Board										
	1	1	1	1	1	1	2	2	2	VB00451
Feedback Interface Board										
							2	2	2	VB00448
Star Coupler Board										
							1	1	1	VB00336
Power Modules										
	1	1	1	2	2	2	2	2	2	FR10820 [1]
	2	2	2							FR10828
	1									FR10-250-4-ANS [2]
		1								FR10-300-4-ANS [2]
			1				2	2	2	FR10-350-4-ANS [2]
				3						FR11-400-4-ANS [2]
					3					FR11-500-4-ANS [2]
						3				FR11-550-4-ANS [2]

[1] Rectifying board not included.
[2] See **Table D-9** for details.

Table D-6: Replacement Parts — FR10 – FR12 9000X Drives, 380 – 500V (Continued)

Frame:	10			11			12			Catalog Number
hp (I$_H$):	250	300	350	400	500	550	600	650	700	
Electrolytic Capacitors										
	2	2	2	3	3	3	4	4	4	PP00060
	12	12	12	18	18	18	24	24	24	PP01005
Fuses										
	1	1	1	1	1	1	2	2	2	PP01094
	2	2	2	2	2	2	4	4	4	PP01095
Cooling Fans and Isolation Transformers										
	2	2	2	3	3	3	4	4	4	VB00299
	2	2	2	3	3	3	4	4	4	PP01080 [1]
	2	2	2				4	4	4	PP01068
	1	1	1	1	1	1	2	2	2	PP01096
	1	1	1				2	2	2	FR10844
	1	1	1	3	3	3	2	2	2	FR10845
	1	1	1				2	2	2	FR10846
	1	1	1	3	3	3	2	2	2	FR10847
Rectifying Board										
	1	1	1	2	2	2	2	2	2	VB00459

[1] PP00060 capacitor not included in main fan; please order separately.

October 2007

FR6 – FR9, 525 – 690V

Table D-7: Replacement Parts — FR6 – FR9 9000X Drives, 525 – 690V

Frame:	6									7		8			9				Catalog Number
hp (I_H):	2	3	5①	5	7-1/2	10	15	20	25	30	40	50	60	75	100	125	150	200①	
Control Board																			
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**VB00252** (for SVX)
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**VB00561** (for SPX)
Driver Board																			
	1																		**VB00404-0004-6**
		1																	**VB00404-0005-6**
			1																**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**
Power Boards																			
	1	1	1	1	1	1	1	1	1										**VB00414**
										1									**VB00419-0041-6**
											1								**VB00419-0052-6**
												1							**VB00422-0062-6**
													1						**VB00422-0080-6**
														1					**VB00422-0100-6**
Power Modules																			
															1				**FR09-100-5-ANS** ②
																1			**FR09-125-5-ANS** ②
																	1		**FR09-150-5-ANS** ②
																		1	**FR09-175-5-ANS** ②
Electrolytic Capacitors																			
	2	2	2	2	2	2	2	2	2										**PP01093**
										2	2	4	4		8	8	8	8	**PP01041**
														4					**PP01040**
Fuses																			
												1	1	1	1	1	1	1	**PP01094**
												2	2	2	2	2	2	2	**PP01095**

① I_L only; has no corresponding I_H rated hp rating.
② See **Table D-9** for details.

E·T·N | Cutler-Hammer

Table D-7: Replacement Parts — FR6 – FR9 9000X Drives, 525 – 690V (Continued)

Frame:	6									7		8			9				Catalog Number
hp (I_H):	2	3	5①	5	7-1/2	10	15	20	25	30	40	50	60	75	100	125	150	200①	
Cooling Fans																			
	1	1	1	1	1														PP01061
						1	1	1	1										PP01062
										1	1								PP01063
												1	1	1					PP01123
	1	1	1	1	1	1	1	1	1	1	1								PP01049
												1	1	1					CP01180
															1	1	1	1②	PP01068
															1	1	1	1	PP01080
Fan Power Supply																			
															1	1	1		VB00299
IGBT Modules																			
	3	3	3	3	3	3	3	3	3										PP01091
										1	1								PP01089
												1	1	1					PP01127
IGBT/Diode (Brake)																			
	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	PP01040
Diode Module																			
	1	1	1	1	1	1	1	1	1										PP01092
Diode/Thyristor Modules																			
										3	3								PP01071
															3	3	3	3	PP01072
Rectifying Boards																			
										1	1								VB00442
															1	1	1	1	VB00460
Rectifying Module Sub-assemblies																			
															1	1	1		FR09810
															1	1	1		FR09811

① I_L only; has no corresponding I_H rated hp rating.
② For NEMA Type 12, two PP01068 internal fans are needed.

