EATON | Cutler-Hammer

SVX9000 AF Drives

User Manual
Application Manual

Supersedes October 2003
April 2004

Volume Contents

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Important Notice – Please Read

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

Cover Photo: Cutler-Hammer® SVX9000 AF Drives.

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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 Adjustable Frequency Drive from Eaton Electrical®.

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 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 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 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 drive covers:

- Disconnect all power to the SVX9000 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 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 output terminals (U, V, W) to avoid damaging the SVX9000 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's Cutler-Hammer business unit will void all warranties and may result in a safety hazard in addition and voiding of the UL listing.

CAUTION

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

CAUTION

Install the SVX9000 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 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 HXV9000 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 output or the motor terminals to prevent SVX9000 malfunction and potential damage.

CAUTION

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

Chapter 1 — Overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations and the Cutler-Hammer® SVX9000 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 drive by Eaton Electrical®. 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. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

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

Receiving and Inspection

This SVX9000 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 drive, please check for the following:

- Check to make sure that the package(s) includes the SVX9000 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 Electrical Cutler-Hammer 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 on the wall or cabinet.

Open SVX9000 Catalog Numbers

Table 1-1: SVX9000 AF Drive Catalog Numbering System

SVX 007A 1 - 4 A 1 B 1 _ _ _

Product	
SVX =	SVX Industrial Drive
SPX =	SPX Drive (Fr10 and larger only)

Horsepower (CT) [1][2]	
F07 = 3/4	**030** = 30
001 = 1	**040** = 40
F15 = 1-1/2	**050** = 50
002 = 2	**060** = 60
003 = 3	**075** = 75
004 = 5 VT Only	**100** = 100
005 = 5	**125** = 125
006 = 7-1/2 VT Only	**150** = 150
007 = 7-1/2	**200** = 200
010 = 10	**250** = 250
015 = 15	**300** = 300
020 = 20	**350** = 350
025 = 25	

AFD Software Series
A = Standard Software

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

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

Keypad
A = AlphaNumeric

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

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

Board Modifications
1 = Standard Boards (A9, A2)

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

[1] All 230V Drives and 480V Drives up to 200 hp (CT) are only available with Input Option **1**.
[2] 480V Drives 250 hp (CT) or larger are only available with Input Option **2**.
[3] 480V Drives up to 30 hp (CT) are only available with Brake Chopper Option **B.**
[4] 480V Drives 40 hp (CT) and larger come with Brake Chopper Option **N** as standard.
[5] 230V Drives up to 15 hp (CT) are only available with Brake Chopper Option **B.**
[6] 230V Drives 20 hp (CT) or larger come with Brake Chopper Option **N** as standard.
[7] 480V Drives 250 hp, 300 hp and 350 hp (CT) are only available with Enclosure Style **0** (Chassis).

Chapter 2 — Mounting

The SVX9000 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 Drive

Frame	Drive Type	Dimensions in Inches (mm) ①				
		A	A_2	B	C	D
4	230V, 1 – 3 hp VT, 3/4 – 3 hp CT 480V, 1 – 5 hp CT, 1-1/2 – 7-1/2 hp VT	0.8 (20)	—	0.8 (20)	3.9 (100)	2.0 (50)
5	230V, 5 – 10 hp VT, 5 – 7-1/2 hp CT 480V, 7-1/2 – 15 hp CT, 10 – 20 hp VT	1.2 (30)	—	0.8 (20)	4.7 (120)	2.4 (60)
6	230V, 15 – 20 hp VT, 10 – 15 hp CT 480V, 20 – 30 hp CT, 25 – 40 hp VT 575V, 2 – 25 hp CT, 3 – 30 hp VT	1.2 (30)	—	0.8 (20)	6.3 (160)	3.1 (80)
7	230V, 25 – 40 hp VT, 20 – 30 hp CT 480V, 40 – 60 hp CT, 50 – 75 hp VT 575V, 30 – 40 hp CT, 40 – 50 hp VT	3.1 (80)	—	3.1 (80)	11.8 (300)	3.9 (100)
8	480V, 75 – 125 hp CT, 100 – 150 hp VT 575V, 50 – 75 hp CT, 60 – 100 hp VT	3.1 (80)	5.9 (150)	3.1 (80)	11.8 (300)	7.9 (200)
9	480V, 200 – 250 hp VT, 150 – 200 hp CT 575V, 100 – 150 hp CT, 150 – 200 hp VT	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. See **Figure 2-1** below.
A = clearance around the SVX9000.
A_2 = clearance needed to change the fan without disconnecting the motor cables.
B = distance between adjacent SVX9000s or between the SVX9000 and an enclosure wall.
C = clearance above the SVX9000.
D = clearance below the SVX9000.
② Minimum clearance below the SVX9000 needed to change the fan.

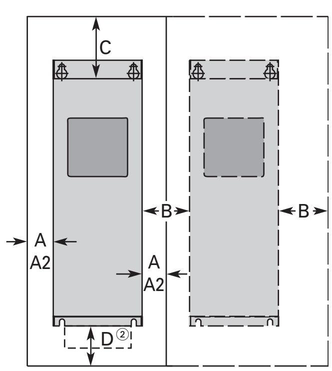


Figure 2-1: Mounting Space Requirements.

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 CT 480V, 1 – 5 hp CT	41 cfm (70 m^3/h)
230V, 5 – 7-1/2 hp CT 480V, 7-1/2 – 15 hp CT	112 cfm (190 m^3/h)
230V, 10 – 15 hp CT 480V, 20 – 30 hp CT 575V, 2 – 25 hp CT	250 cfm (425 m^3/h)
230V, 20 – 30 hp CT 480V, 40 – 60 hp CT 575V, 30 – 40 hp CT	250 cfm (425 m^3/h)
480V, 75 – 125 hp CT 575V, 60 – 75 hp CT	383 cfm (650 m^3/h)
480V, 150 – 200 hp CT 575V, 100 – 150 hp CT	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** and **3-5.**
- Consistent with UL listing requirements, for maximum protection of the SVX9000 drive, UL recognized fuses type RK5 should be used for 480V and 230V ratings.
- 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: Cable and Fuse Sizes – 230V Ratings

hp	Frame Size	I_I (A)	Fuse (A) ①	Wire Size ② Power	Wire Size ② Ground	Terminal Size Power	Terminal Size Ground
1 1-1/2 2 3	FR4	4.8 6.6 7.8 11	10 10 10 15	14 14 14 12	14 14 14 14	12 – 16 12 – 16 12 – 16 12 – 16	14 – 16 14 – 16 14 – 16 14 – 16
5 7-1/2	FR5	17.5 25	20 30	10 8	10 8	8 – 16 8 – 18	8 – 16 8 – 16
10 15	FR6	31 48	40 60	8 4	8 6	0 – 14 0 – 14	2 – 10 2 – 10
20 25 30	FR7	61 72 87	80 100 110	2 2 1/0	6 6 4	0 – 14 0 – 14 0 – 14	00 – 10 00 – 10 00 – 10

① UL recognized type RK.
② Based on a maximum environment of 104°F (40°C).

Table 3-3: Cable and Fuse Sizes – 480V Ratings

hp	Frame Size	I_I (A)	Fuse (A) ①	Wire Size ② Power	Wire Size ② Ground	Terminal Size Power	Terminal Size Ground
1-1/2 2 3 5	FR4	3.3 4.3 5.6 7.6	10 10 10 10	14 14 14 14	14 14 14 14	12 – 16 12 – 16 12 – 16 12 – 16	14 – 16 14 – 16 14 – 16 14 – 16
7-1/2 10 15	FR5	12 16 23	15 20 30	12 10 8	12 10 8	8 – 16 8 – 16 8 – 16	8 – 16 8 – 16 8 – 16
20 25 30	FR6	31 38 46	35 50 60	8 6 4	8 8 6	0 – 14 0 – 14 0 – 14	2 – 10 2 – 10 2 – 10
40 50 60	FR7	61 72 87	80 100 110	2 2 1/0	6 6 4	0 – 14 0 – 14 0 – 14	2/0 – 10 2/0 – 10 2/0 – 10
75 100 125	FR8	105 140 170	125 175 200	2/0 4/0 300	2 1/0 2/0	3/0 – 4 350MCM – 3/0 350MCM – 3/0	3/0 – 4 3/0 – 4 3/0 – 4
150 200	FR9	205 261	250 350	350MCM 2x250MCM	3/0 3/0	350MCM – 2x3/0 350MCM – 2x3/0	3/0 – 4 3/0 – 4
250 300 350	FR10	300 385 460	400 450 600	2x250 2x300 2x400	300MCM 300MCM 300MCM	600MCM 600MCM 600MCM	600MCM 600MCM 600MCM

① UL recognized type RK.
② Based on a maximum environment of 104°F (40°C).

Table 3-4: Cable and Fuse Sizes – 575V Ratings

hp	Frame Size	I_I (A)	Fuse (A) ①	Wire Size ② Power	Wire Size ② Ground	Terminal Size Power	Terminal Size Ground
2	FR6	3.3	10	14	14	14 – 0	14 – 2
3		4.5	10	14	14	14 – 0	14 – 2
5		7.5	10	14	14	14 – 0	14 – 2
7-1/2		10	15	12	14	14 – 0	14 – 2
10		13.5	20	10	12	14 – 0	14 – 2
15		18	30	10	10	14 – 0	14 – 2
20		22	35	8	8	14 – 0	14 – 2
25		27	40	8	8	14 – 0	14 – 2
30	FR7	34	50	6	8	14 – 0	10 – 0
40		41	60	4	6	14 – 0	10 – 0
50	FR8	52	80	2	6	4 – 3/0	4 – 3/0
60		62	100	1	6	4 – 3/0	4 – 3/0
75		80	125	1/0	6	4 – 3/0	4 – 3/0
100		100	175	3/0	6	4 – 3/0	4 – 3/0
125	FR9	125	200	4/0	2	2x3/0 – 350MCM	4 – 3/0
150		144	250	350	1/0	2x3/0 – 350MCM	4 – 3/0
200	FR10	208	350	2x250	300MCM	600MCM	600MCM
250		261	450	2x300	300MCM	600MCM	600MCM
300		325	500	2x350	300MCM	600MCM	600MCM

① UL recognized type RK.
② Based on a maximum environment of 104°F (40°C).

Table 3-5: 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

Table 3-6: 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 3-7**.

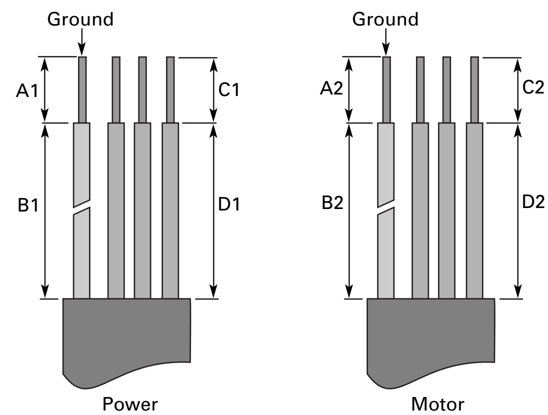


Figure 3-1: Input Power and Motor Cable Stripping and Wire Lengths

Cable Stripping Lengths for Power and Motor Cables

Table 3-7: 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.

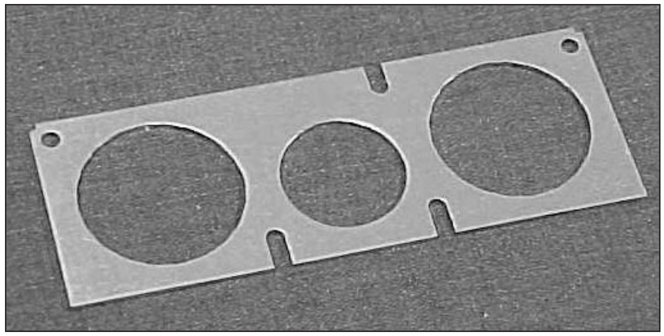


Figure 3-2: Wiring Plate

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 3-7.**
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 drive, the motor and the line power supply.

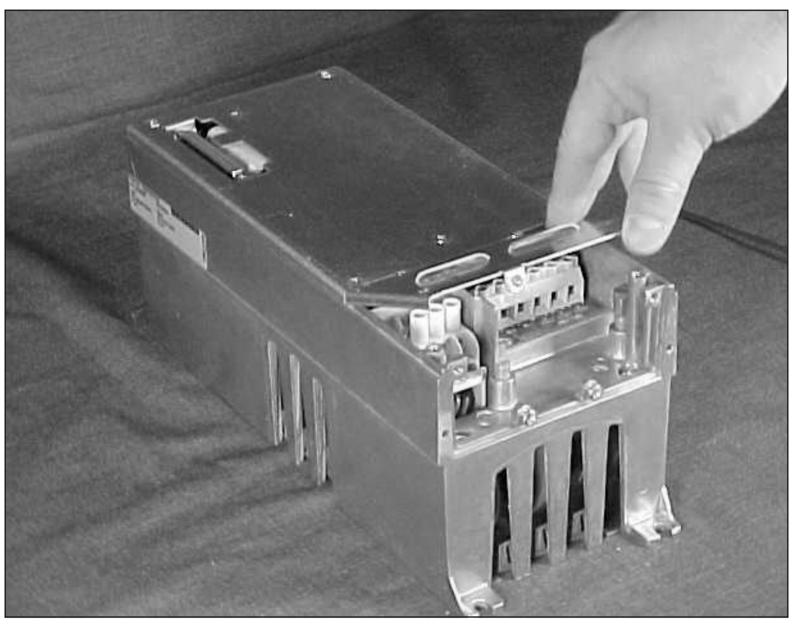


Figure 3-3: Ground Terminal Locations

8. If shielded cable is not used, check the connection of the ground cable to the motor, the SVX9000 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**.

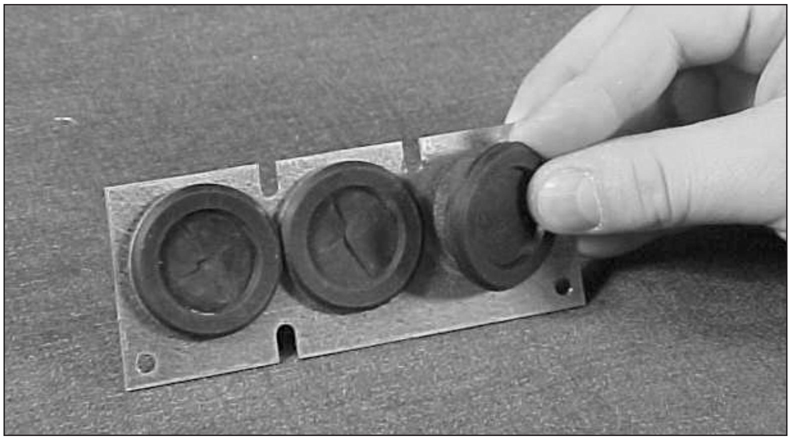


Figure 3-4: Cable Protection Plate

Standard Wiring Diagrams and Terminal Locations

The following wiring diagrams show the line and motor connections of the frequency converter.

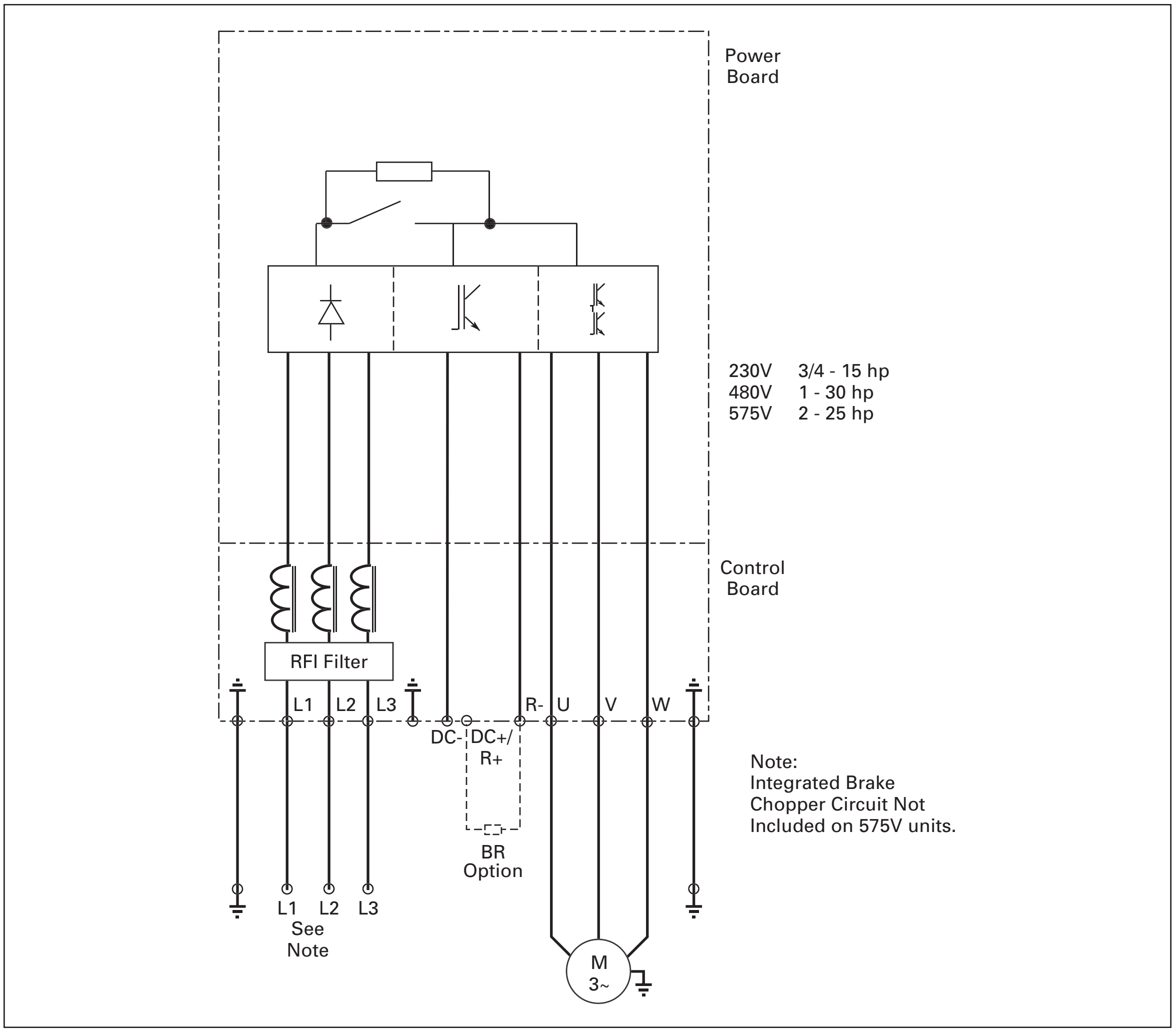


Figure 3-5: Principle Wiring Diagram of SVX Power Unit, FR4 to FR5 and FR6

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

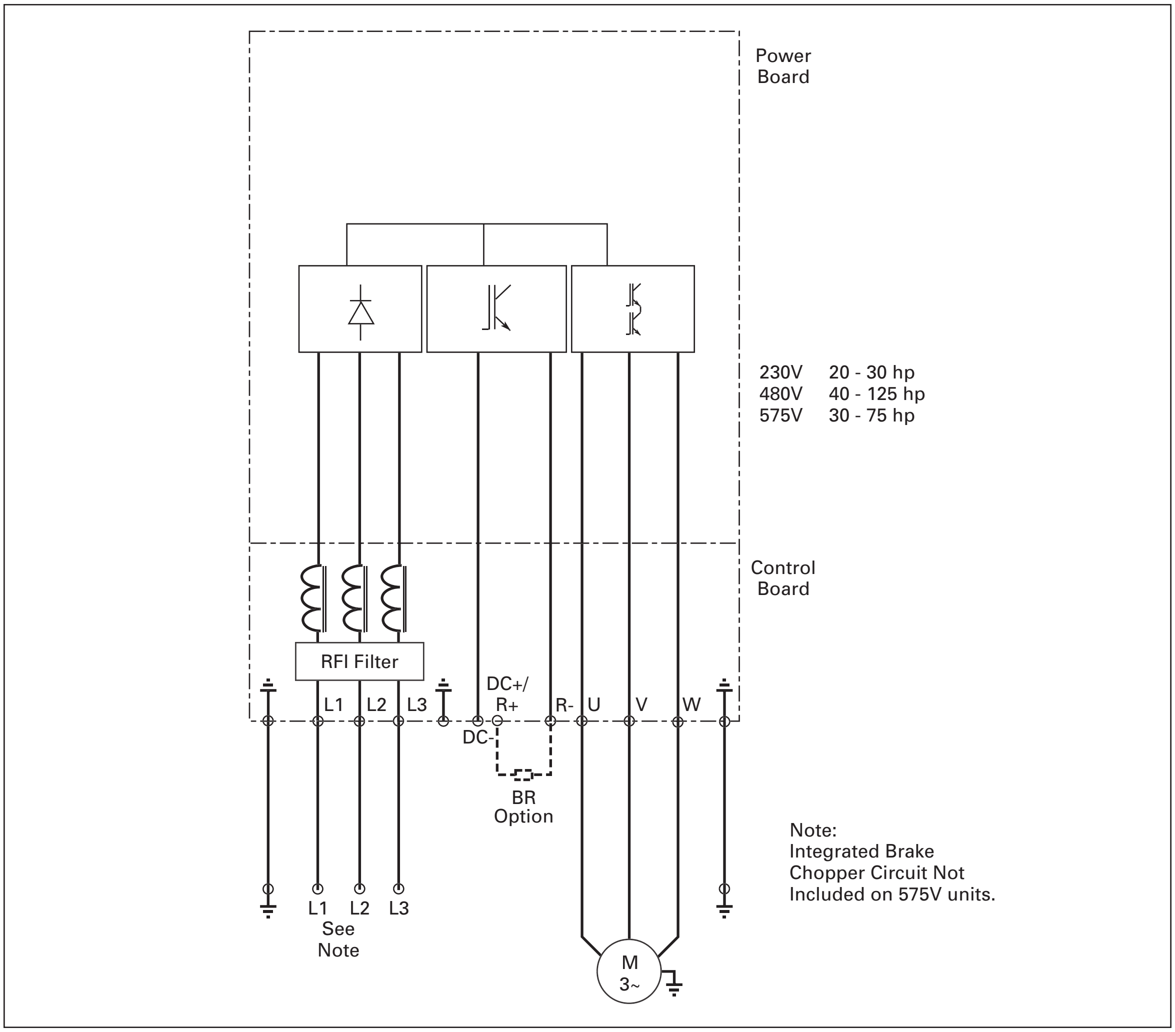


Figure 3-6: Principle Wiring Diagram of SVX Power Unit, FR6, FR7 and FR8

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

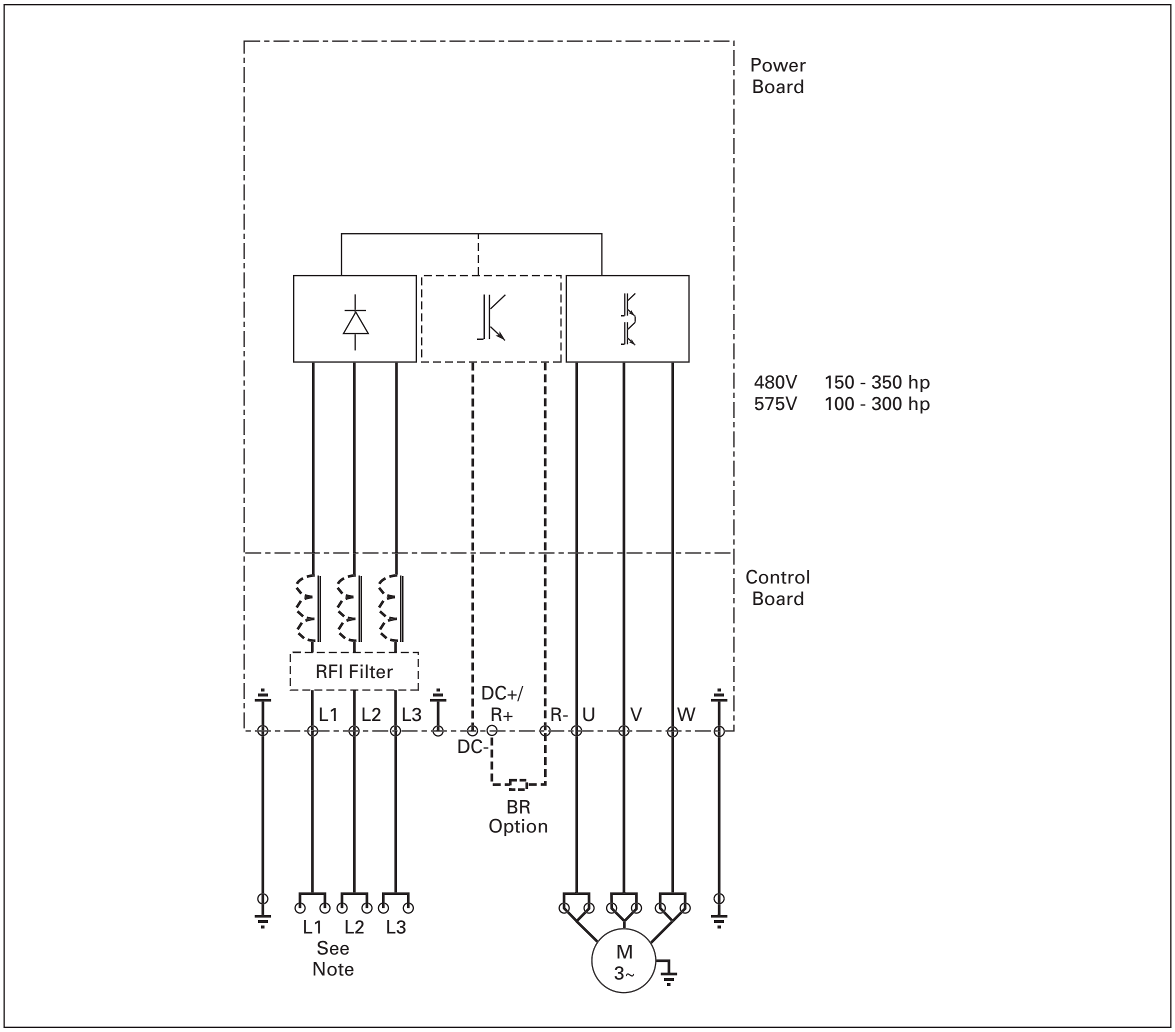


Figure 3-7: Principle Wiring Diagram of SVX Power Unit, FR9 to FR10

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 Electrical for more information.