FR10 – FR12, 525 – 690V

Table D-8: Replacement Parts — FR10 – FR12 9000X Drives, 525 – 690V

Frame:	10			11			12			Catalog Number
hp (I$_H$):	200	250	300	400	450	500	550	600	700	
Control Board										
	1	1	1	1	1	1	1	1	1	VB00561
Shunt Boards										
	6									VB00545
		6								VB00510
			6				12	12	12	VB00511
				9						VB00546
					9					VB00547
						9				VB00512
Driver Boards										
	1	1	1				2	2	2	VB00487
				3	3	3				VB00489
Driver Adapter Board										
	1	1	1				2	2	2	VB00330
ASIC Board										
	1	1	1	1	1	1	2	2	2	VB00451
Feedback Interface Board										
							2	2	2	VB00448
Star Coupler Board										
							1	1	1	VB00336
Power Modules										
	1	1	1	2	2	2	2	2	2	FR10821 ①
	2	2	2							FR10829
	1									FR10-200-5-ANS ②
		1								FR10-250-5-ANS ②
			1				2	2	2	FR10-300-5-ANS ②
				3						FR11-400-5-ANS ②
					3					FR11-450-5-ANS ②
						3				FR11-500-5-ANS ②
Electrolytic Capacitors										
	2	2	2	3	3	3	4	4	4	PP00060
	12	12	12	18	18	18	24	24	24	PP01099

① Rectifying board not included.
② See **Table D-9** for details.

Table D-8: Replacement Parts — FR10 – FR12 9000X Drives, 525 – 690V (Continued)
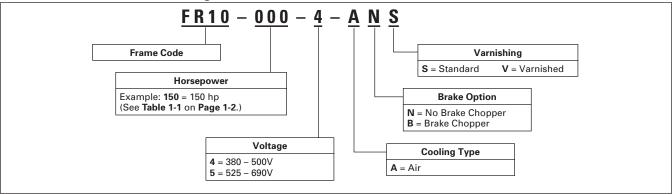
Frame:	10			11			12			Catalog Number
hp (I_H):	200	250	300	400	450	500	550	600	700	
Fuses										
	1	1	1	1	1	1	2	2	2	PP01094
	2	2	2	2	2	2	4	4	4	PP01095
Cooling Fans and Isolation Transformers										
	2	2	2	3	3	3	4	4	4	VB00299
	2	2	2	3	3	3	4	4	4	PP01080 [1]
	2	2	2				4	4	4	PP01068
	1	1	1	1	1	1	2	2	2	PP01096
	1	1	1				2	2	2	FR10844
	1	1	1	3	3	3	2	2	2	FR10845
	1	1	1				2	2	2	FR10846
	1	1	1	3	3	3	2	2	2	FR10847
Fan Power Supply										
							1	1	1	VB00299
Rectifying Boards										
	1	1	1	2	2	2	2	2	2	VB00460

[1] PP00060 capacitor not included in main fan; please order separately.

Power Module

Table D-9: Power Module Catalog Number Matrix

FR10 – 000 – 4 – A N S

Frame Code

Horsepower
Example: **150** = 150 hp
(See **Table 1-1** on **Page 1-2**.)

Voltage
4 = 380 – 500V
5 = 525 – 690V

Cooling Type
A = Air

Brake Option
N = No Brake Chopper
B = Brake Chopper

Varnishing
S = Standard   **V** = Varnished

Company Information

Eaton's electrical business is a global leader in electrical control, power distribution, uninterruptible power supply and industrial automation products and services. Eaton's global electrical brands, including Cutler-Hammer®, Powerware®, Holec® and MEM®, provide customer-driven PowerChain Management™ solutions to serve the power system needs of the industrial, institutional, government, utility, commercial, residential, IT, mission critical and OEM markets worldwide.

Eaton Corporation is a diversified industrial manufacturer with 2006 sales of $12.4 billion. Eaton is a global leader in electrical systems and components for power quality, distribution and control; fluid power systems and services for industrial, mobile and aircraft equipment; intelligent truck drivetrain systems for safety and fuel economy; and automotive engine air management systems, powertrain solutions and specialty controls for performance, fuel economy and safety. Eaton has 62,000 employees and sells products to customers in more than 125 countries. For more information, visit **www.eaton.com**.

E·T·N | **Cutler-Hammer**