Power and Motor Wiring Terminal Photos

230V, 3/4 – 3 hp
480V, 1 – 5 hp

Frame Size: FR4

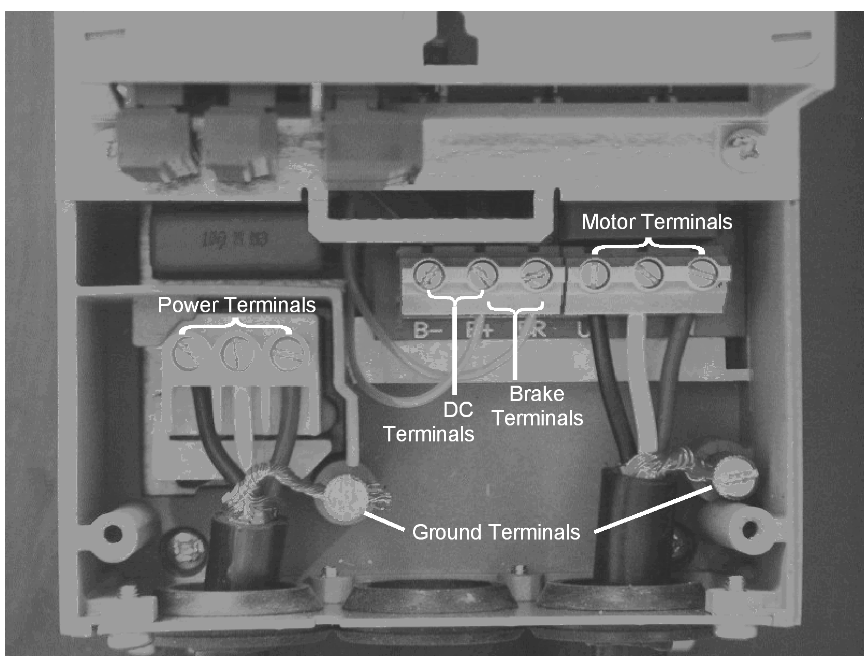


Figure 3-8: FR4 Power and Motor Wiring Terminals

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

Frame Size: FR5

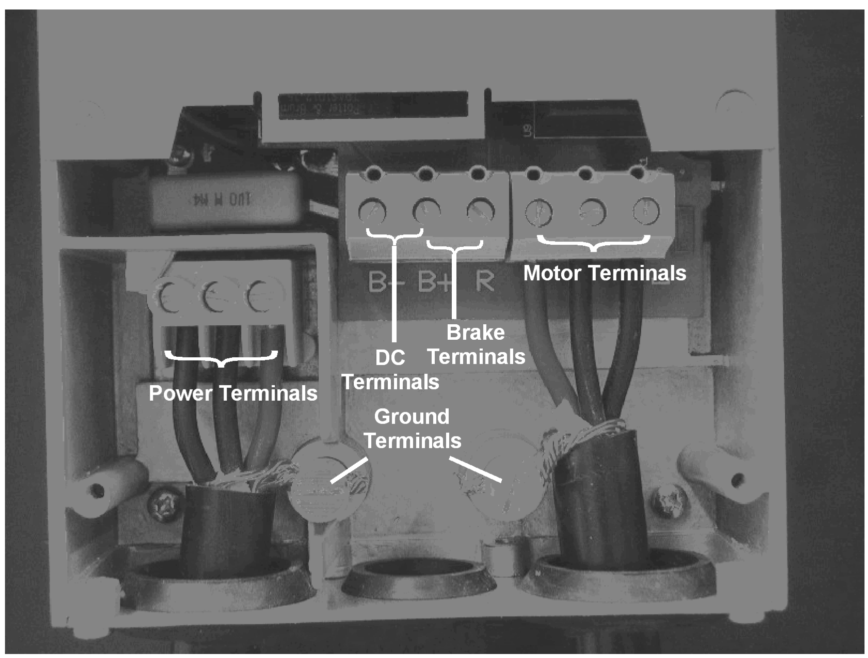


Figure 3-9: FR5 Power and Motor Wiring Terminals

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

Frame Size: FR6

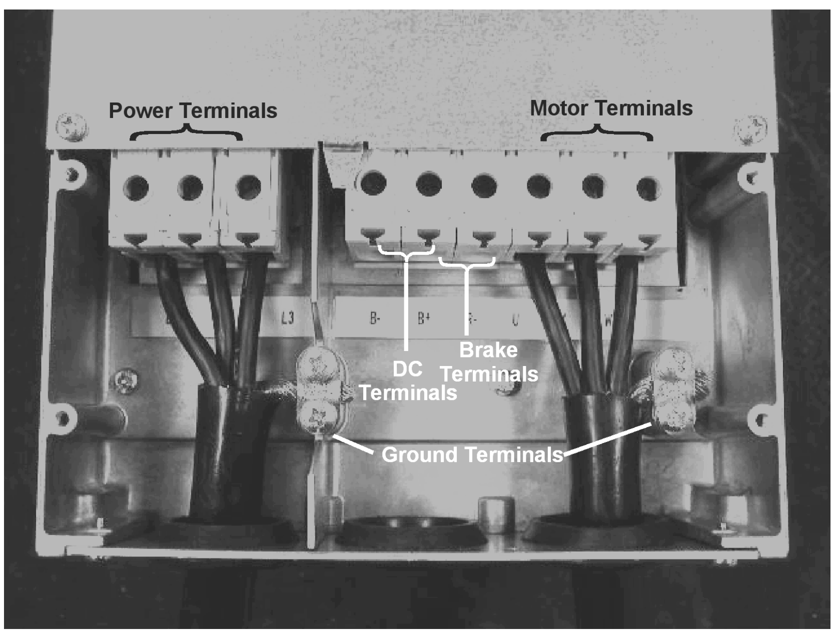


Figure 3-10: FR6 Power and Motor Wiring Terminals

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

Frame Size: FR7

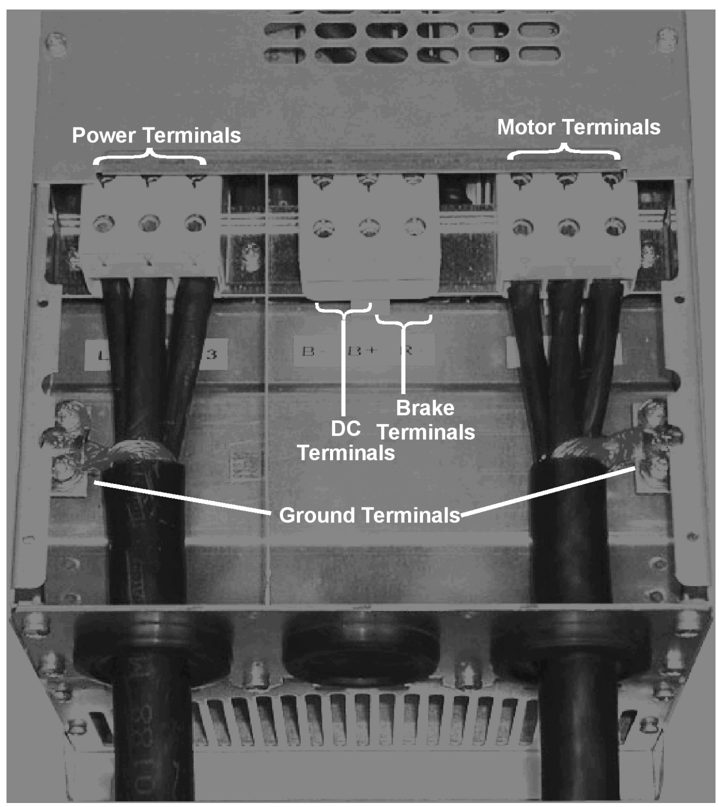


Figure 3-11: FR7 Power and Motor Wiring Terminals

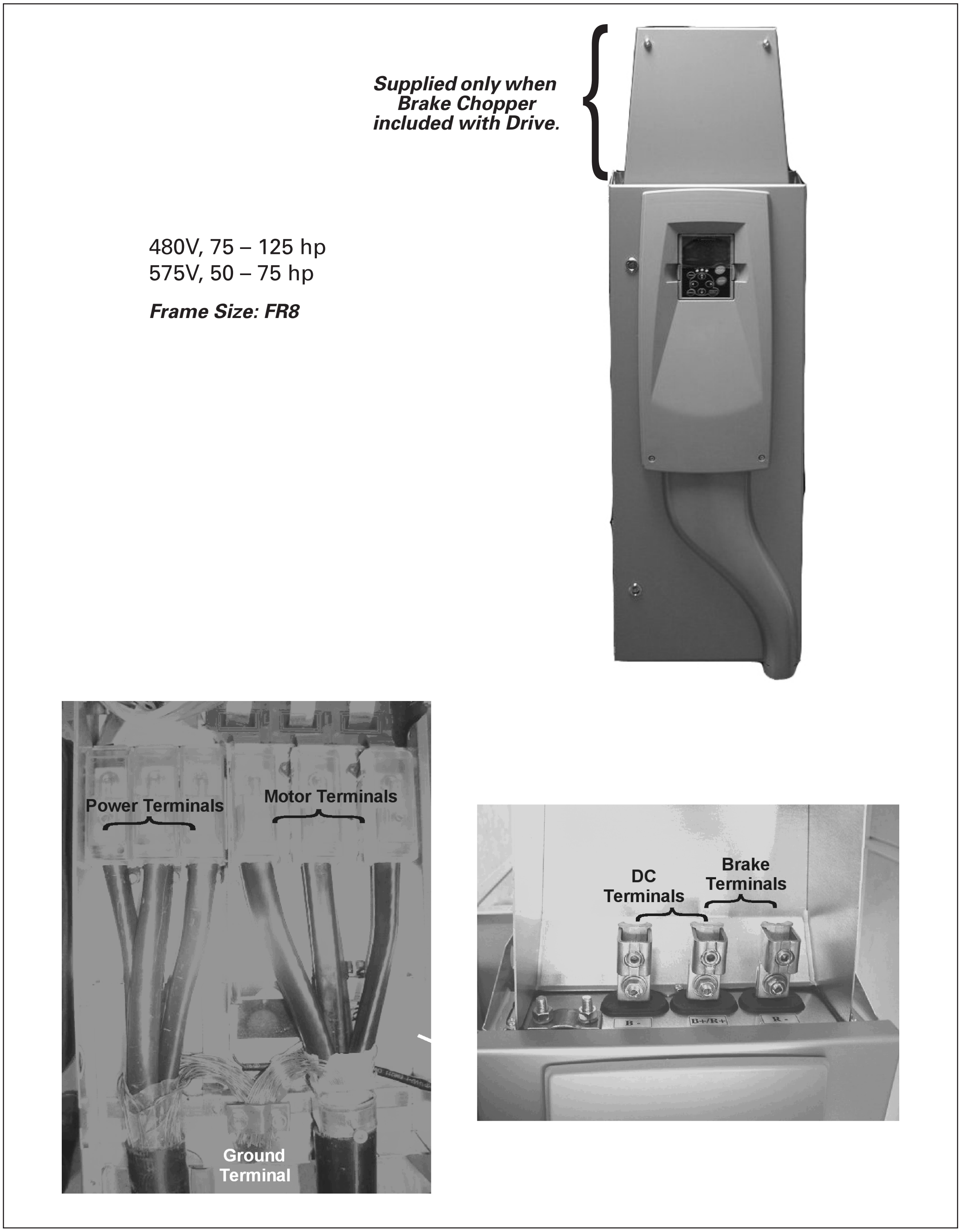


Figure 3-12: FR8 Power and Motor Wiring Terminals

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 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 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 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 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 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*.

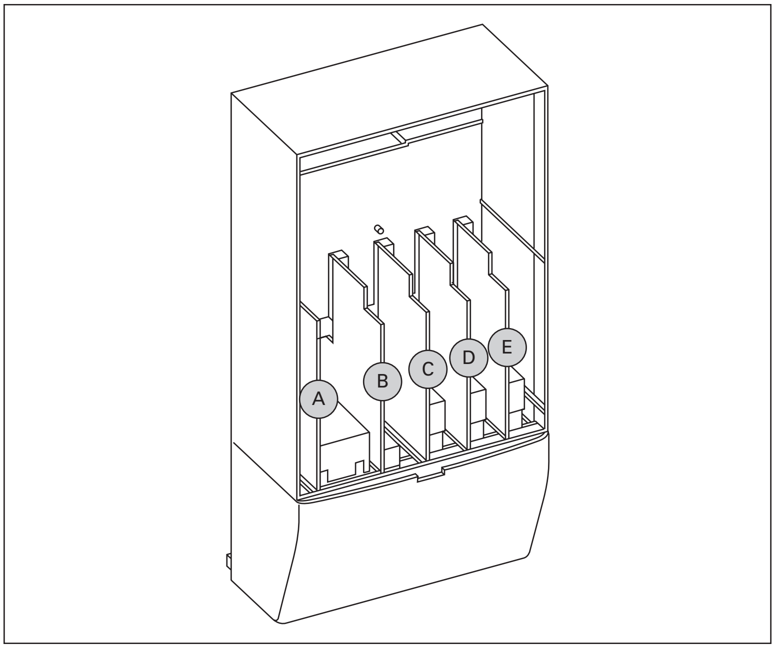


Figure 4-1: Option Board Slots

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

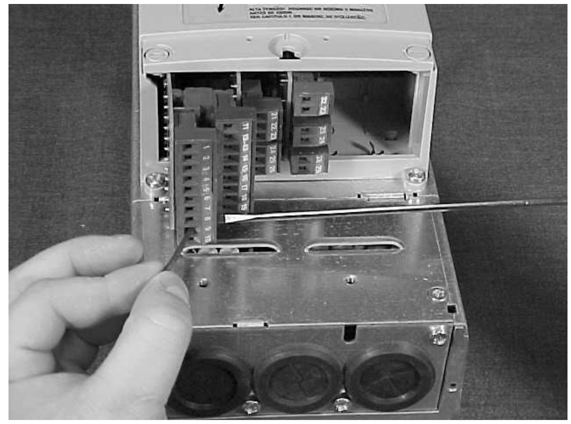
Terminal Screw	Tightening Torque	
	in-lbs	**Nm**
Relay and thermistor terminals (M3 screw)	4.5	0.5
Other terminals (M2.6 screw)	2.2	0.25

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

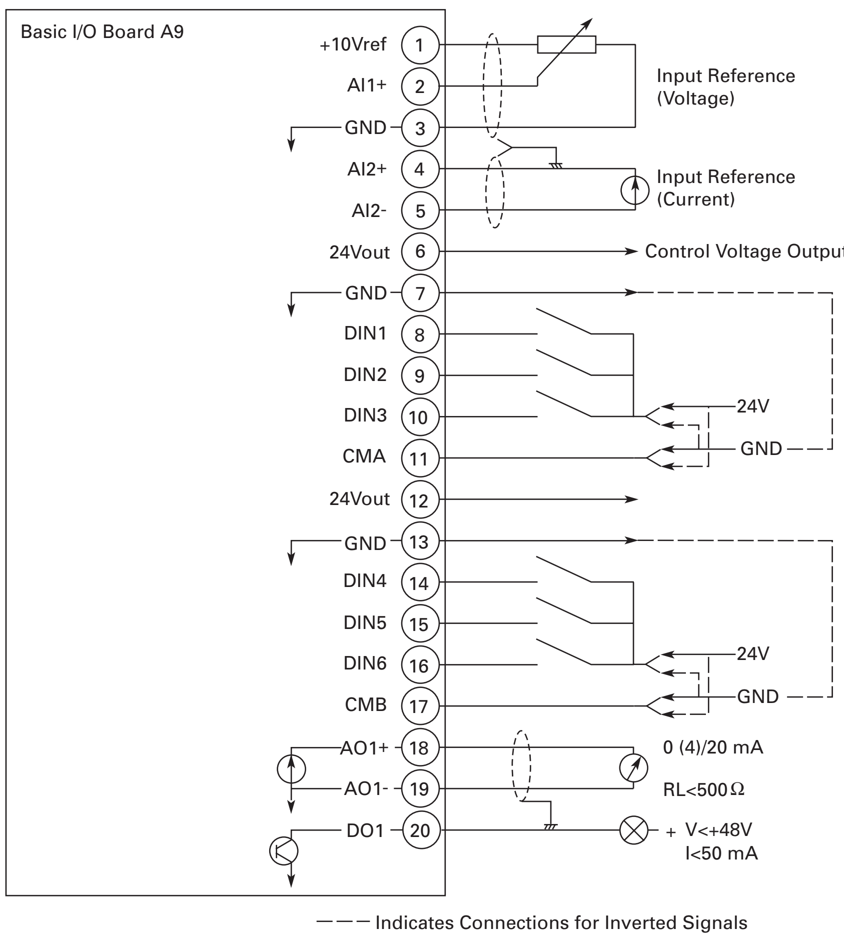


Figure 4-2: Option Board A9 Wiring Diagram

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) -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
3	GND	Analog input common	
4	AI2+	Analog input	Default: 0 – 20 mA (R_i = 250 Ω) 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
5	GND/AI2-	Analog input common	
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

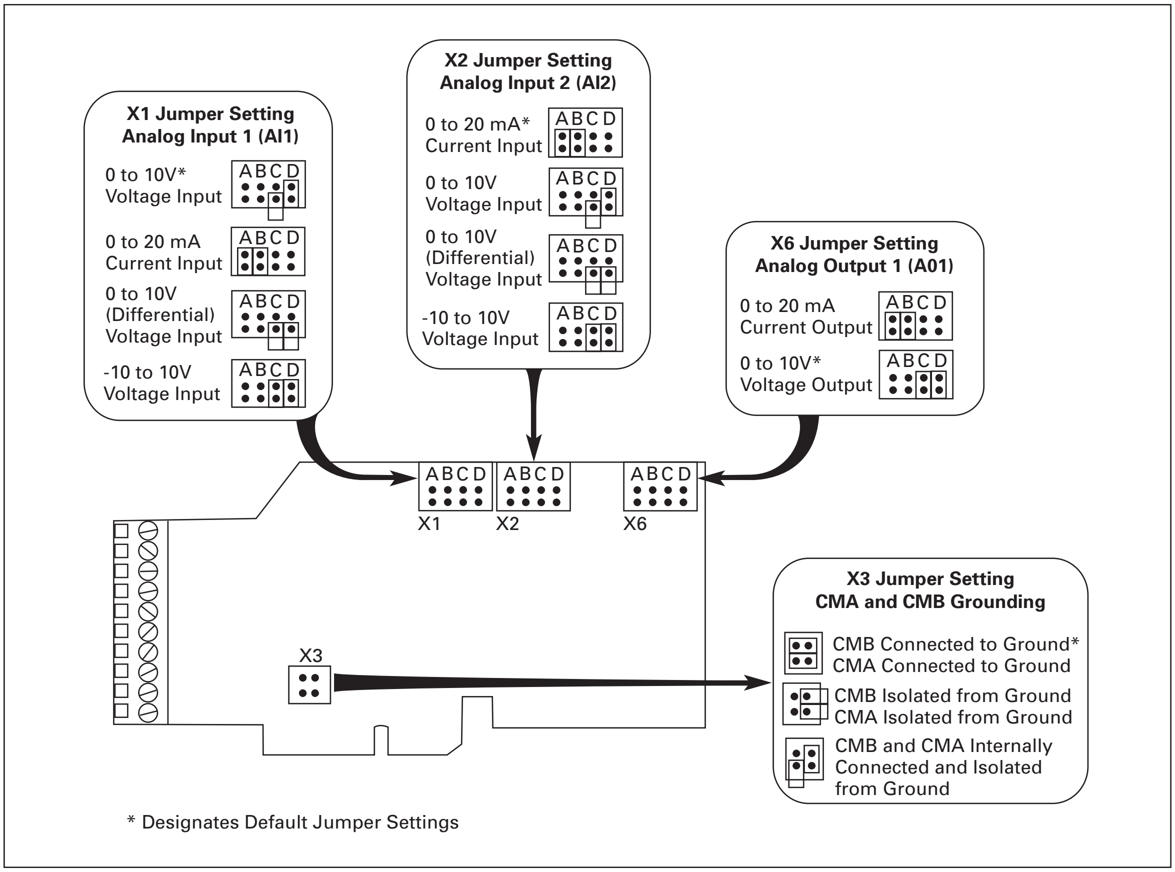


Figure 4-3: Option Board A9 Jumper Location and Settings

Wiring Option Board A2

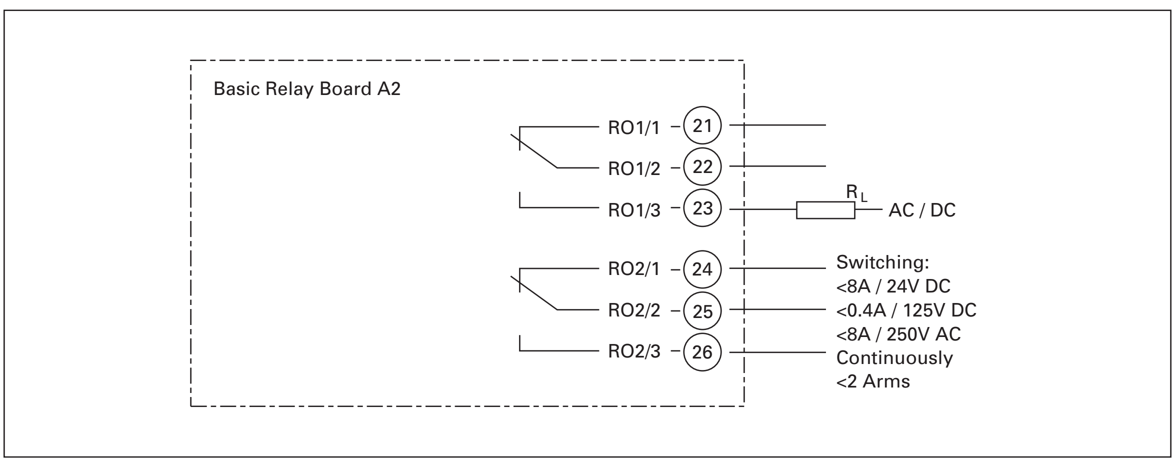


Figure 4-4: Option Board A2 Wiring Diagram

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 125V DC / 0.4A Min Switching Load: 5V/10 mA Continuous Capacity: <2 Arms
22	RO1/2	Common	
23	RO1/3	Normally Open (NO)	
24	RO2/1	Normally Closed (NC)	Switching Capacity: 24V DC / 8A 250V AC / 8A 125V DC / 0.4A Min Switching Load: 5V/10 mA Continuous Capacity: <2 Arms
25	RO2/2	Common	
26	RO2/3	Normally Open (NO)	

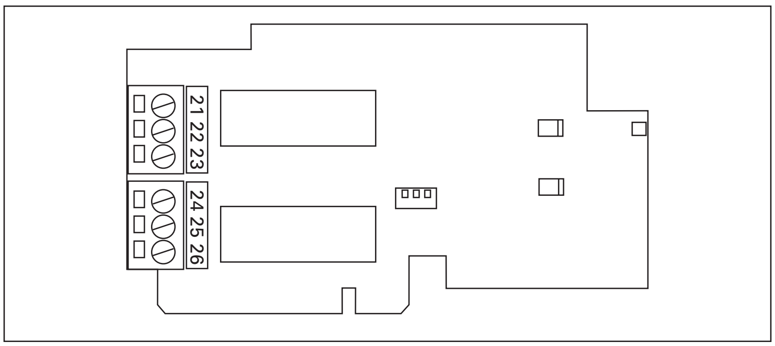


Figure 4-5: Option Board A2 Terminal Locations

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.

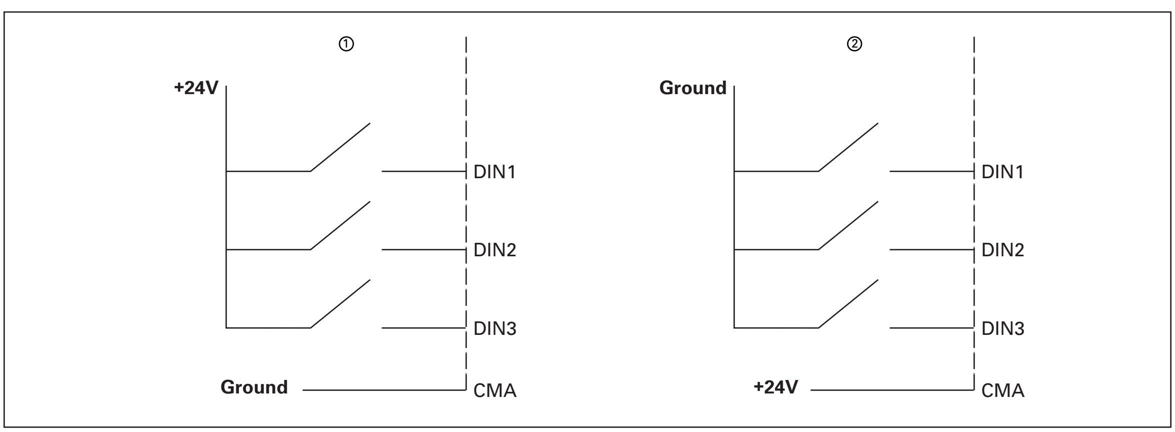


Figure 4-6: Positive/Negative Logic

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

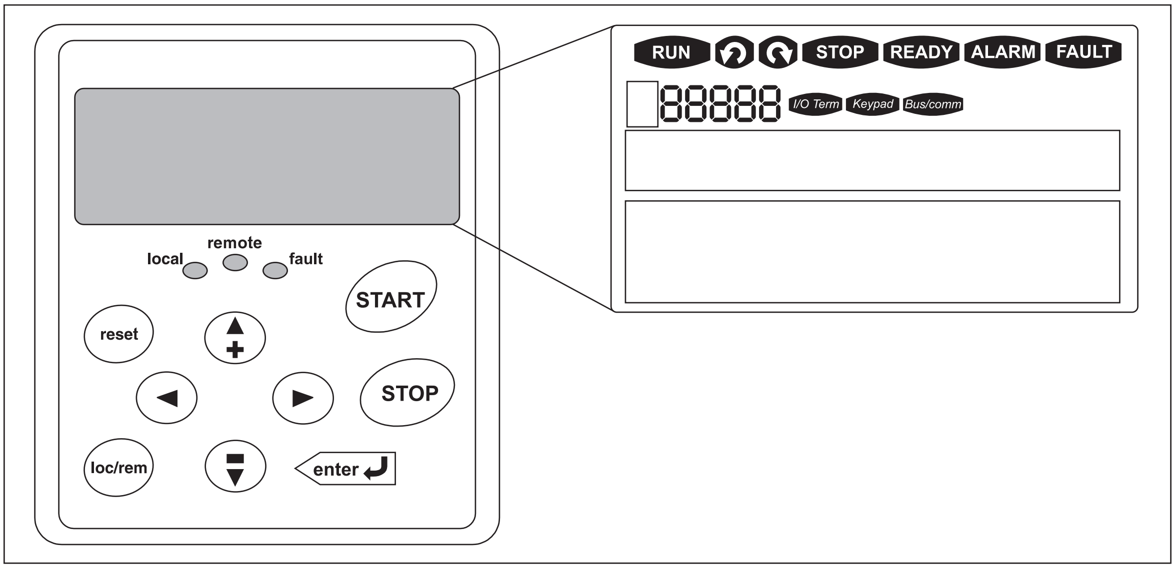


Figure 5-1: Keypad and Display

Table 5-1: LCD Status Indicators

Indicator	Description
RUN	**Run** Indicates that the SVX9000 is running and controlling the load. Blinks when a stop command has been given but the SVX9000 is still ramping down.
(counterclockwise arrow)	**Counterclockwise Operation** The output phase rotation is BAC, corresponding to counterclockwise rotation of most motors.
(clockwise arrow)	**Clockwise Operation** The output phase rotation is ABC, corresponding to clockwise rotation of most motors.
STOP	**Stop** Indicates that the SVX9000 is stopped and not controlling the load.
READY	**Ready** Indicates that the SVX9000 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 is ready to be started and operated from the Local mode. **Local — Flashing** Indicates that the SVX9000 is ready for operating command to select Local or Remote operation.
remote	**Remote** Indicates that the SVX9000 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 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 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 *SVX9000 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.

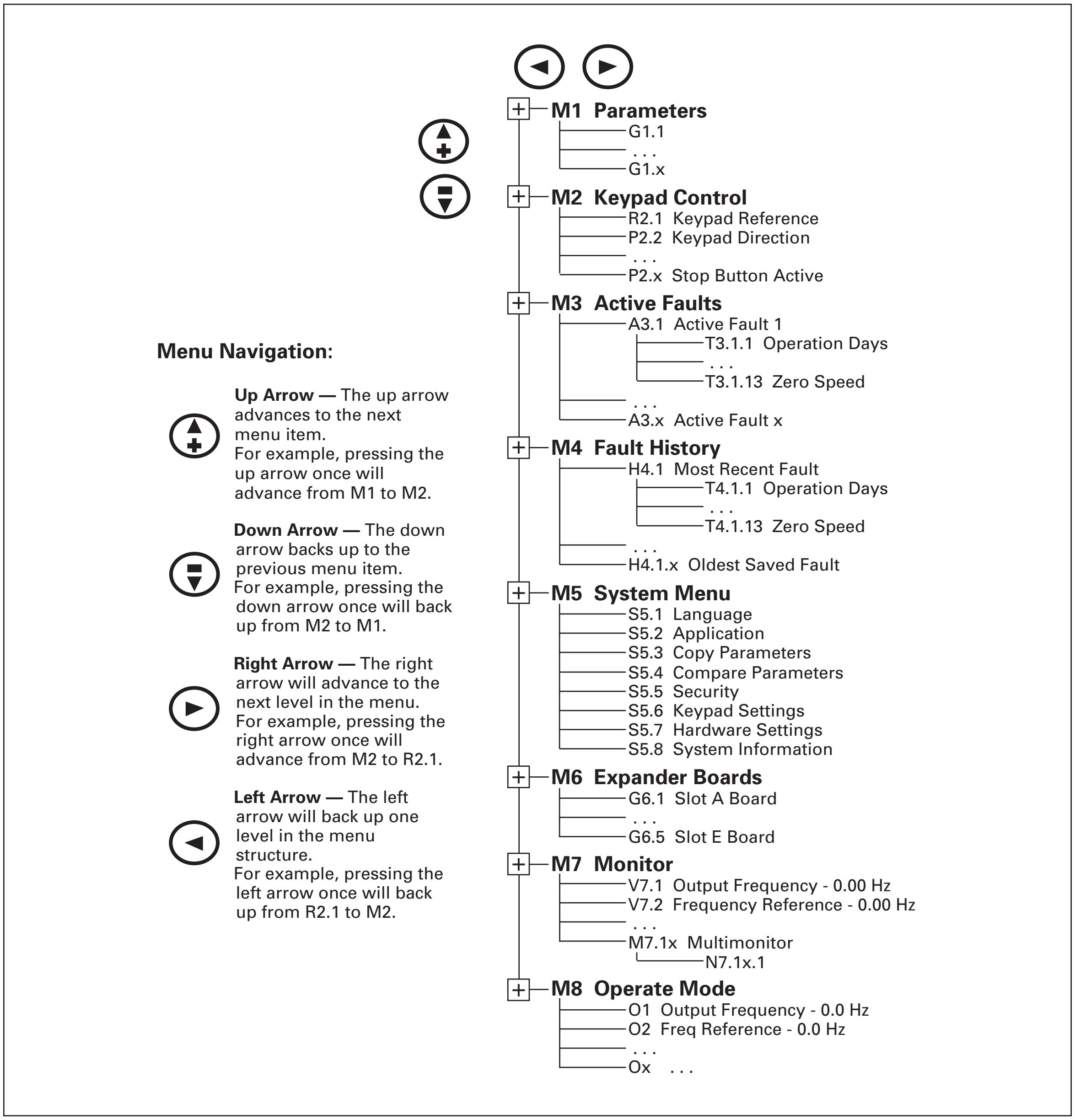


Figure 5-2: Main Menu Navigation

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 *SVX9000 Application Manual*.

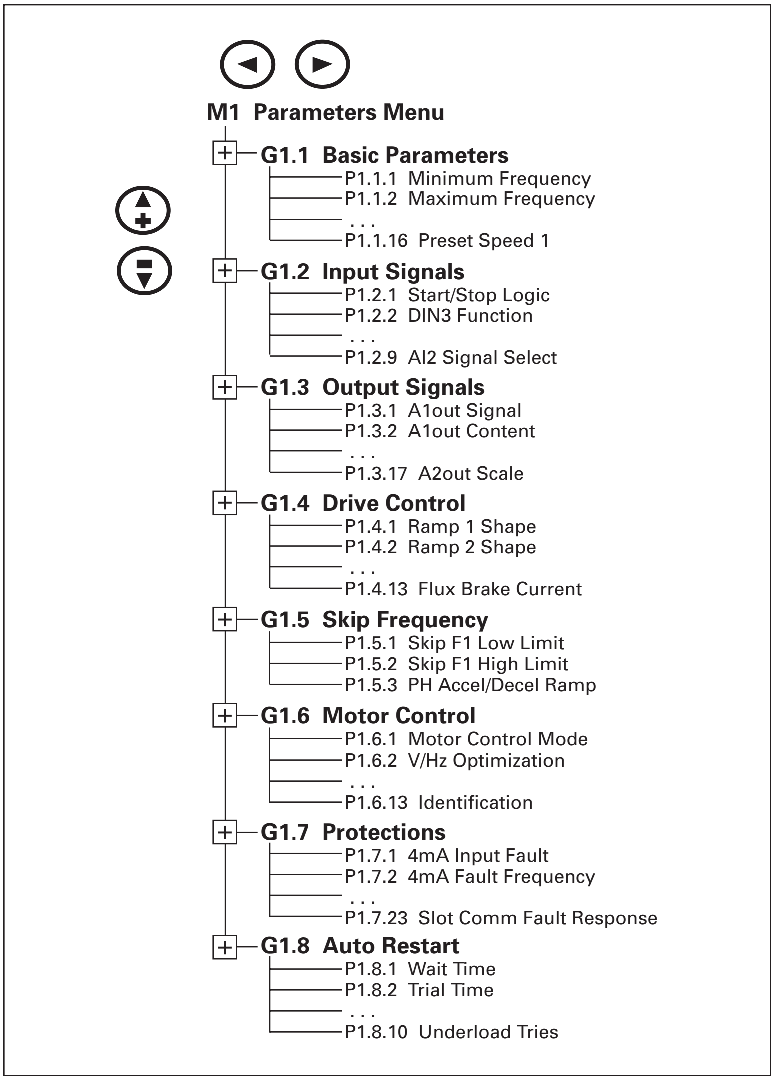


Figure 5-3: Parameter Menu Structure Example

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**.

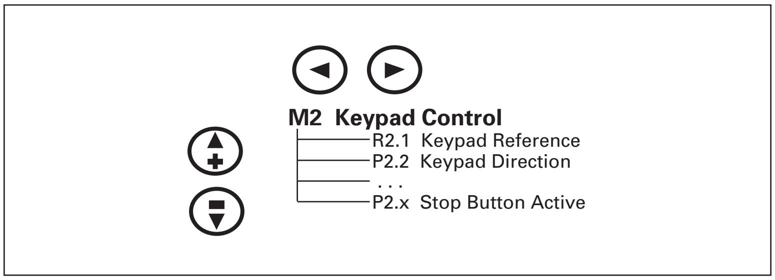


Figure 5-4: Keypad Control Menu

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 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.

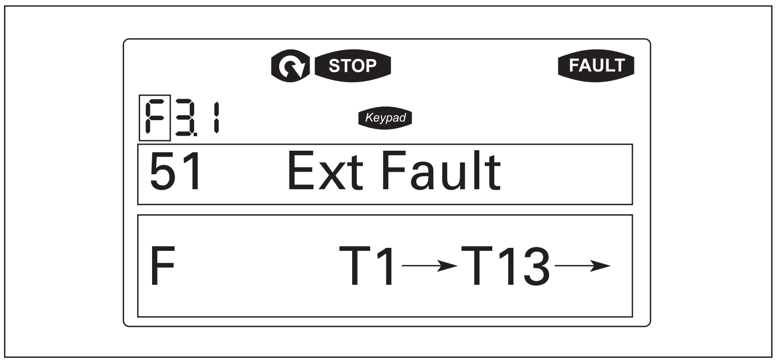


Figure 5-5: Active Fault Display Example

CAUTION

Remove any External Start signals or permissives before resetting the fault to prevent an unintentional restart of the SVX9000, 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 T.5 T.6 T.7 T.8	A V % % V	Motor current Motor voltage Motor power Motor torque DC bus voltage
T.9 T.10 T.11 T.12 T.13	°C — — — —	Unit temperature Run status Direction Warnings 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'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.

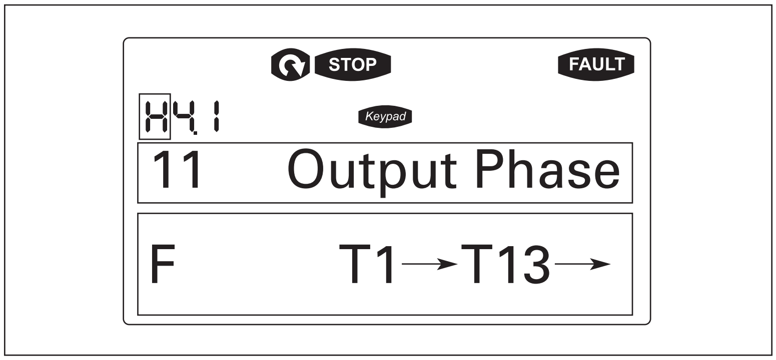


Figure 5-6: Sample Fault History Display

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**.

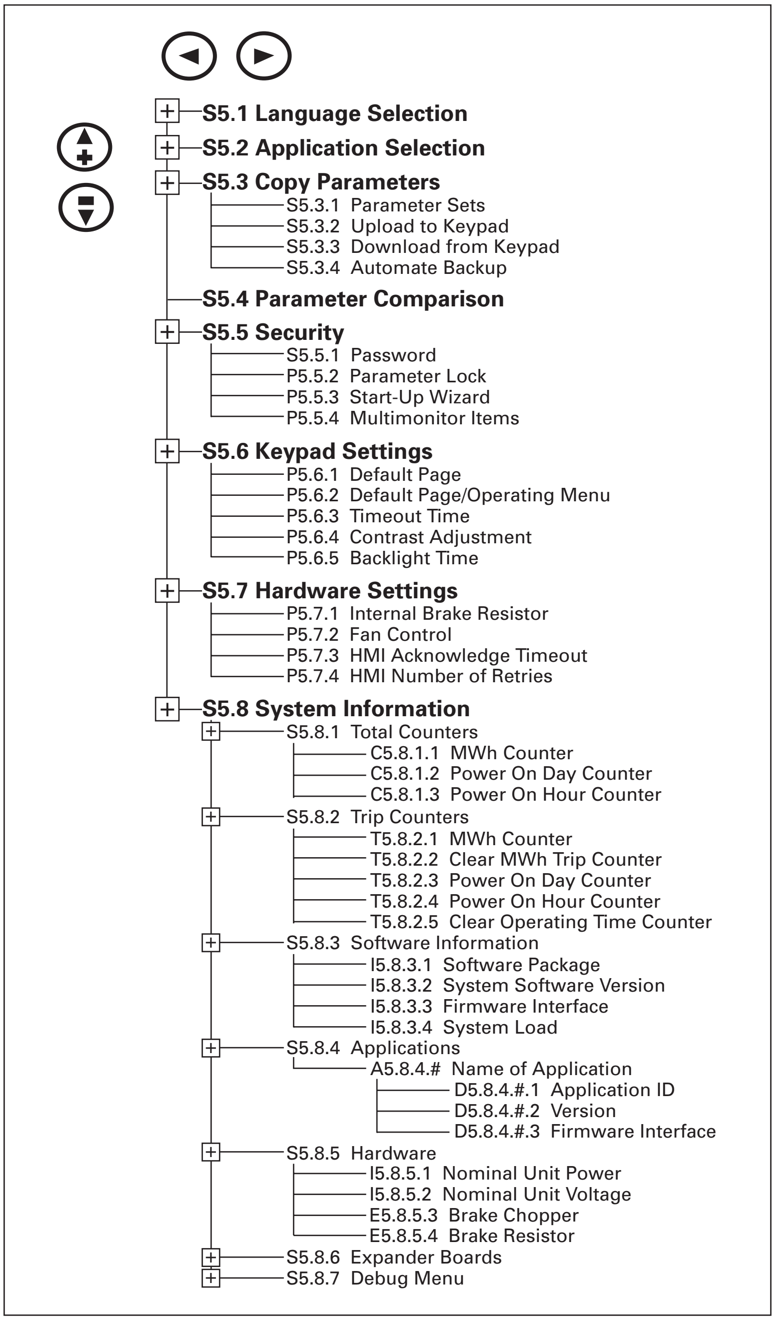


Figure 5-7: System Menu Structure

System Menu Parameters

S5.1 Language Selection

Range: English, Spanish, French, Portuguese Default: English

LANGUAGE

This parameter offers the ability to control the SVX9000 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. 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.

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 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.

P5.7.2 Fan Control

Range: Continuous, Temperature Default: Continuous

FAN CONTROL

This function sets the control method of the SVX9000's cooling fan. You can set the fan to run continuously when the power is switched on or to run based on the temperature of the unit. If the latter function has been selected, the fan is switched on automatically when the heatsink temperature reaches 60°C. The fan receives a stop command when the heatsink temperature 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".

Note: The fan runs continuously, regardless of this setting, when the SVX9000 is in RUN state.

P5.7.3 Keypad Acknowledge Timeout

Range: 200 – 5,000 Default: 200

Units: mseconds

KEYPAD ACK TIMEOUT

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

Note: If the SVX9000 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 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 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 drive monitoring.

P5.7.4 Number of Retries to Receive Keypad Acknowledgement

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 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.

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 has been supplied with power
C5.8.1.3	Power On hour counter	Number of hours the SVX9000 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 has been run since the last reset
T5.8.2.4	Power On hour counter	Number of hours the SVX9000 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. 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.

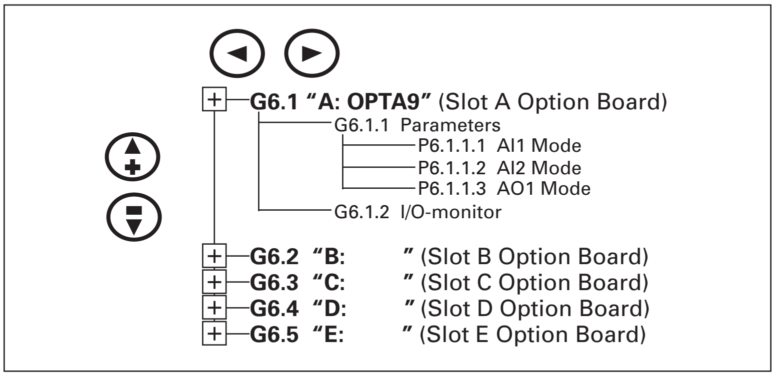


Figure 5-8: Expander Board Menu Structure

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.

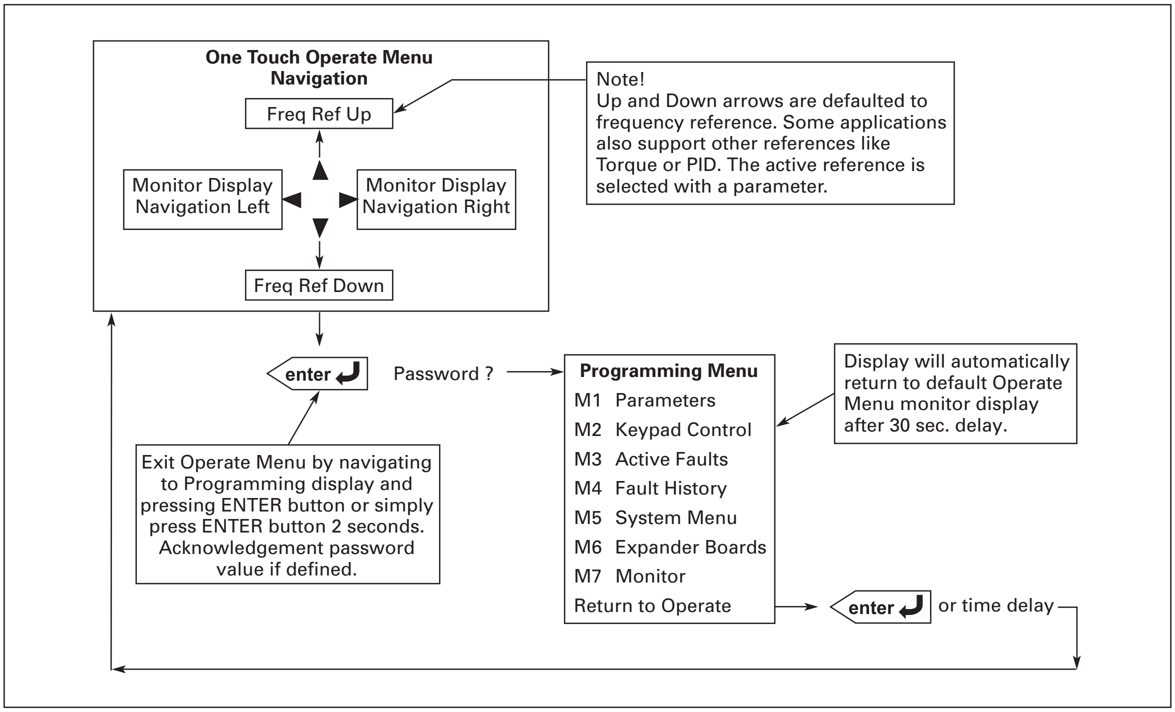


Figure 5-12: Operate Menu Navigation

Start-Up Wizard

Upon initial power up, the **Start-Up Wizard** guides the commissioner through the basic SVX9000 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 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 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 SVX9000 drive is connected to the utility line.

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

6 Before connecting to the utility, make sure that the cover of the SVX9000 is closed.

Sequence of Operation

1. Read and follow all safety warnings and cautions in this manual.
2. At installation ensure:
   - That the SVX9000 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.
   - That the common input of each digital input groups is connected to +24V or ground of the I/O terminal supply or an external supply as detailed in **Chapter 6 — Start-Up** 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.
5. Check that all START/STOP switches connected to the I/O terminals are in the STOP state.
6. Connect the SVX9000 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 the 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 are 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.

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

   Test A — Control from the Control Panel

   - Apply input power to the SVX9000.
   - 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.
   - Change control from the keypad to the I/O terminals using the LOCAL/REMOTE button.
   - Start the drive by closing the START/STOP switch 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 switch on DIN1.

9. Disconnect all power to the SVX9000. 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. Switch the power back on and run test 8A or 8B again and check for correct motor rotation. If possible, perform a start-up test with the motor connected to the SVX9000 but not connected to the process. If the SVX9000 must be tested with the motor connected to the process, perform it under no-load or light load conditions.

10. Disconnect all power to the SVX9000. 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.

Appendix A — Technical Data

General

Figure A-1 shows a block diagram of the SVX9000 drive. The SVX9000 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 as well as the high frequency disturbances caused by the SVX9000 on the utility line. It also improves the input current waveform to the SVX9000. 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. 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 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. They are only needed for compliance with the EU EMC directive as detailed in the following section.

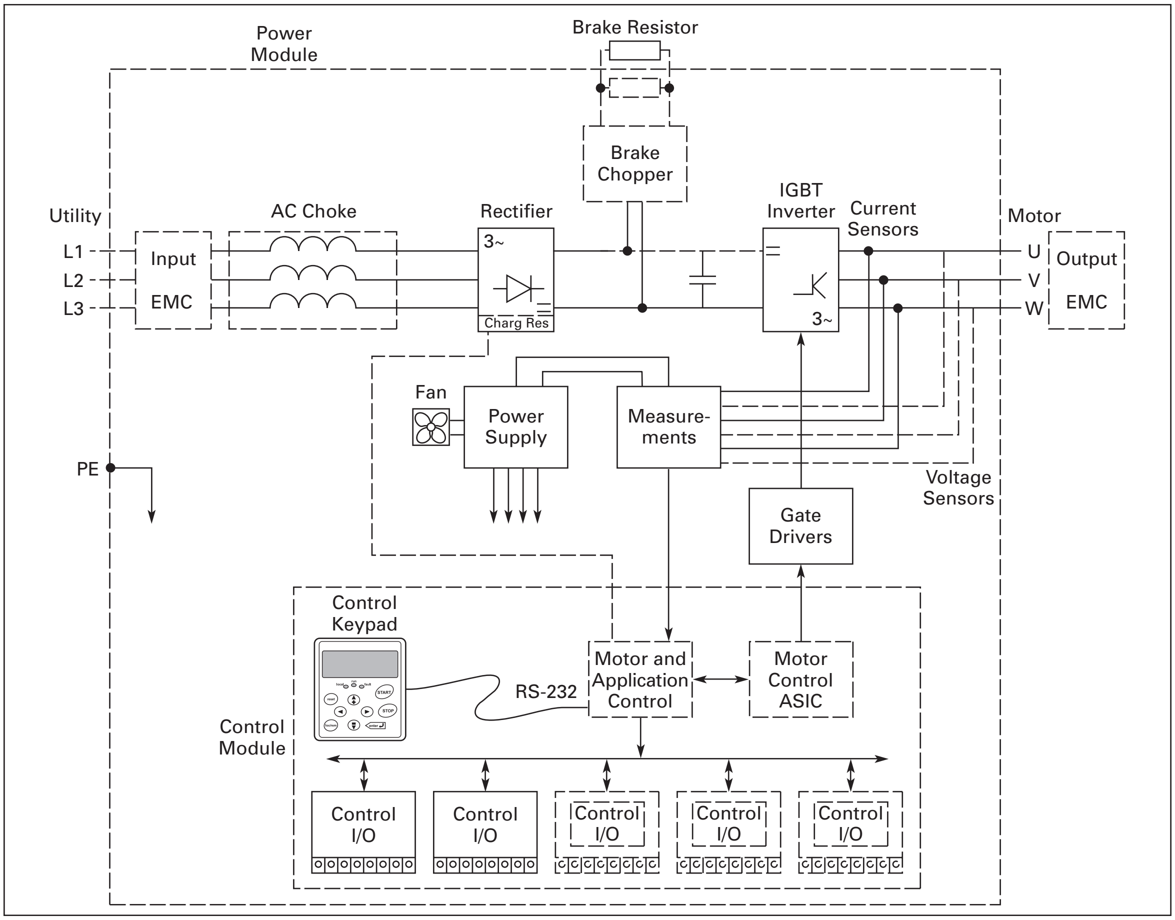


Figure A-1: SVX9000 Block Diagram

Specifications

Table A-1: SVX9000 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 Drive Specifications (Continued)

Description	Specification
Control Characteristics	
Control Method	Frequency Control (V/f) Open Loop Sensorless Vector 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 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 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 CT

Catalog Number ①	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.

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

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

Table A-4: Output Power Ratings — 575V CT

Catalog Number	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.

Power Loss and Switching Frequency

In some situations it may be desirable to change the switching frequency of the SVX9000 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 models. When operating above the default switching frequency the SVX9000 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 CT, 61A, 480V SVX9000 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.

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

Thus at the increased switching frequency the maximum load allowed is reduced to 56A to avoid overheating the SVX9000.

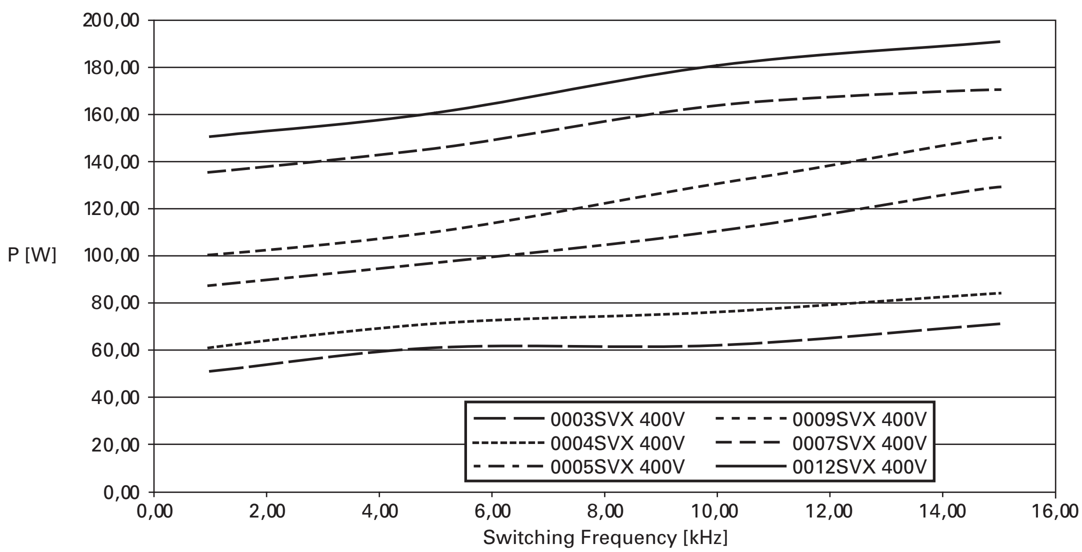


Figure A-2: Power Loss as Function of Switching Frequency — 3/4 – 3 hp 230V, 1 – 5 hp 480V

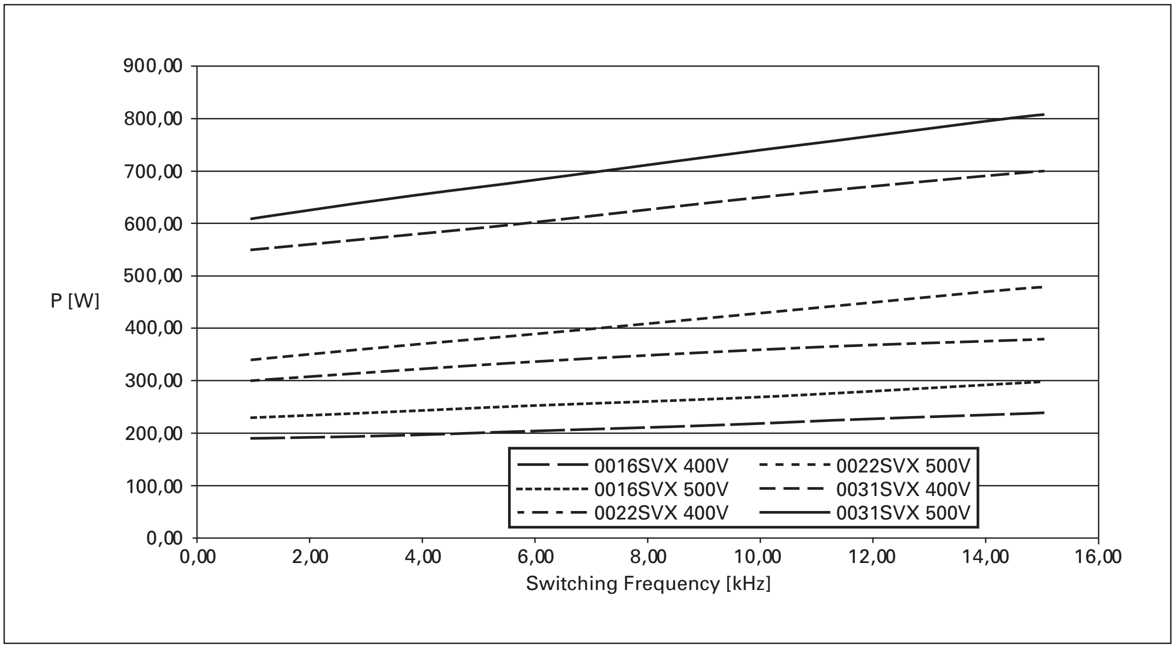


Figure A-3: Power Loss as Function of Switching Frequency — 5 – 7-1/2 hp 230V, 7-1/2 – 15 hp 480V

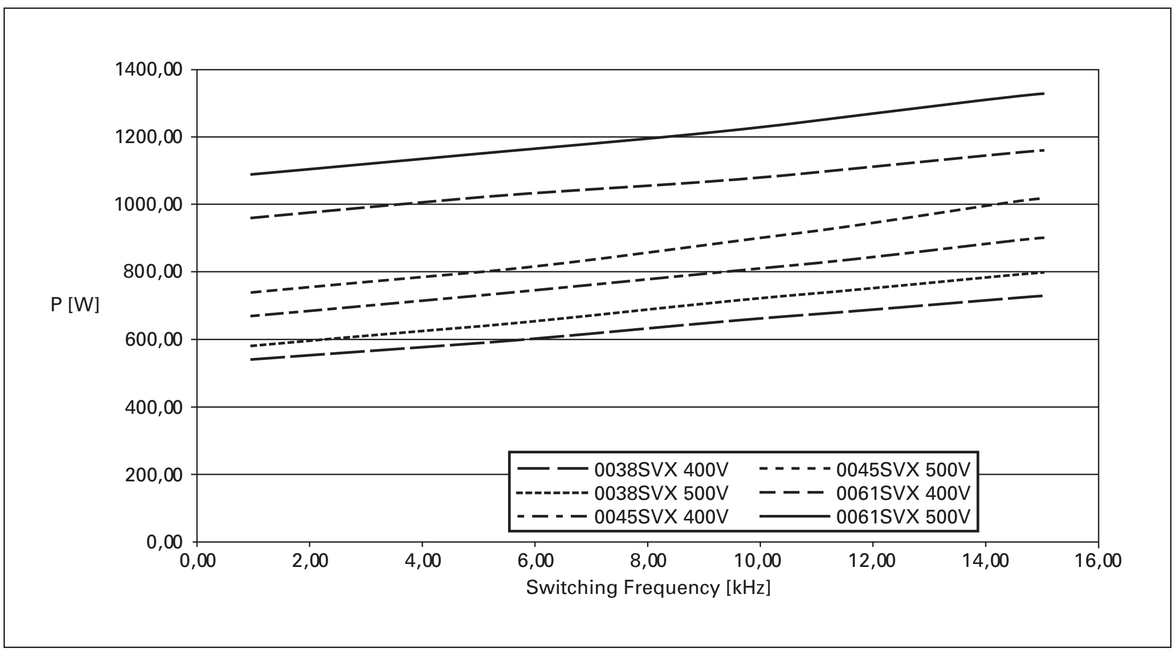


Figure A-4: Power Loss as Function of Switching Frequency — 10 – 15 hp 230V, 20 – 30 hp 480V

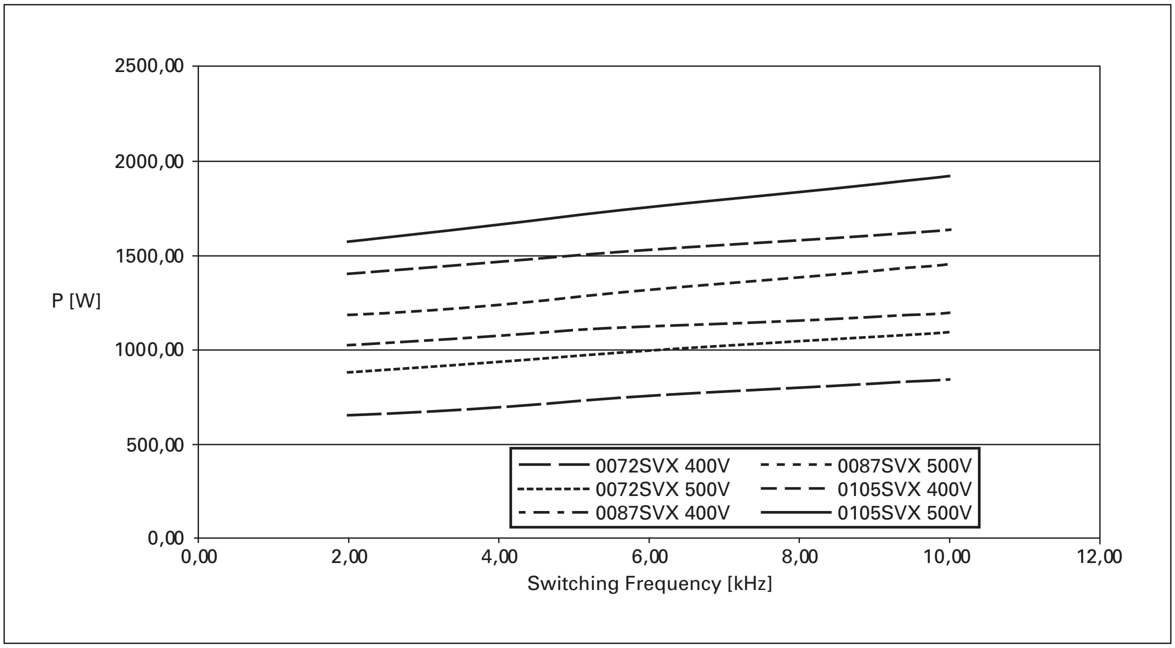


Figure A-5: Power Loss as Function of Switching Frequency — 20 – 30 hp 230V, 40 – 60 hp 480V

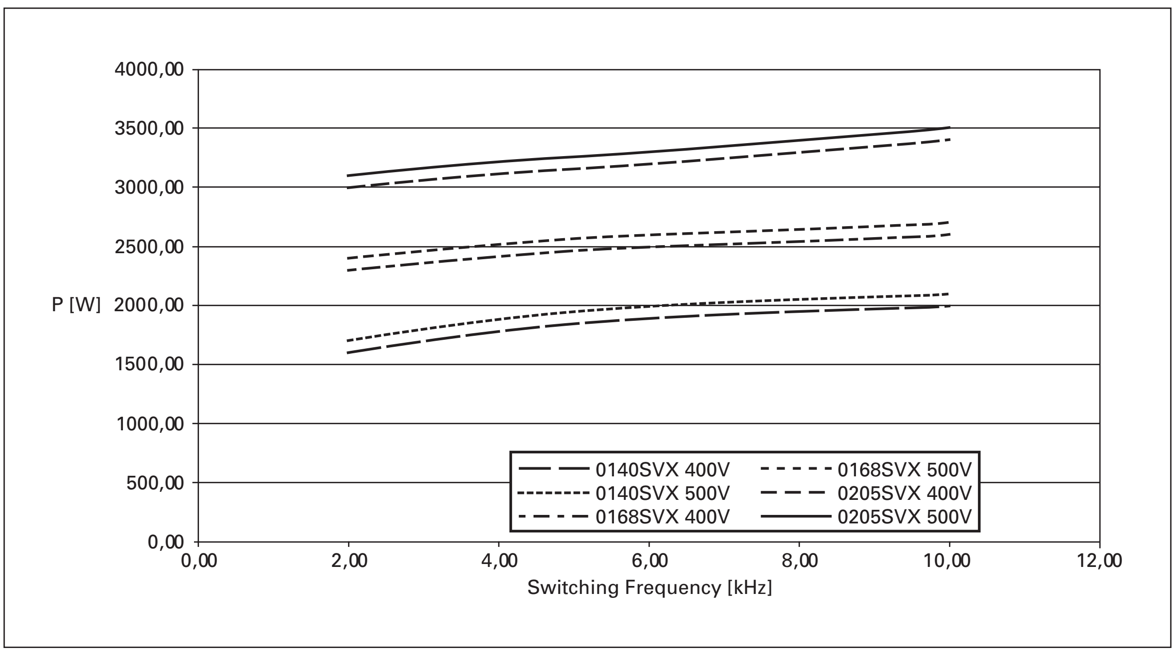


Figure A-6: Power Loss as Function of Switching Frequency — 75 – 125 hp 480V

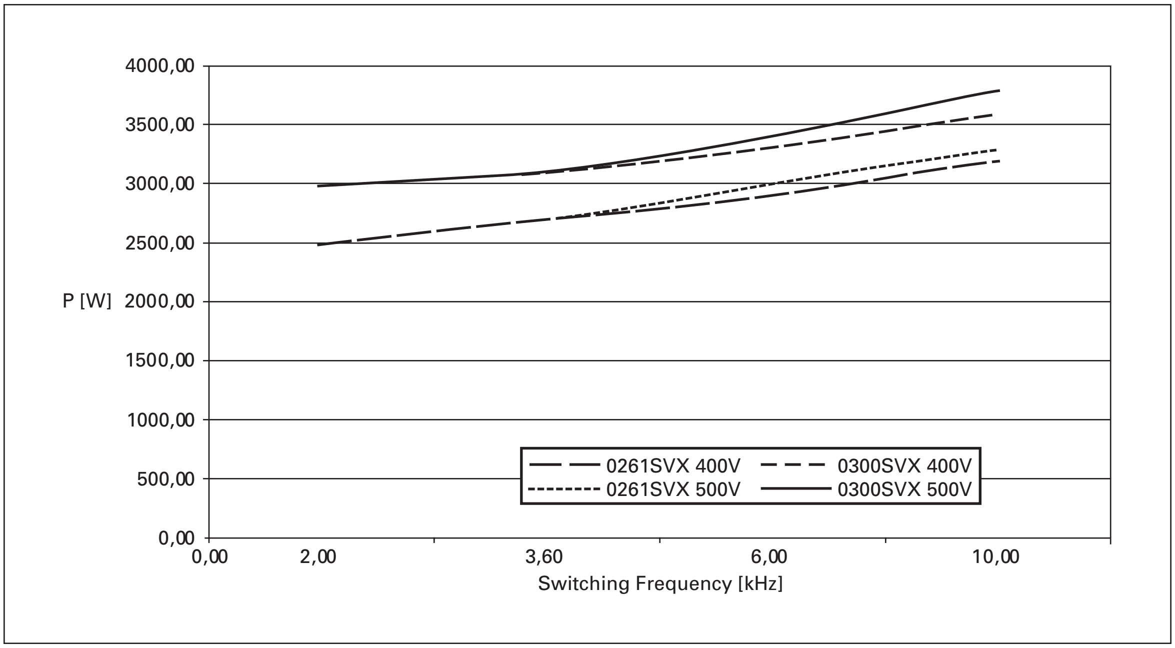


Figure A-7: Power Loss as Function of Switching Frequency — 150 – 200 hp 480V

Dimensions

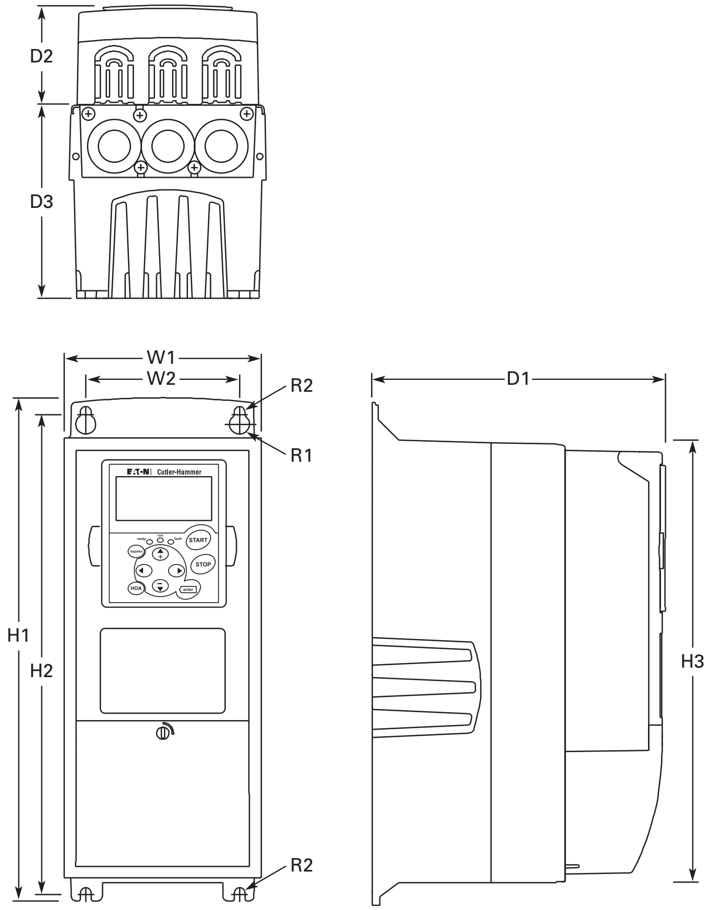


Figure A-8: NEMA Type 1 Enclosure Dimensions

Table A-5: NEMA Type 1/Type 12 Enclosure Dimensions

Frame Size	Voltage	hp (CT)	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											

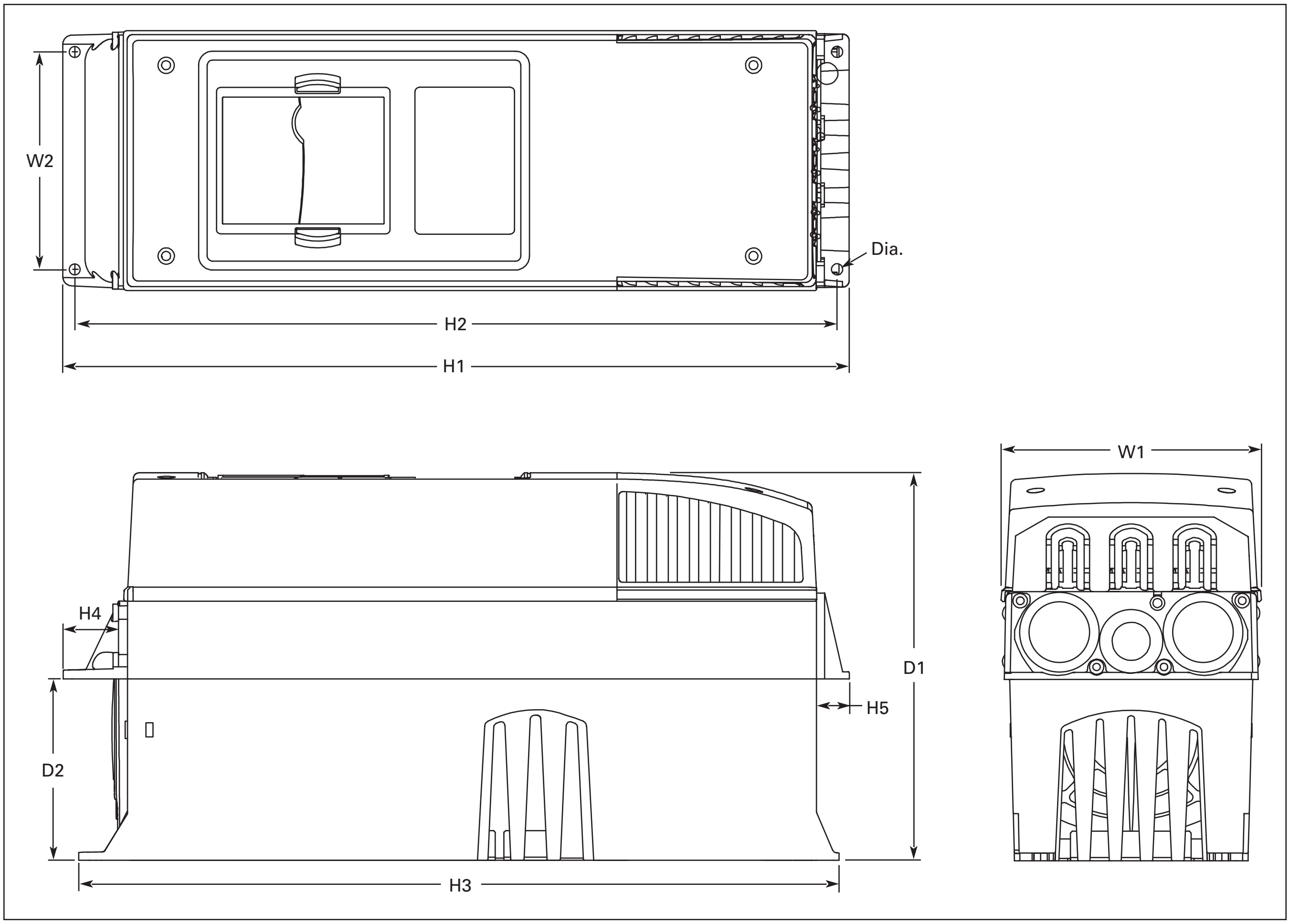


Figure A-9: NEMA 1 and NEMA 12 with Flange Kit, FR4, FR5 and FR6 Enclosure Dimensions

Table A-6: 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 480V	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)
FR5	230V 480V	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)
FR6	230V 480V 575V	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)

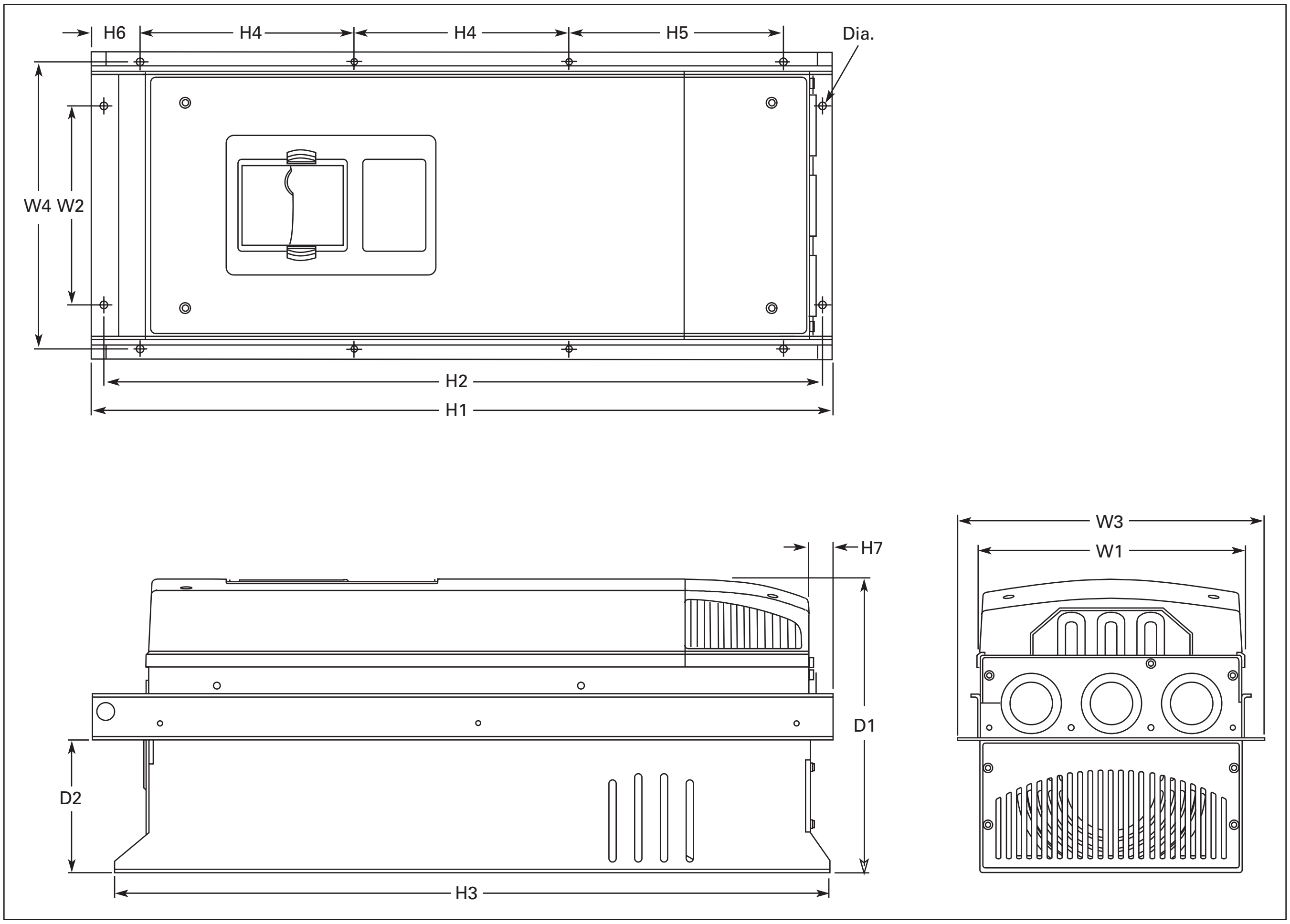


Figure A-10: NEMA 1 with Flange Kit, FR7 and FR8 Enclosure Dimensions

Table A-7: 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 480V 575V	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)
FR8	480V 575V	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)

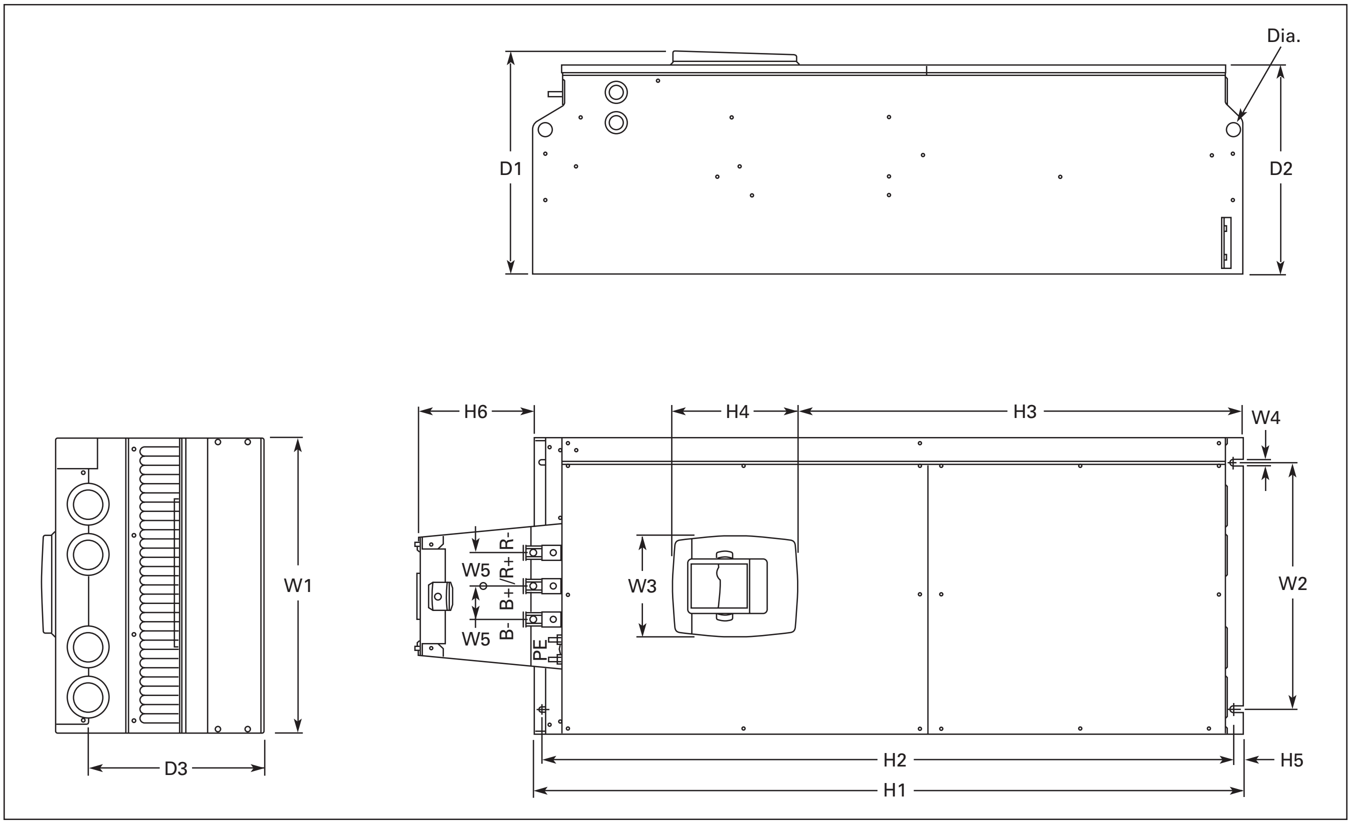


Figure A-11: FR9 Enclosure Dimensions

Table A-8: 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 575V	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)

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

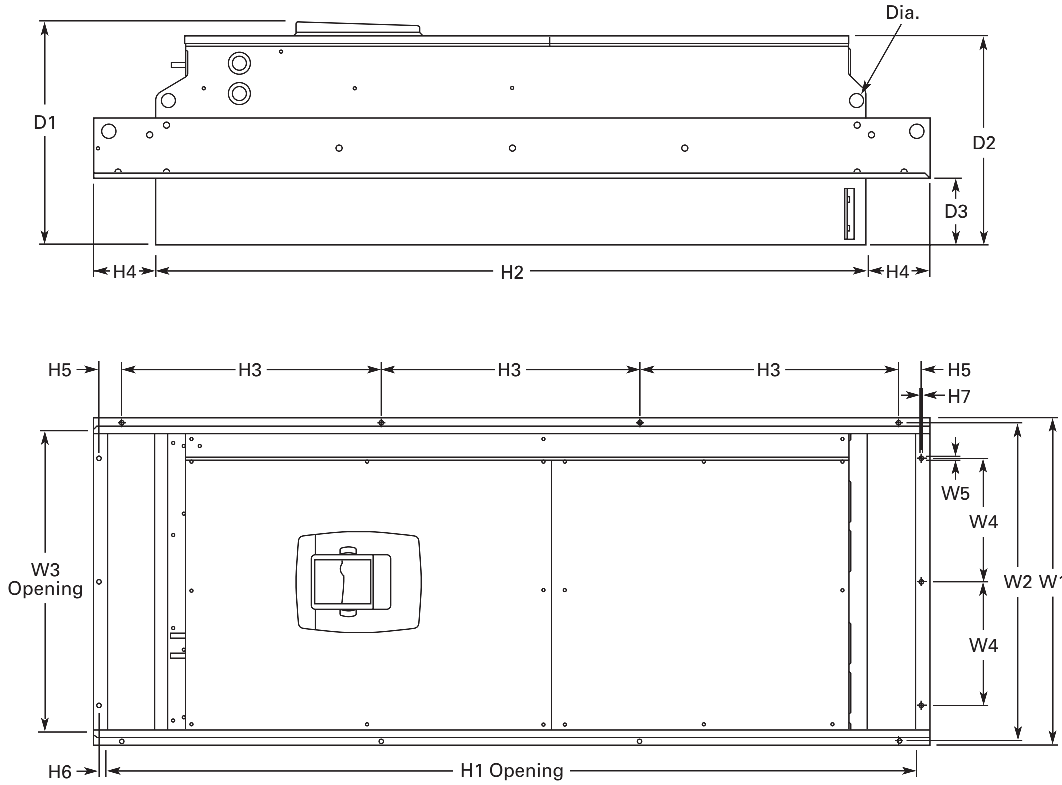


Figure A-12: FR9 with Flange Kit Enclosure Dimensions

Table A-9: 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 575V	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)

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 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 drive series are EMC classification H capable.

Class H

SVX9000 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 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 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 *SVX9000 Application Manual* for specific application details.

Table B-1: Fault Codes

Fault Code	Fault	Possible Cause	Solution
1	Overcurrent	The SVX9000 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 NOT 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 internal fault	If there was a supply voltage loss or dip, reset the fault and restart the SVX9000. Check the supply voltage. If it was within specification at the time of the fault, an internal failure has occurred. Contact your Cutler-Hammer 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 Cutler-Hammer distributor.
13	SVX9000 undertemperature	Heatsink temperature is under 14°F (-10°C)	Provide supplemental heating or relocate the SVX9000 to a warmer location.
14	SVX9000 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 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 will automatically reload the parameter default settings. Check all parameter settings after reset. If the fault reoccurs, contact your Cutler-Hammer 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 Cutler-Hammer 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 cooling fan did not start when commanded	Contact your Cutler-Hammer 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 Cutler-Hammer 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 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 Cutler-Hammer 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 Cutler-Hammer 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.

EATON | Cutler-Hammer

SVX9000 AF Drives

Application Manual

Supersedes October 2003
April 2004

April 2004

Important Notice – Please Read

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

Cover Photo: Cutler-Hammer® SVX9000 AF Drives.

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List of Tables, continued

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 product. 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, Cautions and Notices

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

Warnings

WARNING

Be ABSOLUTELY sure not to connect two functions to one output to avoid function overruns and to ensure flawless operation.

Cautions

CAUTION

The calculated model does not protect the motor if the airflow to the motor is reduced by a cooling fan failure or a blocked air intake grill.

Notices

Notice

The *inputs*, unlike the *outputs*, cannot be changed in RUN state.

Chapter 1 — Basic Application

Introduction

The Basic Application of the Cutler-Hammer® SVX9000 drive by Eaton Electrical® is the easiest to use because of its shorter list of parameters. Although it has the lowest parameter count, it still provides versatility with the availability of the communication bus (fieldbus) features. This is the default application as shipped from the factory. If you have been using another application and wish to switch to the Basic Application see Chapter 5, System Menu Parameters section parameter S5.2, of the *SVX9000 User Manual* for selection information.

Digital input DIN3 is programmable.

Details on the parameters shown in this section are available in **Chapter 8** of this manual, listed by parameter ID number.

Motor Protection Functions

The Basic Application provides most of the protection functions of the other applications:

- External fault protection
- Input phase supervision
- Undervoltage protection
- Output phase supervision
- Ground (earth) fault protection
- Motor thermal protection
- Thermistor fault protection
- Fieldbus fault protection
- Slot fault protection

Unlike the other applications, the Basic Application does not provide any parameters for choosing the response function or the limit values for faults. The motor thermal protection is preset based on the settings of P1.6 to P1.9.

Control Input/Output

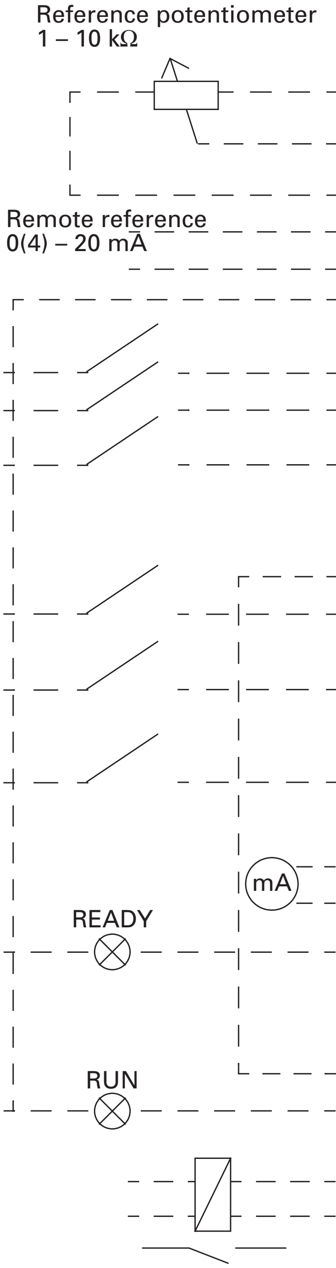


Table 1-1: Basic Application Default I/O Configuration

Terminal		Signal	Description
OPTA9			
1	+10V$_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 20 mA	Current input frequency reference
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start forward	Contact closed = start forward
9	DIN2	Start reverse	Contact closed = start reverse
10	DIN3	External fault input (programmable)	Contact open = no fault Contact closed = fault
11	CMA	Common for DIN 1 – DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Multi-step speed select 1	**DIN4 / DIN5 / Frequency ref.**
15	DIN5	Multi-step speed select 2	Open / Open / Ref.V$_{in}$ Closed / Open / Multi-step ref.1 Open / Closed / Multi-step ref.2 Closed / Closed / Ref$_{Max}$
16	DIN6	Fault reset	Contact open = no action Contact closed = fault reset
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R$_L$ max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO1	Relay output 1 RUN	
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	
25	RO2		
26	RO2		

Note: For more information on jumper selections, see the *SVX9000 User Manual*, Chapter 4.

Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 8.**

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min.	=	Minimum value of parameter
Max.	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	User's customized setting
ID	=	ID number of the parameter for reference to **Chapter 8**
①	=	Parameter value can only be changed when the SVX9000 is stopped

Basic Parameters — M1

Table 1-2: Basic Parameters — M1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1	Min frequency	0.00	P1.2	Hz	0.00		101	
P1.2	Max frequency	P1.1	320.00	Hz	60.00		102	**NOTE**: If f_{Max} > motor synchronous speed, check suitability for motor and drive system
P1.3	Acceleration time 1	0.1	3000.0	s	3.0		103	
P1.4	Deceleration time 1	0.1	3000.0	s	3.0		104	
P1.5	Current limit	0.4 x I_H	2 x I_H	A	I_L		107	I_H is the nominal current rating of the SVX9000
P1.6 ①	Nominal voltage of the motor	180	690	V	SVX-2: 230V SVX-4: 460V		110	Motor nameplate value
P1.7 ①	Nominal frequency of the motor	30.00	320.00	Hz	60.00		111	Motor nameplate value
P1.8 ①	Nominal speed of the motor	300	20 000	rpm	1775		112	Motor nameplate value — The default applies for a 4-pole motor and a nominal size SVX9000.
P1.9 ①	Nominal current of the motor	0.4 x I_H	2 x I_H	A	I_H		113	Motor nameplate value
P1.10 ①	Power factor	0.30	1.00		0.85		120	Motor nameplate value
P1.11	Start mode	0	1		0		505	**0** = Ramp **1** = Flying start
P1.12	Stop mode	0	3		1		506	**0** = Coasting **1** = Ramp **2** = Ramp+Run enable coast **3** = Coast+Run enable ramp
P1.13	Local Control Place	1	3		2		171	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus

Table 1-2: Basic Parameters — M1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.14	Remote Control Place	1	3		1		172	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.15	Remote reference	0	3		0		174	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus
P1.16①	V/Hz optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P1.17	Current reference offset	0	1		1		302	**0** = No offset, 0 – 20 mA **1** = Offset, 4 mA – 20 mA
P1.18	Analog output function	0	8		1		307	**0** = Not used **1** = Output freq. (0 – f_{Max}) **2** = Freq. reference (0 – f_{Max}) **3** = Motor speed (0 – Motor nominal speed) **4** = Output current (0 – I_{nMotor}) **5** = Motor torque (0 – T_{nMotor}) **6** = Motor power (0 – P_{nMotor}) **7** = Motor voltage (0 – U_{nMotor}) **8** = DC-bus volt (0 – 1000V)
P1.19①	DIN3 function	0	6		1		301	**0** = Not used **1** = Ext. fault, closing cont. **2** = Ext. fault, opening cont. **3** = Run enable, cc **4** = Run enable, oc **5** = Force cp. to Local **6** = Force cp. to Remote
P1.20	Preset speed 1	0.00	P1.2	Hz	0.00		105	Speeds preset by operator
P1.21	Preset speed 2	0.00	P1.2	Hz	60.00		106	Speeds preset by operator
P1.22	Automatic restart	0	1		0		731	**0** = Disabled **1** = Enabled

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 1-3: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
R2.1	Keypad reference	P1.1	P1.2	Hz				
P2.2	Keypad direction	0	1		0		123	**0** = Forward **1** = Reverse
P2.3	Stop button active	0	1		1		114	**0** = Stop enabled only in keypad operation **1** = Stop button always enabled

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in Chapter 5 of the *SVX9000 User Manual*.

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See the *SVX9000 User Manual*, Chapter 5 — Menu information item M7, for more information.

Table 1-4: Monitoring Menu

Code	Parameter	Unit	ID	Description
V7.1	Output frequency	Hz	1	Output frequency to motor
V7.2	Frequency reference	Hz	25	Frequency
V7.3	Motor speed	rpm	2	Calculated motor speed in rpm
V7.4	Motor current	A	3	Motor current
V7.5	Motor torque	%	4	Calculated torque as a percentage of nominal torque
V7.6	Motor power	%	5	Calculated motor shaft power
V7.7	Motor voltage	V	6	Calculated motor voltage
V7.8	DC-Bus voltage	V	7	DC-Bus voltage
V7.9	Unit temperature	°C	8	Heatsink temperature
V7.10	Motor temperature	%	9	Calculated motor temperature
V7.11	Voltage input	V	13	Analog input AI1
V7.12	Current input	mA	14	Analog input AI2
V7.13	DIN1, DIN2, DIN3	—	15	Digital input status
V7.14	DIN4, DIN5, DIN6	—	16	Digital input status
V7.15	DO1, RO1, RO2	—	17	Digital and relay output status
V7.16	Analog I_{out}	mA	26	Analog output AO1
G7.17	Multimonitor		—	Displays three selectable monitoring values

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See Chapter 5 of the *SVX9000 User Manual* for more information.

Table 1-5: Operate Menu Items

Code	Parameter	Unit	Description
O.1	Output frequency	Hz	Output frequency to motor
O.2	Frequency reference	Hz	Frequency
O.3	Motor speed	rpm	Calculated motor speed in rpm
O.4	Motor current	A	Motor current
O.5	Motor torque	%	Calculated torque as a percentage of nominal torque
O.6	Motor power	%	Calculated motor shaft power
O.7	Motor voltage	V	Calculated motor voltage
O.8	DC-Bus voltage	V	DC-Bus voltage
O.9	Unit temperature	°C	Heatsink temperature
O.10	Motor temperature	%	Calculated motor temperature
R1	Keypad Reference	Hz	Keypad frequency reference setting

Chapter 2 — Standard Application

Introduction

The Standard Application of the Cutler-Hammer SVX9000 drive by Eaton Electrical is typically used in pump and fan applications and conveyors for which the Basic Application is too limited but where no special features are needed.

- The Standard Application has the same I/O signals and the same control logic as the Basic Application.
- Digital input DIN3 and all the outputs are freely programmable.

Additional functions:

- Programmable Start/Stop and Reverse signal logic
- Reference scaling
- One frequency limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start and stop functions
- DC-brake at stop
- One skip frequency area
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection: Programmable action; off, warning, fault

Details on the parameters shown in this section are available in **Chapter 8** of this Manual, listed by parameter ID number.

Control Input/Output

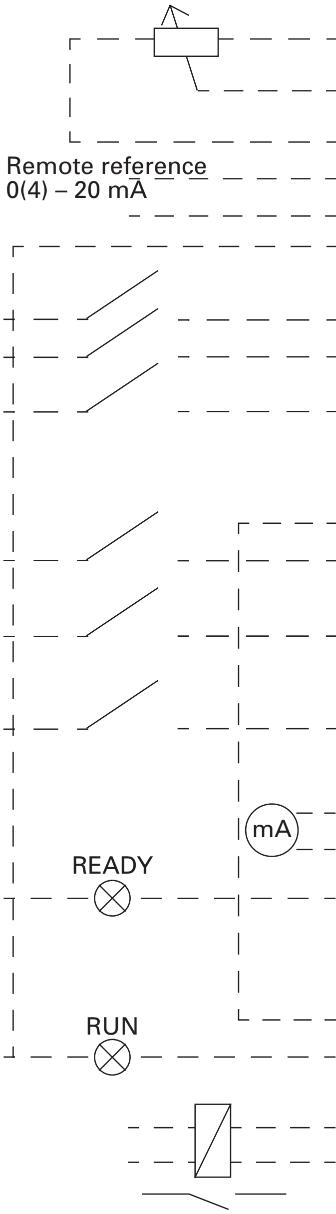


Table 2-1: Standard Application Default I/O Configuration

Terminal		Signal	Description
OPTA9			
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 20 mA	Current input frequency reference
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start forward (programmable)	Contact closed = start forward
9	DIN2	Start reverse (programmable)	Contact closed = start reverse
10	DIN3	External fault input (programmable)	Contact open = no fault Contact closed = fault
11	CMA	Common for DIN 1 – DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Multi-step speed select 1	**DIN4 / DIN5 / Frequency ref.**
15	DIN5	Multi-step speed select 2	Open / Open / $Ref.V_{in}$ Closed / Open / Multi-step ref.1 Open / Closed / Multi-step ref.2 Closed / Closed / Ref_{Max}
16	DIN6	Fault reset	Contact open = no action Contact closed = fault reset
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO1	Relay output 1 RUN	
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	
25	RO2		
26	RO2		

Note: For more information on jumper selections, see the *SVX9000 User Manual*, Chapter 4.

Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 8.**

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min.	=	Minimum value of parameter
Max.	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	User's customized setting
ID	=	ID number of the parameter for reference to **Chapter 8**
①	=	Parameter value can only be changed when the SVX9000 is stopped
②	=	Programmed using *terminal to function* (TTF) method. See **Page 6-3**

Basic Parameters — M1 → G1.1

Table 2-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.1	Min frequency	0.00	P1.1.2	Hz	0.00		101	
P1.1.2	Max frequency	P1.1.1	320.00	Hz	60.00		102	**NOTE**: If f_{Max} > the motor synchronous speed, check suitability for motor and drive system
P1.1.3	Acceleration time 1	0.1	3000.0	s	3.0		103	
P1.1.4	Deceleration time 1	0.1	3000.0	s	3.0		104	
P1.1.5	Current limit	0.4 x I_H	2 x I_H	A	I_L		107	I_H is the nominal current rating of the SVX9000
P1.1.6 ①	Nominal voltage of the motor	180	690	V	SVX-2: 230V SVX-4: 460V		110	Motor nameplate value
P1.1.7 ①	Nominal frequency of the motor	30.00	320.00	Hz	60.00		111	Motor nameplate value
P1.1.8 ①	Nominal speed of the motor	300	20 000	rpm	1720		112	Motor nameplate value — The default applies for a 4-pole motor and a nominal size SVX9000.
P1.1.9 ①	Nominal current of the motor	0.4 x I_H	2 x I_H	A	I_H		113	Motor nameplate value
P1.1.10 ①	Power factor	0.30	1.00		0.85		120	Motor nameplate value
P1.1.11	Local Control Place	1	3		2		171	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus

Table 2-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.12	Remote Control Place	1	3		1		172	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.1.13 [1]	Local reference	0	3		2		173	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus
P1.1.14 [1]	Remote reference	0	3		0		174	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus
P1.1.15	Preset speed 1	0.00	P1.1.2	Hz	10.00		105	Speeds preset by operator
P1.1.16	Preset speed 2	0.00	P1.1.2	Hz	60.00		106	

Input Signals — M1 → G1.2

Table 2-3: Input Signals — M1 → G1.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.1 [1]	Start/Stop logic	0	6		0		300	— **DIN1** / **DIN2** **0** Start fwd / Start rev **1** Start/Stop / Rev/Fwd **2** Start/Stop / Run enable **3** Start pulse / Stop pulse **4** Fwd[3] / Rev[3] **5** Start[3]/Stop / Rev[3]/Fwd **6** Start[3]/Stop / Run enable[3]
P1.2.2 [1]	DIN3 function	0	7		1		301	**0** = Not used **1** = Ext. fault, closing contact **2** = Ext. fault, opening contact **3** = Run enable **4** = Acc./Dec. time select **5** = Force control pt. to Local **6** = Force control pt. to Remote **7** = Rev (if P1.2.1 = 3)
P1.2.3	Current reference offset	0	1		1		302	**0** = 0 – 20 mA **1** = 4 – 20 mA
P1.2.4	Reference scaling minimum value	0.00	P1.2.5	Hz	0.00		303	Selects the frequency that corresponds to the min. reference signal
P1.2.5	Reference scaling maximum value	0.00	320.00	Hz	0.00		304	Selects the frequency that corresponds to the max. reference signal **0.00** = No scaling
P1.2.6	Reference inversion	0	1		0		305	**0** = Not inverted **1** = Inverted
P1.2.7	Reference filter time	0.00	10.00	s	0.10		306	**0.00** = No filtering
P1.2.8 [2]	AI1 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.1		377	TTF programming method used. See **Page 6-3**.
P1.2.9 [2]	AI2 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.2		388	TTF programming method used. See **Page 6-3**.

[3] Rising edge pulse required.

Output Signals — M1 → G1.3

Table 2-4: Output Signals — M1 → G1.3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.1 ②	Analog output 1 signal selection	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1		464	TTF programming method used. See **Page 6-3**.
P1.3.2	Analog output function	0	8		1		307	**0** = Not used **1** = Output freq. (0 – f_{Max}) **2** = Freq. reference (0 – f_{Max}) **3** = Motor speed (0 – Motor nominal speed) **4** = Motor current (0 – I_{nMotor}) **5** = Motor torque (0 – T_{nMotor} **6** = Motor power (0 – P_{nMotor}) **7** = Motor voltage (0 – V_{nMotor}) **8** = DC-Bus volt (0 – 1000V)
P1.3.3	Analog output filter time	0.00	10.00	s	1.00		308	**0.00** = No filtering
P1.3.4	Analog output inversion	0	1		0		309	**0** = Not inverted **1** = Inverted
P1.3.5	Analog output minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P1.3.6	Analog output scale	10	1000	%	100		311	**100** = No scaling
P1.3.7	Digital output 1 function	0	16		2		312	**0** = Not used **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = FC overheat warning **6** = Ext. fault or warning **7** = Ref. fault or warning **8** = Warning **9** = Reversed **10** = Preset speed 1 **11** = At speed **12** = Motor. regulator active **13** = Freq. limit 1 supervision **14** = Remote control active **15** = Thermistor fault/warning **16** = Fieldbus digital input 1
P1.3.8	Relay output 1 function	0	16		2		313	Same as P1.3.7
P1.3.9	Relay output 2 function	0	16		3		314	Same as P1.3.7
P1.3.10	Output frequency limit 1 supervision	0	2		0		315	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.11	Output frequency limit 1; Supervised value	0.00	P1.1.2	Hz	0.00		316	
P1.3.12 ②	Analog output 2 signal selection	AnOUT:0.1	AnOUT:E.10		AnOUT:0.1		471	TTF programming method used. See **Page 6-3**.
P1.3.13	Analog output 2 function	0	8		4		472	See P1.3.2

Table 2-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.14	Analog output 2 filter time	0.00	10.00	s	1.00		473	**0.00** = No filtering
P1.3.15	Analog output 2 inversion	0	1		0		474	**0** = Not inverted **1** = Inverted
P1.3.16	Analog output 2 minimum	0	1		0		475	**0** = 0 mA **1** = 4 mA
P1.3.17	Analog output 2 scaling	10	1000	%	100		476	**100** = No scaling

Drive Control Parameters — M1 → G1.4

Table 2-5: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.1	Ramp 1 shape	0.0	10.0	s	0.0		500	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.2	Ramp 2 shape	0.0	10.0	s	0.0		501	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.3	Acceleration time 2	0.1	3000.0	s	10.0		502	
P1.4.4	Deceleration time 2	0.1	3000.0	s	10.0		503	
P1.4.5 ①	Brake chopper	0	4		0		504	**0** = Disabled **1** = Used when running **2** = External brake chopper **3** = Used when stopped/ running **4** = Used when running (no testing)
P1.4.6	Start mode	0	1		0		505	**0** = Ramp **1** = Flying start
P1.4.7	Stop mode	0	3		1		506	**0** = Coasting **1** = Ramp **2** = Ramp+Run enable coast **3** = Coast+Run enable ramp
P1.4.8	DC braking current	0.4 x I_H	2.0 x I_H	A	I_H		507	
P1.4.9	DC braking time at stop	0.00	600.00	s	0.00		508	**0.00** = DC brake is off at stop
P1.4.10	Frequency to start DC braking during ramp stop	0.10	10.00	Hz	1.50		515	
P1.4.11	DC braking time at start	0.00	600.00	s	0.00		516	**0.00** = DC brake is off at start
P1.4.12	Flux brake	0	1		0		520	**0** = Off **1** = On
P1.4.13	Flux braking current	0.4 x I_H	2.0 x I_H	A	I_H		519	

Skip Frequencies — M1 → G1.5

Table 2-6: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.5.1	Skip frequency range 1 low limit	0.00	P1.5.2	Hz	0.00		509	
P1.5.2	Skip frequency range 1 high limit	P1.5.1	320.00	Hz	0.00		510	
P1.5.3	Prohibit acc./dec. ramp	0.1	10.0		1.0		518	Multiplier for ramp time in prohibit frequency range, e.g. 0.1 = 10% of normal ramp time

Motor Control Parameters — M1 → G1.6

Table 2-7: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.1 ①	Motor control mode	0	1		0		600	**0** = Frequency control **1** = Speed control
P1.6.2 ①	V/Hz optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P1.6.3 ①	V/Hz ratio selection	0	3		0		108	**0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optimiz.
P1.6.4 ①	Field weakening point	8.00	320.00	Hz	60.00		602	
P1.6.5 ①	Voltage at field weakening point	10.00	200.00	%	100.00		603	n% x V_{nMotor}
P1.6.6 ①	V/Hz curve midpoint frequency	0.00	P1.6.4	Hz	60.00		604	
P1.6.7 ①	V/Hz curve midpoint voltage	0.00	P1.6.5	%	100.00		605	n% x V_{nMotor}
P1.6.8 ①	Output voltage at zero frequency	0.00	40.00	%	0.00		606	n% x V_{nMotor}
P1.6.9	Switching frequency	1.0	Varies	kHz	Varies		601	See **Table 8-12** for exact values
P1.6.10	Overvoltage controller	0	2		1		607	**0** = Not used **1** = Used (no ramping) **2** = Used (ramping)
P1.6.11	Undervoltage controller	0	1		1		608	**0** = Not used **1** = Used
P1.6.12	Load Drooping	0.00	100.00	%	0.01		620	Drooping % of nominal speed at nominal torque
P1.6.13	Identification	0	2		0		631	**0** = Not used **1** = OL V/Hz Ratio **2** = OL V/Hz+Boost

Protections — M1 → G1.7

Table 2-8: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.1	Response to 4 mA reference fault	0	5		0		700	**0** = No response **1** = Warning **2** = Warning+Previous Freq. **3** = Wrng+Preset Freq P1.7.2 **4** = Fault, stop per P1.4.7 **5** = Fault, stop by coasting
P1.7.2	4 mA reference fault frequency	0.00	P1.1.2	Hz	0.00		728	
P1.7.3	Response to external fault	0	3		2		701	**0** = No response **1** = Warning **2** = Fault, stop per P1.4.7 **3** = Fault, stop by coasting
P1.7.4	Input phase supervision	0	3		0		730	See P1.7.3
P1.7.5	Response to undervoltage fault	0	1		0		727	**0** = Fault Stored **1** = No History
P1.7.6	Output phase supervision	0	3		2		702	See P1.7.3
P1.7.7	Ground fault protection	0	3		2		703	See P1.7.3
P1.7.8	Thermal protection of the motor	0	3		2		704	See P1.7.3
P1.7.9	Motor ambient temperature factor	-100.0	100.0	%	0.0		705	
P1.7.10	MTP cooling factor at zero speed	0.0	150.0	%	40.0		706	As a % of I_{nMotor}
P1.7.11	MTP time constant	1	200	min	45		707	
P1.7.12	Motor duty cycle	0	100	%	100		708	
P1.7.13	Stall protection	0	3		0		709	See P1.7.3
P1.7.14	Stall current	0.1	I_{nMotor} x 2	A	I_L		710	
P1.7.15	Stall time limit	1.00	120.00	s	15.00		711	
P1.7.16	Stall frequency limit	1.0	P1.1.2	Hz	25.0		712	
P1.7.17	Underload protection	0	3		0		713	See P1.7.13
P1.7.18	Underload protect. f_{nom} torque	10.0	150.0	%	50.0		714	
P1.7.19	Underload protect. f_0 torque	5.0	150.0	%	10.0		715	
P1.7.20	Underload protect. time limit	2.00	600.00	s	20.00		716	

Table 2-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.21	Response to thermistor fault	0	3		2		732	See P1.7.3
P1.7.22	Response to com. fault	0	3		2		733	See P1.7.3
P1.7.23	Response to slot fault	0	3		2		734	See P1.7.3

Auto Restart Parameters — M1 → G1.8

Table 2-9: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.8.1	Wait time	0.10	10.00	s	0.50		717	
P1.8.2	Trial time	0.00	60.00	s	30.00		718	
P1.8.3	Start mode	0	2		0		719	**0** = Ramp **1** = Flying start per P1.4.6 **2** = System defined
P1.8.4	Number of tries after undervoltage trip	0	10		0		720	
P1.8.5	Number of tries after overvoltage trip	0	10		0		721	
P1.8.6	Number of tries after overcurrent trip	0	3		0		722	
P1.8.7	Number of tries after 4 mA trip	0	10		0		723	
P1.8.8	Number of tries after motor temperature fault trip	0	10		0		726	
P1.8.9	Number of tries after external fault trip	0	10		0		725	
P1.8.10	Number of tries after underload fault trip	0	10		1		738	

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 2-10: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
R2.1	Keypad reference	P1.1.1	P1.1.2	Hz				
P2.2	Keypad direction	0	1		0		123	**0** = Forward **1** = Reverse
P2.3	Stop button active	0	1		1		114	**0** = Stop enabled only in keypad operation **1** = Stop button always enabled

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in Chapter 5 of the *SVX9000 User Manual*.

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See the *SVX9000 User Manual*, Chapter 5 — Menu information item M7, for more information.

Table 2-11: Monitoring Menu

Code	Parameter	Unit	ID	Description
V7.1	Output frequency	Hz	1	Output frequency to motor
V7.2	Frequency reference	Hz	25	Frequency
V7.3	Motor speed	rpm	2	Calculated motor speed in rpm
V7.4	Motor current	A	3	Motor current
V7.5	Motor torque	%	4	Calculated torque as a percentage of nominal torque
V7.6	Motor power	%	5	Calculated motor shaft power
V7.7	Motor voltage	V	6	Calculated motor voltage
V7.8	DC-Bus voltage	V	7	DC-Bus voltage
V7.9	Unit temperature	°C	8	Heatsink temperature
V7.10	Motor temperature	%	9	Calculated motor temperature
V7.11	Analog input 1	V	13	Analog input AI1
V7.12	Analog input 2	mA	14	Analog input AI2
V7.13	DIN1, DIN2, DIN3	—	15	Digital input status
V7.14	DIN4, DIN5, DIN6	—	16	Digital input status
V7.15	DO1, RO1, RO2	—	17	Digital and relay output status
V7.16	Analog I_{out}	mA	26	Analog output AO1
G7.17	Multimonitor		—	Displays three selectable monitoring values

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See Chapter 5 of the *SVX9000 User Manual* for more information.

Table 2-12: Operate Menu Items

Code	Parameter	Unit	Description
O.1	Output frequency	Hz	Output frequency to motor
O.2	Frequency reference	Hz	Frequency
O.3	Motor speed	rpm	Calculated motor speed in rpm
O.4	Motor current	A	Motor current
O.5	Motor torque	%	Calculated torque as a percentage of nominal torque
O.6	Motor power	%	Calculated motor shaft power
O.7	Motor voltage	V	Calculated motor voltage
O.8	DC-Bus voltage	V	DC-Bus voltage
O.9	Unit temperature	°C	Heatsink temperature
O.10	Motor temperature	%	Calculated motor temperature
R1	Keypad Reference	Hz	Keypad frequency reference setting

Chapter 3 — Local/Remote Application

Introduction

The Local/Remote Control Application of the Cutler-Hammer SVX9000 drive by Eaton Electrical provides for two different control places. For each control place the frequency reference can be selected from either the control keypad, the I/O terminals or the communication bus/fieldbus. The active control place is selected by digital input DIN6.

- All outputs are freely programmable.

Additional functions:

- Programmable Start/Stop and Reverse signal logic
- Reference scaling
- One frequency limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start and stop functions
- DC-brake at stop
- One skip frequency area
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection: Programmable action; off, warning, fault

Details of the parameters shown in this section are available in **Chapter 8** of this Manual, listed by parameter ID number.

Control Input/Output

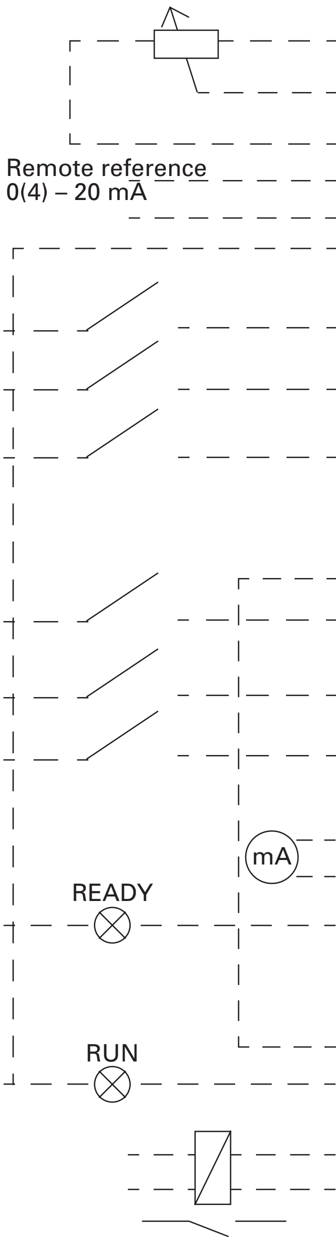
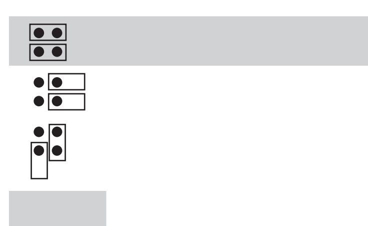


Table 3-1: Local/Remote Application Default I/O Configuration

Terminal		Signal	Description
OPTA9			
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0 – 10V DC	Place B input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 20 mA	Place A frequency reference
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Place A start forward (programmable)	Contact closed = start forward
9	DIN2	Place A start reverse (programmable)	Contact closed = start reverse
10	DIN3	External fault input (programmable)	Contact open = no fault Contact closed = fault
11	CMA	Common for DIN 1 – DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Place B start forward (programmable)	Contact closed = start forward
15	DIN5	Place B start reverse (programmable)	Contact closed = start reverse
16	DIN6	Place A/B selection	Contact open = Place A is active Contact closed = Place B is active
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Note: For more information on jumper selections, see the *SVX9000 User Manual*, Chapter 4.



Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 8.**

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min.	=	Minimum value of parameter
Max.	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	User's customized setting
ID	=	ID number of the parameter for reference to **Chapter 8**
①	=	Parameter value can only be changed when the SVX9000 is stopped
②	=	Programmed using *terminal to function* (TTF) method. See **Page 6-3**

Basic Parameters — M1 → G1.1

Table 3-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.1	Min frequency	0.00	P1.1.2	Hz	0.00		101	
P1.1.2	Max frequency	P1.1.1	320.00	Hz	60.00		102	**NOTE**: If f_{Max} > the motor synchronous speed, check suitability for motor and drive system
P1.1.3	Acceleration time 1	0.1	3000.0	s	3.0		103	
P1.1.4	Deceleration time 1	0.1	3000.0	s	3.0		104	
P1.1.5	Current limit	0.4 x I_H	2 x I_H	A	I_L		107	I_H is the nominal current rating of the SVX9000
P1.1.6 ①	Nominal voltage of the motor	180	690	V	SVX-2: 230V SVX-4: 460V		110	Motor nameplate value
P1.1.7 ①	Nominal frequency of the motor	30.00	320.00	Hz	60.00		111	Motor nameplate value
P1.1.8 ①	Nominal speed of the motor	300	20 000	rpm	1775		112	Motor nameplate value — The default applies for a 4-pole motor and a nominal size SVX9000.
P1.1.9 ①	Nominal current of the motor	0.4 x I_H	2 x I_H	A	I_H		113	Motor nameplate value
P1.1.10 ①	Power Factor	0.30	1.00		0.85		120	Motor nameplate value
P1.1.11	Local Control Place	1	3		2		171	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus

Table 3-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.12	Remote Control Place	1	3		1		172	**1** = I/O Terminal **2** = Keypad **3** = Fieldbus
P1.1.13	Location A reference	0	4		2		173	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus **4** = Motor potentiometer
P1.1.14	Location B reference	0	4		0		131	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus **4** = Motor potentiometer
P1.1.15	Remote control reference	0	4		0		174	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus **4** = Motor potentiometer
P1.1.16	Jog speed reference	0.00	P1.1.2	Hz	0.00		124	

Input Signals — M1 → G1.2

Table 3-3: Input Signals — M1 → G1.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.1 ①	Place A Start/ Stop logic selection	0	8		0		300	DIN1 / DIN2: **0** Start fwd / Start rev **1** Start/Stop / Rev/Fwd **2** Start/Stop / Run enable **3** Start pulse / Stop pulse **4** Start fwd / Mot. pot. UP **5** Fwd ③ / Rev ③ **6** Start③/Stop / Rev③/Fwd **7** Start③/Stop / Run enable ③ **8** Start fwd ③ / Mot. pot. UP
P1.2.2 ①	DIN3 function	0	12		1		301	**0** = Not used **1** = Ext. fault, closing contact **2** = Ext. fault, opening contact **3** = Run enable **4** = Acc./Dec. time select **5** = Force control pt. to Local **6** = Force control pt. to Remote **7** = Rev (if P1.2.1 = 3) **8** = Jog speed select **9** = Fault reset **10** = Acc./Dec. operation prohibit **11** = DC Braking command **12** = Motor potentiometer DOWN
P1.2.3 ②	AI1 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.1		377	TTF programming method used. See **Page 6-3**.

③ Rising edge pulse required.

Table 3-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.4	AI1 signal range	0	2		0		320	**0** = 0 – 100% ④ **1** = 20 – 100% ④ **2** = Custom setting range ④
P1.2.5	AI1 custom setting minimum	0.00	100.00	%	0.00		321	Analog. input 1 scale minimum
P1.2.6	AI1 custom setting maximum	0.00	100.00	%	100.0		322	Analog. input 1 scale maximum
P1.2.7	AI1 signal inversion	0	1		0		323	**0** = Not inverted **1** = Inverted
P1.2.8	AI1 signal filter time	0.00	10.00	s	0.10		324	**0.00** = No filtering
P1.2.9 ②	AI2 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.2		388	TTF programming method used. See **Page 6-3**.
P1.2.10	AI2 signal range	0	2		1		325	**0** = 0 – 20 mA ④ **1** = 4 – 20 mA ④ **2** = custom setting range
P1.2.11	AI2 custom setting minimum	0.00	100.00	%	0.00		326	Analog input 2 scale minimum
P1.2.12	AI2 custom setting maximum	0.00	100.00	%	100.00		327	Analog input 2 scale maximum
P1.2.13	AI2 signal inversion	0	1		0		328	**0** = Not inverted **1** = Inverted
P1.2.14	AI2 signal filter time	0.00	10.00	s	0.10		329	**0.00** = No filtering
P1.2.15 ①	Place B Start/ Stop logic selection	0	6		0		363	**DIN4** / **DIN5** **0** Start fwd / Start rev **1** Start/Stop / Rev/Fwd **2** Start/Stop / Run enable **3** Start pulse / Stop pulse **4** Fwd ③ / Rev ③ **5** Start③/Stop / Rev③/Fwd **6** Start③/Stop / Run enable ③
P1.2.16	Place A Reference scaling minimum value	0.00	P1.2.17	Hz	0.00		303	Selects the frequency that corresponds to the min. reference signal
P1.2.17	Place A Reference scaling maximum value	0.00	320.00	Hz	0.00		304	Selects the frequency that corresponds to the max. reference signal **0.00** = No scaling
P1.2.18	Place B Reference scaling minimum value	0.00	P1.2.19	Hz	0.00		364	Selects the frequency that corresponds to the min. reference signal
P1.2.19	Place B Reference scaling maximum value	0.00	320.00	Hz	0.00		365	Selects the frequency that corresponds to the max. reference signal **0.00** = No scaling

③ Rising edge pulse required.
④ Place jumpers of block X2 appropriately.

Table 3-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.20	Free analog input signal selection	0	2		0		361	**0** = Not used **1** = AI1 **2** = AI2
P1.2.21	Free analog input, function	0	4		0		362	**0** = No function **1** = Reduces current limit (P1.1.5) **2** = Reduces DC braking current **3** = Reduces accel. and decel. times **4** = Reduces torque supervision limit
P1.2.22	Motor potentiometer ramp time	0.1	2000.0	Hz/s	10.0		331	
P1.2.23	Motor potentiometer frequency reference memory reset	0	2		1		367	**0** = No reset **1** = Reset if stopped or powered down **2** = Reset if powered down
P1.2.24	Start pulse memory	0	1		0		498	**0** = Run state not copied **1** = Run state copied

Output Signals — M1 → G1.3

Table 3-4: Output Signals — M1 → G1.3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.1 ②	AO1 signal selection	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1		464	TTF programming method used. See **Page 6-3**.
P1.3.2	Analog output function	0	8		1		307	**0** = Not used **1** = Output freq. (0 – f_{Max}) **2** = Freq. reference (0 – f_{Max}) **3** = Motor speed (0 – Motor nominal speed) **4** = Motor current (0 – I_{nMotor}) **5** = Motor torque (0 – T_{nMotor}) **6** = Motor power (0 – P_{nMotor}) **7** = Motor voltage (0 – V_{nMotor}) **8** = DC-bus volt (0 – 1000V)
P1.3.3	Analog output filter time	0.00	10.00	s	1.00		308	**0.00** = No filtering
P1.3.4	Analog output inversion	0	1		0		309	**0** = Not inverted **1** = Inverted
P1.3.5	Analog output minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P1.3.6	Analog output scale	10	1000	%	100		311	**100** = No scaling

Table 3-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.7	Digital output 1 function	0	22		1		312	**0** = Not used **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = Overheat warning **6** = Ext. fault or warning **7** = Ref. fault or warning **8** = Warning **9** = Reversed **10** = Jog speed selected **11** = At speed **12** = Motor regulator active **13** = OP freq. limit superv. 1 **14** = OP freq. limit superv. 2 **15** = Torque limit superv. **16** = Ref. limit superv. **17** = Ext. brake control **18** = Remote control active **19** = FC temp. limit superv. **20** = Unrequested rotation direction **21** = Ext. brake control inverted **22** = Thermistor fault/warn.
P1.3.8	Relay output 1 function	0	22		2		313	See P1.3.7
P1.3.9	Relay output 2 function	0	22		3		314	See P1.3.7
P1.3.10	Output frequency limit 1 supervision	0	2		0		315	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.11	Output frequency limit 1 Supervision value	0.00	P1.1.2	Hz	0.00		316	
P1.3.12	Output frequency limit 2 supervision	0	2		0		346	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.13	Output frequency limit 2 Supervision value	0.00	P1.1.2	Hz	0.00		347	
P1.3.14	Torque limit supervision function	0	2		0		348	**0** = No **1** = Low limit **2** = High limit
P1.3.15	Torque limit supervision value	0.0	200.0	%	0.0		349	
P1.3.16	Reference limit supervision function	0	2		0		350	**0** = No **1** = Low limit **2** = High limit
P1.3.17	Reference limit supervision value	0.0	100.0	%	0.0		351	

Table 3-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.18	External brake Off-delay	0.0	100.0	s	0.5		352	
P1.3.19	External brake On-delay	0.0	100.0	s	1.5		353	
P1.3.20	Temperature limit supervision	0	2		0		354	**0** = No **1** = Low limit **2** = High limit
P1.3.21	Temperature Supv limit value	-10	75	°C	0		355	
P1.3.22 ②	Analog output 2 signal selection	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1		471	TTF programming method used. See **Page 6-3**.
P1.3.23	Analog output 2 function	0	8		4		472	See P1.3.2
P1.3.24	Analog output 2 filter time	0.00	10.00	s	1.00		473	**0.00** = No filtering
P1.3.25	Analog output 2 inversion	0	1		0		474	**0** = Not inverted **1** = Inverted
P1.3.26	Analog output 2 minimum	0	1		0		475	**0** = 0 mA **1** = 4 mA
P1.3.27	Analog output 2 scaling	10	1000	%	100		476	**100** = No scaling

Drive Control Parameters — M1 → G1.4

Table 3-5: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.1	Ramp 1 shape	0.0	10.0	s	0.0		500	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.2	Ramp 2 shape	0.0	10.0	s	0.0		501	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.3	Acceleration time 2	0.1	3000.0	s	10.0		502	
P1.4.4	Deceleration time 2	0.1	3000.0	s	10.0		503	
P1.4.5 ①	Brake chopper	0	4		0		504	**0** = Disabled **1** = Used when running **2** = External brake chopper **3** = Used when stopped/ running **4** = Used when running (no testing)
P1.4.6	Start mode	0	1		0		505	**0** = Ramp **1** = Flying start
P1.4.7	Stop mode	0	3		1		506	**0** = Coasting **1** = Ramp **2** = Ramp+Run enable coast **3** = Coast+Run enable ramp
P1.4.8	DC braking current	0.4 x I_H	2.0 x I_H	A	I_H		507	
P1.4.9	DC braking time at stop	0.00	600.00	s	0.00		508	**0.00** = DC brake is off at stop

Table 3-5: Drive Control Parameters — M1 → G1.4, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.10	Frequency to start DC braking during ramp stop	0.10	10.00	Hz	1.50		515	
P1.4.11	DC braking time at start	0.00	600.00	s	0.00		516	**0.00** = DC brake is off at start
P1.4.12	Flux brake	0	1		0		520	**0** = Off **1** = On
P1.4.13	Flux braking current	0.4 x I_H	2.0 x I_H	A	I_H		519	

Skip Frequencies — M1 → G1.5

Table 3-6: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.5.1	Skip frequency range 1 low limit	0.00	P1.5.2	Hz	0.00		509	
P1.5.2	Skip frequency range 1 high limit	P1.5.1	320.00	Hz	0.00		510	**0.00** = No prohibit range 1
P1.5.3	Skip frequency range 2 low limit	0.00	P1.5.4	Hz	0.00		511	
P1.5.4	Skip frequency range 2 high limit	P1.5.3	320.00	Hz	0.00		512	**0.00** = No prohibit range 2
P1.5.5	Skip frequency range 3 low limit	0.00	P1.5.6	Hz	0.00		513	
P1.5.6	Skip frequency range 3 high limit	P1.5.5	320.00	Hz	0.00		514	**0.00** = No prohibit range 3
P1.5.7	Prohibit acc./dec. ramp	0.1	10.0		1.0		518	Multiplier for ramp time in prohibit frequency range, e.g. 0.1 = 10% of normal ramp time

Motor Control Parameters — M1 → G1.6

Table 3-7: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.1 ①	Motor control mode	0	1		0		600	**0** = Frequency control **1** = Speed control
P1.6.2 ①	V/Hz optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P1.6.3 ①	V/Hz ratio selection	0	3		0		108	**0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optimization
P1.6.4 ①	Field weakening point	8.00	320.00	Hz	60.00		602	
P1.6.5 ①	Voltage at field weakening point	10.00	200.00	%	100.00		603	n% x V_{nMotor}
P1.6.6 ①	V/Hz curve midpoint frequency	0.00	P1.6.4	Hz	60.00		604	
P1.6.7 ①	V/Hz curve midpoint voltage	0.00	P1.6.5	%	100.00		605	n% x V_{nMotor}
P1.6.8 ①	Output voltage at zero frequency	0.00	40.00	%	0.00		606	n% x V_{nMotor}
P1.6.9	Switching frequency	1.0	Varies	kHz	Varies		601	See **Table 8-12** for exact values
P1.6.10	Overvoltage controller	0	2		1		607	**0** = Not used **1** = Used (no ramping) **2** = Used (ramping)
P1.6.11	Undervoltage controller	0	1		1		608	**0** = Not used **1** = Used
P1.6.12	Load Drooping	0.00	100.00		0.01		620	Drooping % of nominal speed at nominal torque
P1.6.13	Identification	0	2		0		631	**0** = Not used **1** = OL V/Hz Ratio **2** = OL V/Hz+Boost

Protections — M1 → G1.7

Table 3-8: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.1	Response to 4 mA reference fault	0	5		0		700	**0** = No response **1** = Warning **2** = Warning+Previous Freq. **3** = Wrng+Preset Freq P1.7.2 **4** = Fault, stop per P1.4.7 **5** = Fault, stop by coasting
P1.7.2	4 mA reference fault frequency	0.00	P1.1.2	Hz	0.00		728	
P1.7.3	Response to external fault	0	3		2		701	**0** = No response **1** = Warning **2** = Fault, stop per P1.4.7 **3** = Fault, stop by coasting
P1.7.4	Input phase supervision	0	3		0		730	See P1.7.3
P1.7.5	Response to undervoltage fault	0	1		0		727	**0** = Fault Stored **1** = No History
P1.7.6	Output phase supervision	0	3		2		702	See P1.7.3
P1.7.7	Ground fault protection	0	3		2		703	See P1.7.3
P1.7.8	Thermal protection of the motor	0	3		2		704	See P1.7.3
P1.7.9	Motor ambient temperature factor	-100.0	100.0	%	0.0		705	
P1.7.10	MTP cooling factor at zero speed	0.0	150.0	%	40.0		706	As a % of I_{nMotor}
P1.7.11	MTP time constant	1	200	min	45		707	
P1.7.12	Motor duty cycle	0	100	%	100		708	
P1.7.13	Stall protection	0	3		0		709	See P1.7.3
P1.7.14	Stall current	0.1	I_{nMotor} x 2	A	I_L		710	
P1.7.15	Stall time limit	1.00	120.00	s	15.00		711	
P1.7.16	Stall frequency limit	1.0	P1.1.2	Hz	25.0		712	
P1.7.17	Underload protection	0	3		0		713	See P1.7.3
P1.7.18	Underload protect. f_{nom} torque	10.0	150.0	%	50.0		714	
P1.7.19	Underload protect. f_0 torque	5.0	150.0	%	10.0		715	
P1.7.20	Underload protection time limit	2.00	600.00	s	20.00		716	

Table 3-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.21	Response to thermistor fault	0	3		2		732	See P1.7.3
P1.7.22	Response to com. fault	0	3		2		733	See P1.7.3
P1.7.23	Response to slot fault	0	3		2		734	See P1.7.3

Auto Restart Parameters — M1 → G1.8

Table 3-9: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.8.1	Wait time	0.10	10.00	s	0.50		717	
P1.8.2	Trial time	0.00	60.00	s	30.00		718	
P1.8.3	Start mode	0	2		0		719	**0** = Ramp **1** = Flying start **2** = Start per P1.4.6
P1.8.4	Number of tries after undervoltage trip	0	10		0		720	
P1.8.5	Number of tries after overvoltage trip	0	10		0		721	
P1.8.6	Number of tries after overcurrent trip	0	3		0		722	
P1.8.7	Number of tries after 4 mA trip	0	10		0		723	
P1.8.8	Number of tries after motor temp fault trip	0	10		0		726	
P1.8.9	Number of tries after external fault trip	0	10		0		725	
P1.8.10	Number of tries after underload fault trip	0	10		1		738	

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 3-10: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
R2.1	Keypad reference	P1.1.1	P1.1.2	Hz				
P2.2	Keypad direction	0	1		0		123	**0** = Forward **1** = Reverse
P2.3	Stop button active	0	1		1		114	**0** = Stop enabled only in keypad operation **1** = Stop button always enabled

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in Chapter 5 of the *SVX9000 User Manual*.

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See the *SVX9000 User Manual*, Chapter 5 — Menu information item M7, for more information.

Table 3-11: Monitoring Menu

Code	Parameter	Unit	ID	Description
V7.1	Output frequency	Hz	1	Output frequency to motor
V7.2	Frequency reference	Hz	25	Frequency
V7.3	Motor speed	rpm	2	Calculated motor speed in rpm
V7.4	Motor current	A	3	Motor current
V7.5	Motor torque	%	4	Calculated torque as a percentage of nominal torque
V7.6	Motor power	%	5	Calculated motor shaft power
V7.7	Motor voltage	V	6	Calculated motor voltage
V7.8	DC-Bus voltage	V	7	DC-Bus voltage
V7.9	Unit temperature	°C	8	Heatsink temperature
V7.10	Motor temperature	%	9	Calculated motor temperature
V7.11	Analog input 1	V	13	Analog input AI1
V7.12	Analog input 2	mA	14	Analog input AI2
V7.13	DIN1, DIN2, DIN3	—	15	Digital input status
V7.14	DIN4, DIN5, DIN6	—	16	Digital input status
V7.15	DO1, RO1, RO2	—	17	Digital and relay output status
V7.16	Analog I_{out}	mA	26	Analog output AO1
G7.17	Multimonitor		—	Displays three selectable monitoring values

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See Chapter 5 of the *SVX9000 User Manual* for more information.

Table 3-12: Operate Menu Items

Code	Parameter	Unit	Description
O.1	Output frequency	Hz	Output frequency to motor
O.2	Frequency reference	Hz	Frequency
O.3	Motor speed	rpm	Calculated motor speed in rpm
O.4	Motor current	A	Motor current
O.5	Motor torque	%	Calculated torque as a percentage of nominal torque
O.6	Motor power	%	Calculated motor shaft power
O.7	Motor voltage	V	Calculated motor voltage
O.8	DC-Bus voltage	V	DC-Bus voltage
O.9	Unit temperature	°C	Heatsink temperature
O.10	Motor temperature	%	Calculated motor temperature
R1	Keypad Reference	Hz	Keypad frequency reference setting

Chapter 4 — Multi-Step Speed Control Application

Introduction

The Multi-Step Speed Control Application of the Cutler-Hammer SVX9000 drive by Eaton Electrical can be used in applications where fixed speeds are needed. A total of 17 different speeds can be programmed: one basic speed, 15 multi-step speeds and one jog speed. The speed steps are selected with digital signals DIN3, DIN4, DIN5 and DIN6. If jog speed is used, DIN3 can be programmed from fault reset to jog speed select. The basic speed reference can be either a voltage or a current signal via analog input terminals (2/3 or 4/5). The other analog inputs can be programmed for other purposes.

- All outputs are freely programmable.

Additional functions:

- Programmable Start/Stop and Reverse signal logic
- Reference scaling
- One frequency limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start and stop functions
- DC-brake at stop
- One skip frequency area
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection: Programmable action; off, warning, fault

Details of the parameters shown in this section are available in **Chapter 8** of this Manual, listed by parameter ID number.

Control Input/Output

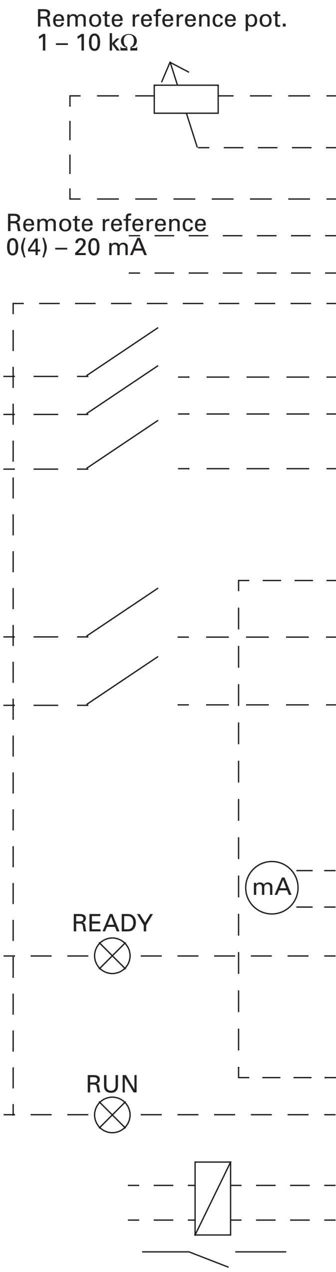
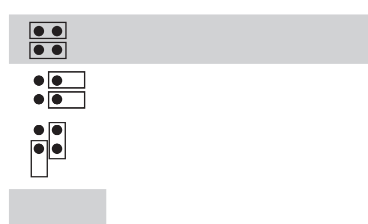


Table 4-1: Multi-Step Speed Control Application Default I/O Configuration

Terminal		Signal	Description
OPTA9			
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0 – 10V DC	Basic reference (programmable)
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 20 mA	Basic reference (programmable)
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start forward (programmable)	Contact closed = start forward
9	DIN2	Start reverse (programmable)	Contact closed = start reverse
10	DIN3	External fault input (programmable)	Contact open = no fault Contact closed = fault
11	CMA	Common for DIN 1 – DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Multi-step speed select 1	**Sel1 | Sel2 | Sel3 | Sel4 (with DIN3)** 0 | 0 | 0 | 0 Basic speed 1 | 0 | 0 | 0 Speed 1
15	DIN5	Multi-step speed select 2	0 | 1 | 0 | 0 Speed 2 ...
16	DIN6	Multi-step speed select	1 | 1 | 1 | 1 Speed 15
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Note: For more information on jumper selections, see the *SVX9000 User Manual*, Chapter 4.



Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 8.**

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min.	=	Minimum value of parameter
Max.	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	User's customized setting
ID	=	ID number of the parameter for reference to **Chapter 8**
①	=	Parameter value can only be changed when the SVX9000 is stopped
②	=	Programmed using *terminal to function* (TTF) method. See **Page 6-3**

Basic Parameters — M1 → G1.1

Table 4-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.1	Min frequency	0.00	P1.1.2	Hz	0.00		101	
P1.1.2	Max frequency	P1.1.1	320.00	Hz	60.00		102	**NOTE**: If f_{Max} > the motor synchronous speed, check suitability for motor and drive system
P1.1.3	Acceleration time 1	0.1	3000.0	s	3.0		103	
P1.1.4	Deceleration time 1	0.1	3000.0	s	3.0		104	
P1.1.5	Current limit	0.4 x I_H	2 x I_H	A	I_L		107	I_H is the nominal current rating of the SVX9000
P1.1.6 ①	Nominal voltage of the motor	180	690	V	SVX-2: 230V SVX-4: 460V		110	
P1.1.7 ①	Nominal frequency of the motor	30.00	320.00	Hz	60.00		111	Check the rating plate of the motor
P1.1.8 ①	Nominal speed of the motor	300	20 000	rpm	1775		112	Motor nameplate value — The default applies for a 4-pole motor and a nominal size SVX9000.
P1.1.9 ①	Nominal current of the motor	0.4 x I_H	2 x I_H	A	I_H		113	Motor nameplate value
P1.1.10 ①	Power Factor	0.30	1.00		0.85		120	Motor nameplate value
P1.1.11 ①	Local control place	1	3		2		171	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.1.12 ①	Remote control place	1	3		1		172	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus

Table 4-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.13 ①	Local control reference	0	3		2		173	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus
P1.1.14 ①	Remote control reference	0	3		3		174	**0** = AI1 **1** = AI2 **2** = Keypad **3** = Fieldbus
P1.1.15	Jog speed reference	0.00	P1.1.2	Hz	0.00		124	
P1.1.16	Preset speed 1	0.00	P1.1.2	Hz	5.00		105	Multi-step speed 1
P1.1.17	Preset speed 2	0.00	P1.1.2	Hz	10.00		106	Multi-step speed 2
P1.1.18	Preset speed 3	0.00	P1.1.2	Hz	12.50		126	Multi-step speed 3
P1.1.19	Preset speed 4	0.00	P1.1.2	Hz	15.00		127	Multi-step speed 4
P1.1.20	Preset speed 5	0.00	P1.1.2	Hz	17.50		128	Multi-step speed 5
P1.1.21	Preset speed 6	0.00	P1.1.2	Hz	20.00		129	Multi-step speed 6
P1.1.22	Preset speed 7	0.00	P1.1.2	Hz	22.50		130	Multi-step speed 7
P1.1.23	Preset speed 8	0.00	P1.1.2	Hz	25.00		133	Multi-step speed 8
P1.1.24	Preset speed 9	0.00	P1.1.2	Hz	27.50		134	Multi-step speed 9
P1.1.25	Preset speed 10	0.00	P1.1.2	Hz	30.00		135	Multi-step speed 10
P1.1.26	Preset speed 11	0.00	P1.1.2	Hz	32.50		136	Multi-step speed 11
P1.1.27	Preset speed 12	0.00	P1.1.2	Hz	35.00		137	Multi-step speed 12
P1.1.28	Preset speed 13	0.00	P1.1.2	Hz	40.00		138	Multi-step speed 13
P1.1.29	Preset speed 14	0.00	P1.1.2	Hz	45.00		139	Multi-step speed 14
P1.1.30	Preset speed 15	0.00	P1.1.2	Hz	60.00		140	Multi-step speed 15

Input Signals — M1 → G1.2

Table 4-3: Input Signals — M1 → G1.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note		
P1.2.1 ①	Start/Stop logic	0	6		0		300		**DIN1**	**DIN2**
								0	Start fwd	Start rev
								1	Start/Stop	Rev/Fwd
								2	Start/Stop	Run enable
								3	Start pulse	Stop pulse
								4	Fwd③	Rev③
								5	Start③/Stop	Rev③/Fwd
								6	Start③/Stop	Run enable③

③ Rising edge pulse required.

Table 4-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.2 ①	DIN3 function	0	12		1		301	**0** = Not used **1** = Ext. fault, closing cont. **2** = Ext. fault, opening cont. **3** = Run enable **4** = Acc./Dec. time select. **5** = Force control pt. to Local **6** = Force control pt. to Remote **7** = Rvs (if P1.2.1 = 3) **8** = Jog speed **9** = Fault reset **10** = Acc./Dec. operation prohibit **11** = DC Braking command **12** = Preset speed
P1.2.3 ②	AI1 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.1		377	TTF programming method used. See **Page 6-3**.
P1.2.4	AI1 signal range	0	2		0		320	**0** = 0 – 10V ④ **1** = 2 – 10V ④ **2** = Custom setting range ④
P1.2.5	AI1 custom setting minimum	0.00	100.00	%	0.00		321	Analog input 1 scale minimum
P1.2.6	AI1 custom setting maximum	0.00	100.00	%	100.0		322	Analog input 1 scale maximum
P1.2.7	AI1 signal inversion	0	1		0		323	**0** = Not inverted **1** = Inverted
P1.2.8	AI1 signal filter time	0.00	10.00	s	0.10		324	**0.00** = No filtering
P1.2.9 ②	AI2 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.2		388	TTF programming method used. See **Page 6-3**.
P1.2.10	AI2 signal range	0	2		1		325	**0** = 0 – 20 mA ④ **1** = 4 – 20 mA ④ **2** = custom setting range
P1.2.11	AI2 custom setting minimum	0.00	100.00	%	0.00		326	Analog input 2 scale minimum
P1.2.12	AI2 custom setting maximum	0.00	100.00	%	100.00		327	Analog input 2 scale maximum
P1.2.13	AI2 signal inversion	0	1		0		328	**0** = Not inverted **1** = Inverted
P1.2.14	AI2 signal filter time	0.00	10.00	s	0.10		329	**0.00** = No filtering
P1.2.15	Reference scaling minimum value	0.00	P1.2.16	Hz	0.00		303	Selects the frequency that corresponds to the min. reference signal
P1.2.16	Reference scaling maximum value	0.00	320.00	Hz	0.00		304	Selects the frequency that corresponds to the max. reference signal **0.00** = No scaling

④ Place jumpers of block X2 appropriately.

Table 4-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.17	Free analog input, signal selection	0	2		0		361	**0** = Not used **1** = V_{in} (analog voltage input) **2** = I_{in} (analog current input)
P1.2.18	Free analog input function	0	4		0		362	0 = No function **1** = Reduces current limit (P1.1.5) **2** = Reduces DC braking current **3** = Reduces accel. and decel. times **4** = Reduces torque supervision limit

Output Signals — M1 → G1.3

Table 4-4: Output Signals — M1 → G1.3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.1 ②	AO1 signal selection	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1		464	TTF programming method used. See **Page 6-3**.
P1.3.2	Analog output function	0	8		1		307	**0** = Not used **1** = Output freq. (0 – f_{Max}) **2** = Freq. reference (0 – f_{Max}) **3** = Motor speed (0 – Motor nominal speed) **4** = Motor current (0 – I_{nMotor}) **5** = Motor torque (0 – T_{nMotor}) **6** = Motor power (0 – P_{nMotor}) **7** = Motor voltage (0 – V_{nMotor}) **8** = DC-bus volt (0 – 1000V)
P1.3.3	Analog output filter time	0.00	10.00	s	1.00		308	**0.00** = No filtering
P1.3.4	Analog output inversion	0	1		0		309	**0** = Not inverted **1** = Inverted
P1.3.5	Analog output minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P1.3.6	Analog output scale	10	1000	%	100		311	

Table 4-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.7	Digital output 1 function	0	22		1		312	**0** = Not used **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = FC overheat warning **6** = Ext. fault or warning **7** = Ref. fault or warning **8** = Warning **9** = Reversed **10** = Jog speed selected **11** = At speed **12** = Mot. regulator active **13** = OP freq. limit superv. 1 **14** = OP freq. limit superv. 2 **15** = Torque limit superv. **16** = Ref. limit superv. **17** = Ext. brake control **18** = Remote Control Active **19** = FC temp. limit superv. **20** = Unrequested rotation direction **21** = Ext. brake control inverted **22** = Thermistor fault/warn.
P1.3.8	Relay output 1 function	0	22		2		313	See P1.3.7
P1.3.9	Relay output 2 function	0	22		3		314	See P1.3.7
P1.3.10	Output frequency limit 1 supervision	0	2		0		315	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.11	Output frequency limit 1 Supervision value	0.00	P1.1.2	Hz	0.00		316	
P1.3.12	Output frequency limit 2 supervision	0	2		0		346	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.13	Output frequency limit 2 Supervision value	0.00	P1.1.2	Hz	0.00		347	
P1.3.14	Torque limit supervision function	0	2		0		348	**0** = No **1** = Low limit **2** = High limit
P1.3.15	Torque limit supervision value	0.0	200.0	%	0.0		349	
P1.3.16	Reference limit supervision function	0	2		0		350	**0** = No **1** = Low limit **2** = High limit

Table 4-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.17	Reference limit supervision value	0.0	100.0	%	0.0		351	
P1.3.18	External brake Off-delay	0.0	100.0	s	0.5		352	
P1.3.19	External brake On-delay	0.0	100.0	s	1.5		353	
P1.3.20	Temperature limit supervision function	0	2		0		354	**0** = No **1** = Low limit **2** = High limit
P1.3.21	Temperature limit value	-10	75	°C	0		355	
P1.3.22 ②	Analog output 2 signal selection	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1		471	TTF programming method used. See **Page 6-3**.
P1.3.23	Analog output 2 function	0	8		4		472	See P1.3.2
P1.3.24	Analog output 2 filter time	0.00	10.00	s	1.00		473	**0.00** = No filtering
P1.3.25	Analog output 2 inversion	0	1		0		474	**0** = Not inverted **1** = Inverted
P1.3.26	Analog output 2 minimum	0	1		0		475	**0** = 0 mA **1** = 4 mA
P1.3.27	Analog output 2 scaling	10	1000	%	100		476	**100** = No scaling

Drive Control Parameters — M1 → G1.4

Table 4-5: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.1	Ramp 1 shape	0.0	10.0	s	0.0		500	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.2	Ramp 2 shape	0.0	10.0	s	0.0		501	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.3	Acceleration time 2	0.1	3000.0	s	10.0		502	
P1.4.4	Deceleration time 2	0.1	3000.0	s	10.0		503	
P1.4.5 ①	Brake chopper	0	4		0		504	**0** = Disabled **1** = Used when running **2** = External brake chopper **3** = Used when stopped/ running **4** = Used when running (no testing)
P1.4.6	Start mode	0	1		0		505	**0** = Ramp **1** = Flying start

Table 4-5: Drive Control Parameters — M1 → G1.4, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.7	Stop mode	0	3		1		506	**0** = Coasting **1** = Ramp **2** = Ramp+Run enable coast **3** = Coast+Run enable ramp
P1.4.8	DC braking current	0.4 x I_H	2.0 x I_H	A	I_H		507	
P1.4.9	DC braking time at stop	0.00	600.00	s	0.00		508	**0.00** = DC brake is off at stop
P1.4.10	Frequency to start DC braking during ramp stop	0.10	10.00	Hz	1.50		515	
P1.4.11	DC braking time at start	0.00	600.00	s	0.00		516	**0.00** = DC brake is off at start
P1.4.12	Flux brake	0	1		0		520	**0** = Off **1** = On
P1.4.13	Flux braking current	0.4 x I_H	2.0 x I_H	A	I_H		519	

Skip Frequencies — M1 → G1.5

Table 4-6: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.5.1	Skip frequency range 1 low limit	0.00	P1.5.2	Hz	0.00		509	
P1.5.2	Skip frequency range 1 high limit	P1.5.1	320.00	Hz	0.00		510	**0.00** = No prohibit range 1
P1.5.3	Skip frequency range 2 low limit	0.00	P1.5.4	Hz	0.00		511	
P1.5.4	Skip frequency range 2 high limit	P1.5.3	320.00	Hz	0.00		512	**0.00** = No prohibit range 2
P1.5.5	Skip frequency range 3 low limit	0.00	P1.5.6	Hz	0.00		513	
P1.5.6	Skip frequency range 3 high limit	P1.5.5	320.00	Hz	0.00		514	**0.00** = No prohibit range 3
P1.5.7	Prohibit acc./dec. ramp	0.1	10.0		1.0		518	Multiplier for ramp time in prohibit frequency range, e.g. 0.1 = 10% of normal ramp time

Motor Control Parameters — M1 → G1.6

Table 4-7: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.1 ①	Motor control mode	0	1		0		600	**0** = Frequency control **1** = Speed control
P1.6.2 ①	V/Hz optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P1.6.3 ①	V/Hz ratio selection	0	3		0		108	**0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optimiz.
P1.6.4 ①	Field weakening point	8.00	320.00	Hz	60.00		602	
P1.6.5 ①	Voltage at field weakening point	10.00	200.00	%	100.00		603	n% x V_{nMotor}
P1.6.6 ①	V/Hz curve midpoint frequency	0.00	P1.6.4	Hz	60.00		604	
P1.6.7 ①	V/Hz curve midpoint voltage	0.00	P1.6.5	%	100.00		605	n% x V_{nMotor}
P1.6.8 ①	Output voltage at zero frequency	0.00	40.00	%	0.00		606	n% x V_{nMotor}
P1.6.9	Switching frequency	1.0	Varies	kHz	Varies		601	See **Table 8-12** for exact values
P1.6.10	Overvoltage controller	0	2		1		607	**0** = Not used **1** = Used (no ramping) **2** = Used (ramping)
P1.6.11	Undervoltage controller	0	1		1		608	**0** = Not used **1** = Used
P1.6.12	Load Drooping	0.00	100.00		0.01		620	Drooping % of nominal speed at nominal torque
P1.6.13	Identification	0	2		0		631	**0** = Not used **1** = OL V/Hz Ratio **2** = OL V/Hz+Boost

Protections — M1 → G1.7

Table 4-8: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.1	Response to 4 mA reference fault	0	5		0		700	**0** = No response **1** = Warning **2** = Warning+Previous Freq. **3** = Wrng+Preset Freq P1.7.2 **4** = Fault, stop per P1.4.7 **5** = Fault, stop by coasting
P1.7.2	4 mA reference fault frequency	0.00	P1.1.2	Hz	0.00		728	
P1.7.3	Response to external fault	0	3		2		701	**0** = No response **1** = Warning **2** = Fault, stop per P1.4.7 **3** = Fault, stop by coasting
P1.7.4	Input phase supervision	0	3		0		730	See P1.7.3
P1.7.5	Response to undervoltage fault	0	1		0		727	**0** = Fault Stored **1** = No History
P1.7.6	Output phase supervision	0	3		2		702	See P1.7.3
P1.7.7	Ground fault protection	0	3		2		703	See P1.7.3
P1.7.8	Thermal protection of the motor	0	3		2		704	See P1.7.3
P1.7.9	Motor ambient temperature factor	-100.0	100.0	%	0.0		705	
P1.7.10	MTP cooling factor at zero speed	0.0	150.0	%	40.0		706	As a % of I_{nMotor}
P1.7.11	MTP time constant	1	200	min	45		707	
P1.7.12	Motor duty cycle	0	100	%	100		708	
P1.7.13	Stall protection	0	3		0		709	See P1.7.3
P1.7.14	Stall current	0.1	I_{nMotor} x 2	A	I_L		710	
P1.7.15	Stall time limit	1.00	120.00	s	15.00		711	
P1.7.16	Stall frequency limit	1.0	P1.1.2	Hz	25.0		712	
P1.7.17	Underload protection	0	3		0		713	See P1.7.3
P1.7.18	Underload protect. f_{nom} torque	10.0	150.0	%	50.0		714	
P1.7.19	Underload protect. f_0 torque	5.0	150.0	%	10.0		715	
P1.7.20	Underload protection time limit	2.00	600.00	s	20.00		716	

Table 4-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.21	Response to thermistor fault	0	3		2		732	See P1.7.3
P1.7.22	Response to com. fault	0	3		2		733	See P1.7.3
P1.7.23	Response to slot fault	0	3		2		734	See P1.7.3

Auto Restart Parameters — M1 → G1.8

Table 4-9: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.8.1	Wait time	0.10	10.00	s	0.50		717	
P1.8.2	Trial time	0.00	60.00	s	30.00		718	
P1.8.3	Start mode	0	2		0		719	**0** = Ramp **1** = Flying start **2** = Start per P1.4.6
P1.8.4	Number of tries after undervoltage trip	0	10		0		720	
P1.8.5	Number of tries after overvoltage trip	0	10		0		721	
P1.8.6	Number of tries after overcurrent trip	0	3		0		722	
P1.8.7	Number of tries after 4 mA trip	0	10		0		723	
P1.8.8	Number of tries after motor temp fault trip	0	10		0		726	
P1.8.9	Number of tries after external fault trip	0	10		0		725	
P1.8.10	Number of tries after underload fault trip	0	10		1		738	

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 4-10: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
R2.1	Keypad reference	P1.1.1	P1.1.2	Hz				
P2.2	Keypad direction	0	1		0		123	**0** = Forward **1** = Reverse
P2.3	Stop button active	0	1		1		114	**0** = Stop enabled only in keypad operation **1** = Stop button always enabled

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in Chapter 5 of the *SVX9000 User Manual*.

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See the *SVX9000 User Manual*, Chapter 5 — Menu information item M7, for more information.

Table 4-11: Monitoring Menu

Code	Parameter	Unit	ID	Description
V7.1	Output frequency	Hz	1	Output frequency to motor
V7.2	Frequency reference	Hz	25	Frequency
V7.3	Motor speed	rpm	2	Calculated motor speed in rpm
V7.4	Motor current	A	3	Motor current
V7.5	Motor torque	%	4	Calculated torque as a percentage of nominal torque
V7.6	Motor power	%	5	Calculated motor shaft power
V7.7	Motor voltage	V	6	Calculated motor voltage
V7.8	DC-Bus voltage	V	7	DC-Bus voltage
V7.9	Unit temperature	°C	8	Heatsink temperature
V7.10	Motor temperature	%	9	Calculated motor temperature
V7.11	Analog input 1	V	13	Analog input AI1
V7.12	Analog input 2	mA	14	Analog input AI2
V7.13	DIN1, DIN2, DIN3	—	15	Digital input status
V7.14	DIN4, DIN5, DIN6	—	16	Digital input status
V7.15	DO1, RO1, RO2	—	17	Digital and relay output status
V7.16	Analog I_{out}	mA	26	Analog output AO1
G7.17	Multimonitor		—	Displays three selectable monitoring values

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See Chapter 5 of the *SVX9000 User Manual* for more information.

Table 4-12: Operate Menu Items

Code	Parameter	Unit	Description
O.1	Output frequency	Hz	Output frequency to motor
O.2	Frequency reference	Hz	Frequency
O.3	Motor speed	rpm	Calculated motor speed in rpm
O.4	Motor current	A	Motor current
O.5	Motor torque	%	Calculated torque as a percentage of nominal torque
O.6	Motor power	%	Calculated motor shaft power
O.7	Motor voltage	V	Calculated motor voltage
O.8	DC-Bus voltage	V	DC-Bus voltage
O.9	Unit temperature	°C	Heatsink temperature
O.10	Motor temperature	%	Calculated motor temperature
R1	Keypad Reference	Hz	Keypad frequency reference setting

Chapter 5 — PID Control Application

Introduction

The PID Control Application of the Cutler-Hammer SVX9000 drive by Eaton Electrical provides for two different control places – place A is the PID controller, and place B is direct frequency reference. The active control place is selected by digital input DIN6.

The PID controller reference can be selected from the analog inputs, fieldbus, motor potentiometer, by enabling the PID Reference 2, or by applying the control keypad reference. The PID controller actual value can be selected from the analog inputs, fieldbus, the actual values of the motor or through the mathematical functions of these.

The direct frequency reference can be used for the control without the PID controller and is selected from the analog inputs, fieldbus, motor potentiometer or keypad.

The PID Application is typically used to control levels or pumps and fans. In these applications, the PID Application provides a smooth control and an integrated measurement and control package where no additional components are needed.

- Digital inputs DIN2, DIN3 and DIN5 and all outputs are freely programmable.

Additional functions:

- Analog input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start and stop functions
- DC-brake at stop
- Three skip frequency areas
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection: Programmable action; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Sum point frequency addition to PID output
- The PID controller can additionally be used from control places I/O B, the keypad and the fieldbus
- Easy Change Over function
- Sleep function

Details of the parameters shown in this section are available in **Chapter 8** of this Manual, listed by parameter ID number.

Control Input/Output

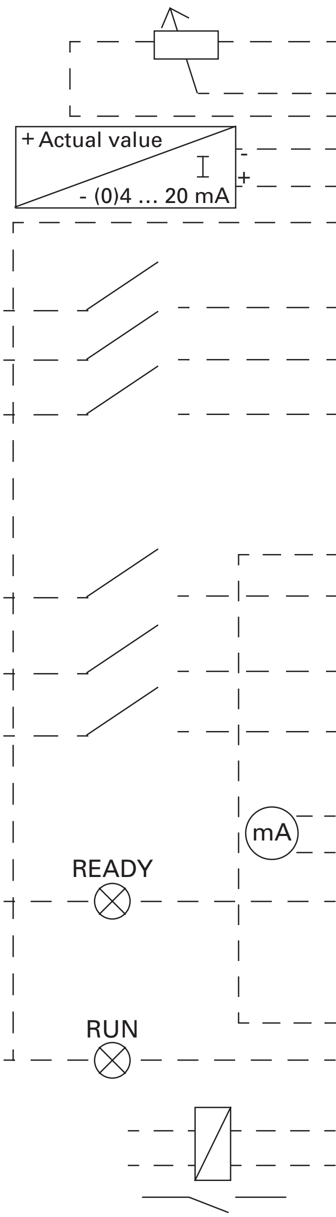
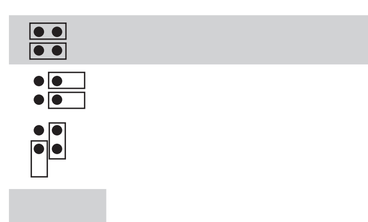


Table 5-1: PID Control Application Default I/O Configuration

Terminal		Signal	Description
OPTA9			
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 20 mA	Current input frequency reference
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start/Stop Control Place A (PID controller)	Contact closed = start
9	DIN2	External fault input (programmable)	Contact closed = fault Contact open = no fault
10	DIN3	Fault reset (programmable)	Contact closed = fault reset
11	CMA	Common for DIN 1 – DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Start/Stop Control Place B (direct frequency reference)	Contact closed = start
15	DIN5	Jog Speed Selection (programmable)	Contact closed = jog speed active
16	DIN6	Control place A/B selection	Contact open = control place A is active Contact closed = control place B is active
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Note: For more information on jumper selections, see the *SVX9000 User Manual*, Chapter 4.



Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 8.**

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min.	=	Minimum value of parameter
Max.	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	User's customized setting
ID	=	ID number of the parameter for reference to **Chapter 8**
①	=	Parameter value can only be changed when the SVX9000 is stopped
②	=	Programmed using *terminal to function* (TTF) method. See **Page 6-3**

Basic Parameters — M1 → G1.1

Table 5-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.1	Min frequency	0.00	P1.1.2	Hz	0.00		101	
P1.1.2	Max frequency	P1.1.1	320.00	Hz	60.00		102	**NOTE**: If f_{Max} > the motor synchronous speed, check suitability for motor and drive system
P1.1.3	Acceleration time 1	0.1	3000.0	s	1.0		103	If the PID controller is used, acceleration time 2 (P1.4.3) is automatically used
P1.1.4	Deceleration time 1	0.1	3000.0	s	1.0		104	If the PID controller is used, deceleration time 2 (P1.4.4) is automatically used
P1.1.5	Current limit	0.4 x I_H	2 x I_H	A	I_L		107	I_H is the nominal current rating of the SVX9000
P1.1.6 ①	Nominal voltage of the motor	180	690	V	SVX-2: 230V SVX-4: 460V		110	
P1.1.7 ①	Nominal frequency of the motor	30.00	320.00	Hz	60.00		111	Motor nameplate value
P1.1.8 ①	Nominal speed of the motor	300	20 000	rpm	1775		112	Motor nameplate value — The default applies for a 4-pole motor and a nominal size SVX9000.
P1.1.9 ①	Nominal current of the motor	0.4 x I_H	2 x I_H	A	I_H		113	Motor nameplate value
P1.1.10 ①	Power Factor	0.30	1.00		0.85		120	Motor nameplate value

Table 5-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.11 ①	Local control place	1	3		2		171	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.1.12 ①	Remote control place	1	3		1		172	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.1.13 ①	Local control reference	0	7		4		173	**0** = AI1 **1** = AI2 **2** = AI3 **3** = AI4 **4** = Keypad reference **5** = Fieldbus reference **6** = Motor potentiometer **7** = PID controller
P1.1.14 ①	Remote control reference	0	7		0		174	**0** = AI1 **1** = AI2 **2** = AI3 **3** = AI4 **4** = Keypad reference **5** = Fieldbus reference **6** = Motor potentiometer **7** = PID controller
P1.1.15 ①	PID controller reference signal (Place A)	0	4		2		332	**0** = AI1 **1** = AI2 **2** = Keypad reference **3** = Fieldbus reference **4** = Motor potentiometer
P1.1.16	PID controller gain	0.0	1000.0	%	100.0		118	
P1.1.17	PID controller I-time	0.00	320.00	s	1.00		119	
P1.1.18	PID controller D-time	0.00	100.00	s	0.00		132	
P1.1.19	Sleep frequency	P1.1.1	P1.1.2	Hz	10.00		1016	
P1.1.20	Sleep delay	0	3600	s	30		1017	
P1.1.21	Wake up limit	0.00	100.00	%	25.00		1018	
P1.1.22	Wake up action	0	1		0		1019	**0** = Wake-up when below wake up level (P1.1.21) **1** = Wake-up when above wake up level (P1.1.21)
P1.1.23	Jog speed reference	0.00	P1.1.2	Hz	10.00		124	

Input Signals — M1 → G1.2

Table 5-3: Input Signals — M1 → G1.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.1 ①	DIN2 function	0	13		1		319	**0** = Not used **1** = Ext. fault, closing cont. **2** = Ext. fault opening cont. **3** = Run enable **4** = Acc/Dec time selection **5** = Force control pt. to Local **6 =** Not used **7** = Force control pt. to Remote **8** = Forward/Reverse **9** = Jog speed select **10** = Fault reset **11** = Acc/Dec prohibit **12** = DC braking command **13** = Motor pot. UP
P1.2.2 ①	DIN3 function	0	13		10		301	Same as P1.2.1 except: **13** = Motor pot. DOWN
P1.2.3 ①	DIN5 function	0	13		9		330	Same as P1.2.1 except: **13** = PID reference 2 select
P1.2.4 ①	PID sum point reference	0	7		0		376	**0** = Direct PID output value **1** = AI1+PID output **2** = AI2+PID output **3** = AI3+PID output **4** = AI4+PID output **5** = PID keypad+PID output **6** = Fieldbus+PID output **7** = Mot.pot.+PID output
P1.2.5 ①	Actual value selection	0	7		0		333	**0** = Actual value 1 **1** = Actual 1 + Actual 2 **2** = Actual 1 – Actual 2 **3** = Actual 1 * Actual 2 **4** = Min (Actual 1, Actual 2) **5** = Max (Actual 1, Actual 2) **6** = Mean (Actual 1, Actual 2) **7** = Sqrt (Act1) + Sqrt (Act2)
P1.2.6 ①	Actual value 1 selection	0	10		2		334	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus **6** = Motor torque **7** = Motor speed **8** = Motor current **9** = Motor power **10** = Actual speed

Table 5-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.7 ①	Actual value 2 input	0	10		0		335	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus **6** = Motor torque **7** = Motor speed **8** = Motor current **9** = Motor power **10** = Actual speed
P1.2.8	Actual value 1 minimum scale	-1600.0	1600.0	%	0.0		336	**0.0** = No minimum scaling
P1.2.9	Actual value 1 maximum scale	-1600.0	1600.0	%	100.0		337	**100.0** = No maximum scaling
P1.2.10	Actual value 2 minimum scale	-1600.0	1600.0	%	0.0		338	**0.0** = No minimum scaling
P1.2.11	Actual value 2 maximum scale	-1600.0	1600.0	%	100.0		339	**100.0** = No maximum scaling
P1.2.12 ②	AI1 signal selection	AnIN:0.1	AnIN:E.10		AnIN:0.1		377	TTF programming method used. See **Page 6-3**.
P1.2.13	AI1 signal range	0	2		0		320	**0** = Signal range 0 – 100% ③ **1** = Signal range 20 – 100% ③ **2** = Custom range ③
P1.2.14	AI1 custom minimum setting	-160.00	160.00	%	0.00		321	
P1.2.15	AI1 custom maximum setting	-160.00	160.00	%	100.00		322	
P1.2.16	AI1 inversion	0	1		0		323	**0** = Not inverted **1** = Inverted
P1.2.17	AI1 filter time	0.00	10.00	s	0.10		324	**0.00** = No filtering
P1.2.18 ②	AI2 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.2		388	TTF programming method used. See **Page 6-3**.
P1.2.19	AI2 signal range	0	2		1		325	**0** = 0 – 20 mA ③ **1** = 4 – 20 mA ③ **2** = custom setting range ③
P1.2.20	AI2 custom minimum setting	-160.00	160.00	%	0.00		326	
P1.2.21	AI2 custom maximum setting	-160.00	160.00	%	100.00		327	
P1.2.22	AI2 inversion	0	1		0		328	**0** = Not inverted **1** = Inverted
P1.2.23	AI2 filter time	0.00	10.00	s	0.10		329	**0** = No filtering
P1.2.24	Motor potentiometer ramp time	0.1	2000.0	Hz/s	10.0		331	

③ Place jumpers of block X2 appropriately.

Table 5-3: Input Signals — M1 → G1.2, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.25	Motor potentiometer frequency reference memory reset	0	2		1		367	**0** = No reset **1** = Reset if stopped or powered down **2** = Reset if powered down
P1.2.26	Motor potentiometer PID reference memory reset	0	2		0		370	**0** = No reset **1** = Reset if stopped or powered down **2** = Reset if powered down
P1.2.27	PID minimum limit	-1000.0	P1.2.28	%	0.00		359	
P1.2.28	PID maximum limit	P1.2.27	1000.0	%	100.00		360	
P1.2.29	Error value inversion	0	1		0		340	**0** = No inversion **1** = Inversion
P1.2.30	PID reference rise time	0.1	100.0	s	5.0		341	
P1.2.31	PID reference fall time	0.1	100.0	s	5.0		342	
P1.2.32	Reference scaling minimum value, place B	0.00	P1.2.33	Hz	0.00		344	
P1.2.33	Reference scaling maximum value, place B	P1.2.32	320.00	Hz	0.00		345	
P1.2.34 ②	AI3 signal selection	AnIN:0.1	AnIN:E.10		AnIN:0.1		141	TTF programming method used. See **Page 6-3**.
P1.2.35	AI3 signal range	0	1		1		143	**0** = 0 – 100% **1** = 20 – 100%
P1.2.36	AI3 inversion	0	1		0		151	**0** = Not inverted **1** = Inverted
P1.2.37	AI3 filter time	0.00	10.00	s	0.10		142	**0.00** = No filtering
P1.2.38 ②	AI4 signal selection	AnIN:0.1	AnIN:E.10		AnIN:0.1		152	TTF programming method used. See **Page 6-3**.
P1.2.39	AI4 signal range	0	1		1		154	**0** = 0 – 100% **1** = 20 – 100%
P1.2.40	AI4 inversion	0	1		0		162	**0** = Not inverted **1** = Inverted
P1.2.41	AI4 filter time	0.00	10.00	s	0.10		153	**0** = No filtering

Output Signals — M1 → G1.3

Table 5-4: Output Signals — M1 → G1.3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.1 ②	AO1 signal selection	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1		464	TTF programming method used. See **Page 6-3**.
P1.3.2	Analog output function	0	14		1		307	**0** = Not used **1** = Output freq. (0 – f_{Max}) **2** = Freq. reference (0 – f_{Max}) **3** = Motor speed (0 – Motor nominal speed) **4** = Motor current (0 – I_{nMotor}) **5** = Motor torque (0 – T_{nMotor}) **6** = Motor power (0 – P_{nMotor}) **7** = Motor voltage (0 – V_{nMotor}) **8** = DC-bus volt (0 – 1000V) **9** = PID reference value **10** = PID actual value 1 **11** = PID actual value 2 **12** = PID error value **13** = PID controller output **14** = PT100 temperature
P1.3.3	Analog output filter time	0.00	10.00	s	1.00		308	**0.00** = No filtering
P1.3.4	Analog output inversion	0	1		0		309	**0** = Not inverted **1** = Inverted
P1.3.5	Analog output minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P1.3.6	Analog output scale	10	1000	%	100		311	
P1.3.7	Digital output 1 function	0	23		1		312	**0** = Not used **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = FC overheat warning **6** = Ext. fault or warning **7** = Ref. fault or warning **8** = Warning **9** = Reversed **10** = Jog speed selected **11** = At speed **12** = Mot. regulator active **13** = OP freq. limit superv. 1 **14** = OP freq. limit superv. 2 **15** = Torque limit superv. **16** = Ref. limit superv. **17** = External brake control **18** = Remote Control Active **19** = FC temp. limit superv. **20** = Unrequested rotation direction **21** = Ext. brake control inverted **22** = Thermistor fault/warning **23** = Fieldbus input data
P1.3.8	Relay output 1 function	0	23		2		313	See P1.3.7

Table 5-4: Output Signals — M1 → G1.3, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.8	Relay output 1 function	0	23		2		313	See P1.3.7
P1.3.9	Relay output 2 function	0	23		3		314	See P1.3.7
P1.3.10	Output frequency limit 1 supervision	0	2		0		315	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.11	Output frequency limit 1 Supervision value	0.00	P1.1.2	Hz	0.00		316	
P1.3.12	Output frequency limit 2 supervision	0	2		0		346	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.13	Output frequency limit 2 Supervision value	0.00	P1.1.2	Hz	0.00		347	
P1.3.14	Torque limit supervision function	0	2		0		348	**0** = No **1** = Low limit **2** = High limit
P1.3.15	Torque limit supervision value	0.0	300.0	%	100.0		349	
P1.3.16	Reference limit supervision function	0	2		0		350	**0** = No **1** = Low limit **2** = High limit
P1.3.17	Reference limit supervision value	0.0	100.0	%	0.0		351	
P1.3.18	External brake Off-delay	0.0	100.0	s	0.5		352	
P1.3.19	External brake On-delay	0.0	100.0	s	1.5		353	
P1.3.20	Temperature limit supervision	0	2		0		354	**0** = No **1** = Low limit **2** = High limit
P1.3.21	Temperature limit value	-10	75	°C	40		355	
P1.3.22 ②	Analog output 2 signal selection	AnOUT:0.1	AnOUT:E.10		AnOUT:0.1		471	TTF programming method used. See **Page 6-3**.
P1.3.23	Analog output 2 function	0	14		4		472	See P1.3.2
P1.3.24	Analog output 2 filter time	0.00	10.00	s	1.00		473	**0.00** = No filtering
P1.3.25	Analog output 2 inversion	0	1		0		474	**0** = Not inverted **1** = Inverted
P1.3.26	Analog output 2 minimum	0	1		0		475	**0** = 0 mA **1** = 4 mA
P1.3.27	Analog output 2 scaling	10	1000	%	100		476	**100** = No scaling

Drive Control Parameters — M1 → G1.4

Table 5-5: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.1	Ramp 1 shape	0.0	10.0	s	0.0		500	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.2	Ramp 2 shape	0.0	10.0	s	0.0		501	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.3	Acceleration time 2	0.1	3000.0	s	0.1		502	
P1.4.4	Deceleration time 2	0.1	3000.0	s	0.1		503	
P1.4.5 ①	Brake chopper	0	4		0		504	**0** = Disabled **1** = Used when running **2** = External brake chopper **3** = Used when stopped/ running **4** = Used when running (no testing)
P1.4.6	Start mode	0	1		0		505	**0** = Ramp **1** = Flying start
P1.4.7	Stop mode	0	3		1		506	**0** = Coasting **1** = Ramp **2** = Ramp+Run enable coast **3** = Coast+Run enable ramp
P1.4.8	DC braking current	0.4 x I_H	2.0 x I_H	A	I_H		507	
P1.4.9	DC braking time at stop	0.00	600.00	s	0.00		508	**0.00** = DC brake is off at stop
P1.4.10	Frequency to start DC braking during ramp stop	0.10	10.00	Hz	1.50		515	
P1.4.11	DC braking time at start	0.00	600.00	s	0.00		516	**0.00** = DC brake is off at start
P1.4.12	Flux brake	0	1		0		520	**0** = Off **1** = On
P1.4.13	Flux braking current	0.4 x I_H	2 x I_H	A	I_H		519	

Skip Frequencies — M1 → G1.5

Table 5-6: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.5.1	Skip frequency range 1 low limit	0.00	P1.5.2	Hz	0.00		509	
P1.5.2	Skip frequency range 1 high limit	P1.5.1	320.00	Hz	0.00		510	**0.00** = No prohibit range 1
P1.5.3	Skip frequency range 2 low limit	0.00	P1.5.4	Hz	0.00		511	

Table 5-6: Skip Frequencies — M1 → G1.5, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.5.4	Skip frequency range 2 high limit	P1.5.3	320.00	Hz	0.00		512	**0.00** = No prohibit range 2
P1.5.5	Skip frequency range 3 low limit	0.00	P1.5.6	Hz	0.00		513	
P1.5.6	Skip frequency range 3 high limit	P1.5.5	320.00	Hz	0.00		514	**0.00** = No prohibit range 3
P1.5.7	Prohibit acc./dec. ramp	0.1	10.0		1.0		518	Multiplier for ramp time in prohibit frequency range, e.g. 0.1 = 10% of normal ramp time

Motor Control Parameters — M1 → G1.6

Table 5-7: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.1 ①	Motor control mode	0	1		0		600	**0** = Frequency control **1** = Speed control
P1.6.2 ①	V/Hz optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P1.6.3 ①	V/Hz ratio selection	0	3		0		108	**0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optimiz.
P1.6.4 ①	Field weakening point	8.00	320.00	Hz	60.00		602	
P1.6.5 ①	Voltage at field weakening point	10.00	200.00	%	100.00		603	n% x V_{nMotor}
P1.6.6 ①	V/Hz curve midpoint frequency	0.00	P1.6.4	Hz	60.00		604	
P1.6.7 ①	V/Hz curve midpoint voltage	0.00	P1.6.5	%	100.00		605	n% x V_{nMotor}
P1.6.8 ①	Output voltage at zero frequency	0.00	40.00	%	0.00		606	n% x V_{nMotor}
P1.6.9	Switching frequency	1.0	Varies	kHz	Varies		601	See **Table 8-12** for exact values
P1.6.10	Overvoltage controller	0	2		1		607	**0** = Not used **1** = Used (no ramping) **2** = Used (ramping)
P1.6.11	Undervoltage controller	0	1		1		608	**0** = Not used **1** = Used
P1.6.12	Load Drooping	0.00	100.00		0.01		620	Drooping % of nominal speed at nominal torque
P1.6.13	Identification	0	2		0		631	**0** = Not used **1** = OL V/Hz Ratio **2** = OL V/Hz+Boost

Protections — M1 → G1.7

Table 5-8: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.1	Response to 4 mA reference fault	0	5		0		700	**0** = No response **1** = Warning **2** = Warning+Previous Freq. **3** = Warning+Preset Freq P1.7.2 **4** = Fault, stop per P1.4.7 **5** = Fault, stop by coasting
P1.7.2	4 mA reference fault frequency	0.00	P1.1.2	Hz	0.00		728	
P1.7.3	Response to external fault	0	3		2		701	**0** = No response **1** = Warning **2** = Fault, stop per P1.4.7 **3** = Fault, stop by coasting
P1.7.4	Input phase supervision	0	3		0		730	See P1.7.3
P1.7.5	Response to undervoltage fault	0	1		0		727	**0** = Fault Stored **1** = No History
P1.7.6	Output phase supervision	0	3		2		702	See P1.7.3
P1.7.7	Ground fault protection	0	3		2		703	See P1.7.3
P1.7.8	Thermal protection of the motor	0	3		2		704	See P1.7.3
P1.7.9	Motor ambient temperature factor	-100.0	100.0	%	0.0		705	
P1.7.10	MTP cooling factor at zero speed	0.0	150.0	%	40.0		706	As a % of I_{nMotor}
P1.7.11	MTP time constant	1	200	min	45		707	
P1.7.12	Motor duty cycle	0	100	%	100		708	
P1.7.13	Stall protection	0	3		0		709	See P1.7.3
P1.7.14	Stall current	0.1	I_{nMotor} x 2	A	I_L		710	
P1.7.15	Stall time limit	1.00	120.00	s	15.00		711	
P1.7.16	Stall frequency limit	1.00	P1.1.2	Hz	25.00		712	
P1.7.17	Underload protection	0	3		0		713	See P1.7.3
P1.7.18	Underload protect. f_{nom} torque	10.0	150.0	%	50.0		714	
P1.7.19	Underload protect. f_0 torque	5.0	150.0	%	10.0		715	
P1.7.20	Underload protection time limit	2.00	600.00	s	20.00		716	

Table 5-8: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.21	Response to thermistor fault	0	3		2		732	See P1.7.3
P1.7.22	Response to fieldbus fault	0	3		2		733	See P1.7.3
P1.7.23	Response to slot fault	0	3		2		734	See P1.7.3
P1.7.24	No. of PT100 numbers	0	3		0		739	
P1.7.25	Response to PT100 fault	0	3		2		740	See P1.7.3
P1.7.26	PT100 warning limit	-30.0	200.0	°C	120.0		741	
P1.7.27	PT100 fault limit	-30.0	200.0	°C	130.0		742	

Auto Restart Parameters — M1 → G1.8

Table 5-9: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.8.1	Wait time	0.10	10.00	s	0.50		717	
P1.8.2	Trial time	0.00	60.00	s	30.00		718	
P1.8.3	Start mode	0	2		0		719	**0** = Ramp **1** = Flying start **2** = Start per P1.4.6
P1.8.4	Number of tries after undervoltage trip	0	10		0		720	
P1.8.5	Number of tries after overvoltage trip	0	10		0		721	
P1.8.6	Number of tries after overcurrent trip	0	3		0		722	
P1.8.7	Number of tries after reference trip	0	10		0		723	
P1.8.8	Number of tries after motor temp fault trip	0	10		0		726	
P1.8.9	Number of tries after external fault trip	0	10		0		725	
P1.8.10	Number of tries after underload fault trip	0	10		1		738	

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 5-10: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
R2.1	Keypad reference	P1.1.1	P1.1.2	Hz				
P2.2	Keypad direction	0	1		0		123	**0** = Forward **1** = Reverse
P2.3	PID reference	0.00	100.00	%	0.00			
P2.4	PID reference 2	0.00	100.00	%	0.00			
P2.5	Stop button active	0	1		1		114	**0** = Stop enabled only in keypad operation **1** = Stop button always enabled

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in Chapter 5 of the *SVX9000 User Manual*.

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See the *SVX9000 User Manual*, Chapter 5 — Menu information item M7, for more information.

Table 5-11: Monitoring Menu

Code	Parameter	Unit	ID	Description
V7.1	Output frequency	Hz	1	Output frequency to motor
V7.2	Frequency reference	Hz	25	Frequency
V7.3	Motor speed	rpm	2	Calculated motor speed in rpm
V7.4	Motor current	A	3	Motor current
V7.5	Motor torque	%	4	Calculated torque as a percentage of nominal torque
V7.6	Motor power	%	5	Calculated motor shaft power
V7.7	Motor voltage	V	6	Calculated motor voltage
V7.8	DC-Bus voltage	V	7	DC-Bus voltage
V7.9	Unit temperature	°C	8	Heatsink temperature
V7.10	Motor temperature	%	9	Calculated motor temperature
V7.11	Analog input 1	V	13	Analog input AI1
V7.12	Analog input 2	mA	14	Analog input AI2
V7.13	Analog input 3		27	Analog input AI3
V7.14	Analog input 4		28	Analog input AI4
V7.15	DIN1, DIN2, DIN3	—	15	Digital input status
V7.16	DIN4, DIN5, DIN6	—	16	Digital input status
V7.17	DO1, RO1, RO2	—	17	Digital and relay output status
V7.18	Analog I_{out}	mA	26	Analog output AO1

Table 5-11: Monitoring Menu, continued

Code	Parameter	Unit	ID	Description
V7.19	PID reference	%	20	% of the maximum frequency
V7.20	PID actual value	%	21	% of the maximum actual value
V7.21	PID error	%	22	% of the maximum error value
V7.22	PID output	%	23	% of the maximum output value
V7.23	PT100 temperature	°C	42	Highest temperature of used inputs, needs option board (OPTB8)
G7.24	Multimonitor		—	Displays three selectable monitoring values

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See Chapter 5 of the *SVX9000 User Manual* for more information.

Table 5-12: Operate Menu Items

Code	Parameter	Unit	Description
O.1	Output frequency	Hz	Output frequency to motor
O.2	Frequency reference	Hz	Frequency
O.3	Motor speed	rpm	Calculated motor speed in rpm
O.4	Motor current	A	Motor current
O.5	Motor torque	%	Calculated torque as a percentage of nominal torque
O.6	Motor power	%	Calculated motor shaft power
O.7	Motor voltage	V	Calculated motor voltage
O.8	DC-Bus voltage	V	DC-Bus voltage
O.9	Unit temperature	°C	Heatsink temperature
O.10	Motor temperature	%	Calculated motor temperature
O.11	PID reference	%	% of the maximum frequency
O.12	PID actual value	%	% of the maximum actual value
O.13	PID error value	%	% of the maximum error value
O.14	PID output	%	% of the maximum output value
R1	Keypad reference	Hz	Keypad frequency reference setting

Chapter 6 — Multi-Purpose Control Application

Introduction

The Multi-Purpose Control Application of the Cutler-Hammer SVX9000 drive by Eaton Electrical provides a wide range of parameters for controlling motors. It can be used a variety of processes, where wide flexibility of I/O signals is needed and PID control is not necessary (if PID control functions are needed, use the PID Control Application or the Pump and Fan Control Application).

The frequency reference can be selected e.g. from the analog inputs, joystick control, motor potentiometer and from a mathematical function of the analog inputs. There are also parameters for Fieldbus communication. Multi-step speeds and jog speed can be selected if the digital inputs are programmed for these functions.

- The digital inputs and all of the outputs are freely programmable. The application supports all I/O option boards.

Additional functions:

- Analog input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start, stop and reverse logic
- DC-brake at start and stop
- Three skip frequency areas
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection: programmable action; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Joystick hysteresis
- Sleep function

Details of the parameters shown in this section are available in **Chapter 8** of this Manual, listed by parameter ID number.

Control Input/Output

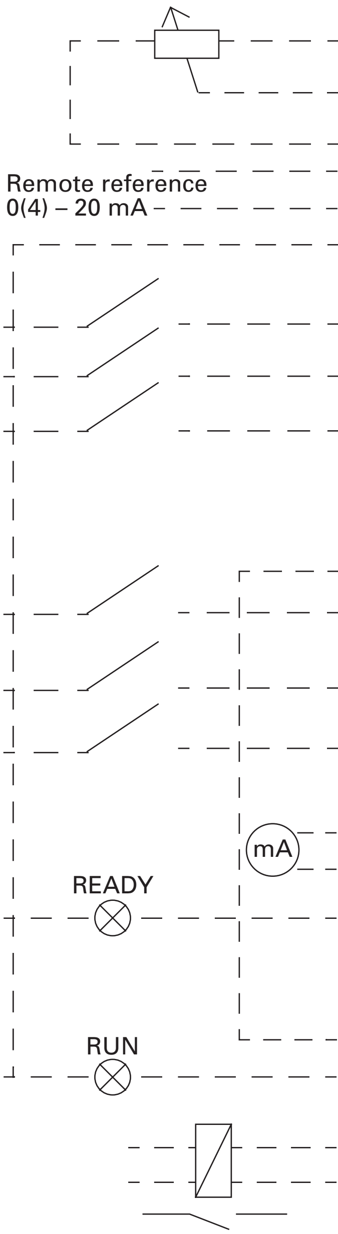
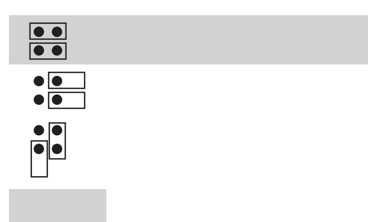


Table 6-1: Multi-Purpose Control Application Default I/O Configuration

Terminal		Signal	Description
OPTA9			
1	+10V$_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 20 mA	Current input frequency reference
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start forward (programmable)	Contact closed = start forward
9	DIN2	Start reverse (programmable)	Contact closed = start reverse
10	DIN3	Fault reset (programmable)	Contact closed = fault reset
11	CMA	Common for DIN 1 – DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Jog speed selection (programmable)	Contact closed = jog speed active
15	DIN5	External fault (programmable)	Contact open = no fault Contact closed = fault
16	DIN6	Accel./decel. time select (programmable)	Contact open = P1.1.3, P1.1.4 in use Contact closed = P1.4.3, P1.4.4 in use
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Note: For more information on jumper selections, see the *SVX9000 User Manual*, Chapter 4.



"Terminal To Function" (TTF) Programming Principle

The programming principle of the input and output signals in the **Multi-Purpose Control Application** as well as in the **Pump and Fan Control Application** (and partly in the other applications) is different compared to the conventional method used in other applications.

In the conventional programming method, *Function to Terminal Programming Method (FTT),* you have a fixed input or output that you define a certain function for. The applications mentioned above, however, use the *Terminal to Function Programming Method (TTF)* in which the programming process is carried out the other way round: Functions appear as parameters for which the operator defines a certain input/output. See *Warning* on **Page 6-4**.

Defining an Input/Output for a Certain Function on Keypad

Connecting a certain input or output with a specific function (parameter) is done by giving the parameter an appropriate value. The value is formed from the *Board slot* on the SVX9000 control board (see the *SVX9000 User Manual*, Chapter 4) and the *respective signal number* as shown in **Figure 6-1**.

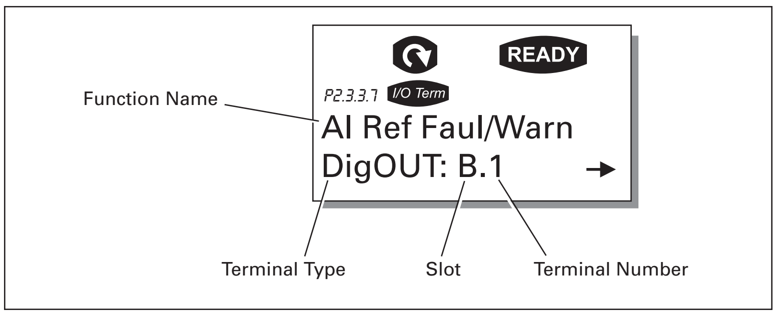


Figure 6-1: Defining Input/Output — Function

Example: You want to connect the digital output function *Reference fault/warning* (P1.3.3.7) to the digital output DO1 on the basic board OPTA1 (see the *SVX9000 User Manual*, Chapter 4).

First find the P1.3.3.7 on the keypad. Press the *Menu button right* once to enter the edit mode. On the *value line*, you will see the terminal type on the left (DigIN, DigOUT, An.IN, An.OUT) and on the right, the present input/output the function is connected to (B.3, A.2 etc.), or if not connected, a value (0.#).

While the value is blinking, hold down the *Browser button up* or *down* to find the desired board slot and signal number. The program will scroll the board slots starting from **0** and proceeding from **A** to **E** and the I/O selection from **1** to **10.**

Once you have set the desired value, press the *Enter button* once to confirm the change.

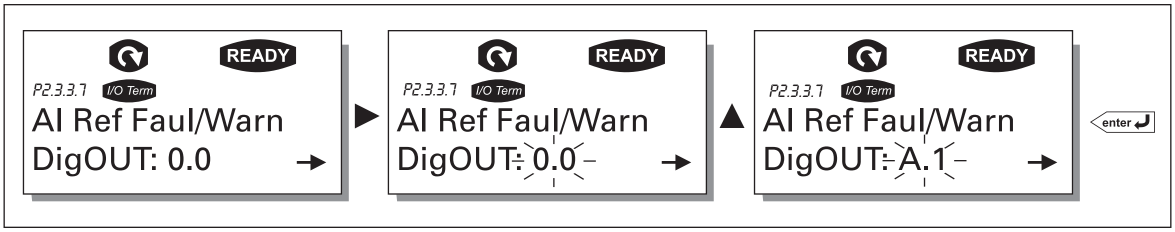


Figure 6-2: Defining Input/Output — Values

Defining a Terminal for a Certain Function with the 9000X Drive Programming Tool

If you use the 9000X Drive Programming Tool for parametizing you would establish the connection between the function and input/output in the same way as with the control panel. Just pick the address code from the drop-down menu in the *Value* column (see **Figure 6-3**).

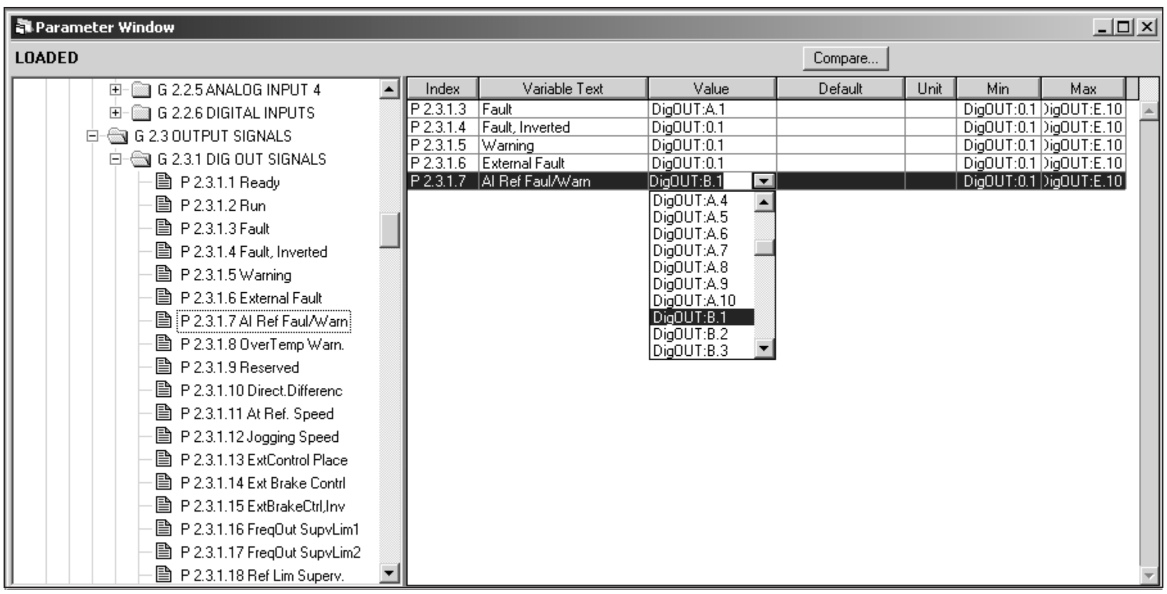


Figure 6-3: Screenshot of the 9000X Programming Tool; Entering the Address Code

⚠ WARNING

Be ABSOLUTELY sure not to connect two functions to one output to avoid function overruns and to ensure flawless operation.

Notice

The *inputs*, unlike the *outputs*, cannot be changed in RUN state.

Defining Unused Inputs/Outputs

All unused inputs and outputs must be given the board slot value **0** and the value **1** for the terminal number. The value **0.0** is also the default value for most of the functions. However, if you want to use the **values of a digital input signal** for e.g. testing purposes only, you can set the board slot value to **0** and the terminal number to any number between 2 and 10 to place the input to a TRUE state. In other words, the value 1 corresponds to an "open contact" and values 2 to 10 to a closed contact.

In the case of analog inputs, setting the value **1** for the terminal number corresponds to 0%, value **2** corresponds to 20%, and any value between **3** and **10** corresponds to 100%.

Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 8**.

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min.	=	Minimum value of parameter
Max.	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	User's customized setting
ID	=	ID number of the parameter for reference to **Chapter 8**
①	=	Parameter value can only be changed when the SVX9000 is stopped
②	=	Programmed using *terminal to function* (TTF) method. See **Page 6-3**

Basic Parameters — M1 → G1.1

Table 6-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.1	Min frequency	0.00	P1.1.2	Hz	0.00		101	
P1.1.2	Max frequency	P1.1.1	320.00	Hz	60.00		102	**NOTE**: If f_{Max} > the motor synchronous speed, check suitability for motor and drive system
P1.1.3	Acceleration time 1	0.1	3000.0	s	3.0		103	
P1.1.4	Deceleration time 1	0.1	3000.0	s	3.0		104	
P1.1.5	Current limit	0.4 x I_H	2 x I_H	A	I_L		107	I_H is the nominal current rating of the SVX9000
P1.1.6 ①	Nominal voltage of the motor	180	690	V	SVX-2: 230V SVX-4: 460V		110	Motor nameplate value
P1.1.7 ①	Nominal frequency of the motor	30.00	320.00	Hz	60.00		111	Motor nameplate value
P1.1.8 ①	Nominal speed of the motor	300	20 000	rpm	1775		112	Motor nameplate value — The default applies for a 4-pole motor and a nominal size SVX9000.
P1.1.9 ①	Nominal current of the motor	0.4 x I_H	2 x I_H	A	I_H		113	Motor nameplate value
P1.1.10 ①	Power Factor	0.30	1.00		0.85		120	Motor nameplate value
P1.1.11 ①	Local control place	1	3		2		171	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.1.12 ①	Remote control place	1	3		1		172	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.1.13 ①	Local control reference	0	14		8		173	**0** = AI1 **1** = AI2 **2** = AI1+AI2 **3** = AI1-AI2 **4** = AI2-AI1 **5** = AI1xAI2 **6** = AI1 Joystick **7** = AI2 Joystick **8** = Keypad **9** = Fieldbus **10** = Motor potentiometer **11** = AI1, AI2 minimum **12** = AI1, AI2 maximum **13** = Max frequency **14** = AI1/AI2 selection

Table 6-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.14 ①	Remote control reference	0	14		0		174	**0** = AI1 **1** = AI2 **2** = AI1+AI2 **3** = AI1-AI2 **4** = AI2-AI1 **5** = AI1xAI2 **6** = AI1 Joystick **7** = AI2 Joystick **8** = Keypad **9** = Fieldbus **10** = Motor potentiometer **11** = AI1, AI2 minimum **12** = AI1, AI2 maximum **13** = Max frequency **14** = AI1/AI2 selection
P1.1.15	Jog speed reference	0.00	P1.1.2	Hz	5.00		124	
P1.1.16	Preset speed 1	0.00	P1.1.2	Hz	10.00		105	Multi-step speed 1
P1.1.17	Preset speed 2	0.00	P1.1.2	Hz	15.00		106	Multi-step speed 2
P1.1.18	Preset speed 3	0.00	P1.1.2	Hz	20.00		126	Multi-step speed 3
P1.1.19	Preset speed 4	0.00	P1.1.2	Hz	25.00		127	Multi-step speed 4
P1.1.20	Preset speed 5	0.00	P1.1.2	Hz	30.00		128	Multi-step speed 5
P1.1.21	Preset speed 6	0.00	P1.1.2	Hz	40.00		129	Multi-step speed 6
P1.1.22	Preset speed 7	0.00	P1.1.2	Hz	60.00		130	Multi-step speed 7

Input Signals — M1 → G1.2

Table 6-3: Basic Input Signals — M1 → G1.2.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note		
P1.2.1.1 [1]	Start/Stop logic	0	7		0		300		**Start Signal 1 (Default: DIN1)**	**Start Signal 2 (Default: DIN2)**
								0	Start forw.	Start rev.
								1	Start/Stop	Reverse
								2	Start/Stop	Run enable
								3	Start pulse	Stop pulse
								4	Start	Mot.pot.UP
								5	Fwd pulse	Rev pulse
								6	Start pulse	Rev pulse
								7	Start pulse	Enabl pulse
P1.2.1.2 [1]	Motor potentiometer ramp time	0.1	2000.0	Hz/s	10.0		331			
P1.2.1.3 [1]	Motor potentiometer frequency reference memory reset	0	2		1		367	**0** = No reset **1** = Reset if stopped or powered down **2** = Reset if powered down		
P1.2.1.4 [1]	Adjust input	0	5		0		493	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus		
P1.2.1.5	Adjust minimum	0.0	100.0	%	0.0		494			
P1.2.1.6	Adjust maximum	0.0	100.0	%	0.0		495			

Table 6-4: Analog Input 1 — M1 → G1.2.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.2.1 [2]	AI1 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.1		377	
P1.2.2.2	AI1 filter time	0.00	10.00	s	0.10		324	**0** = No filtering
P1.2.2.3	AI1 signal range	0	3		0		320	**0** = 0 – 100% [3] **1** = 20 – 100% [3] **2** = -10V – +10V [3] **3** = Custom range [3]
P1.2.2.4	AI1 custom minimum setting	-100.00	100.00	%	0.00		321	
P1.2.2.5	AI1 custom maximum setting	-100.00	100.00	%	100.00		322	
P1.2.2.6	AI1 reference scaling, minimum value	0.00	320.00	Hz	0.00		303	Selects the frequency that corresponds to the min. reference signal
P1.2.2.7	AI1 reference scaling, maximum value	0.00	320.00	Hz	0.00		304	Selects the frequency that corresponds to the max. reference signal

[3] Place jumpers of block X2 appropriately.

Table 6-4: Analog Input 1 Signals — M1 → G1.2.2, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.2.8	AI1 joystick hysteresis	0.00	20.00	%	0.00		384	
P1.2.2.9	AI1 sleep limit	0.00	100.00	%	0.00		385	
P1.2.2.10	AI1 sleep delay	0.00	320.00	s	0.00		386	
P1.2.2.11	AI1 joystick offset	-50.00	50.00	%	0.00		165	

Table 6-5: Analog Input 2 — M1 → G1.2.3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.3.1 ②	AI2 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.2		388	
P1.2.3.2	AI2 filter time	0.00	10.00	s	0.10		329	**0** = No filtering
P1.2.3.3	AI2 signal range	0	3		0		325	**0** = 0 – 100% ③ **1** = 20 – 100% ③ **2** = -10V – +10V ③ **3** = Custom range ③
P1.2.3.4	AI2 custom minimum setting	-100.00	100.00	%	0.00		326	
P1.2.3.5	AI2 custom maximum setting	-100.00	100.00	%	100.00		327	
P1.2.3.6	AI2 reference scaling, minimum value	0.00	320.00	Hz	0.00		393	Selects the frequency that corresponds to the min. reference signal
P1.2.3.7	AI2 reference scaling, maximum value	0.00	320.00	Hz	0.00		394	Selects the frequency that corresponds to the max. reference signal
P1.2.3.8	AI2 joystick hysteresis	0.00	20.00	%	0.00		395	
P1.2.3.9	AI2 sleep limit	0.00	100.00	%	0.00		396	
P1.2.3.10	AI2 sleep delay	0.00	320.00	s	0.00		397	
P1.2.3.11	AI2 joystick offset	-50.00	50.00	%	0.00		166	

③ Place jumpers of block X2 appropriately.

Table 6-6: Analog Input 3 — M1 → G1.2.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.4.1 ②	AI3 signal selection	AnIN:0.1	AnIN:E.10		AnIN:0.1		141	
P1.2.4.2	AI3 filter time	0.00	10.00	s	0.10		142	**0** = No filtering
P1.2.4.3	AI3 signal range	0	3		0		143	**0** = 0 – 100% ④ **1** = 20 – 100% ④ **2** = -10V – +10V ④ **3** = Custom range ④
P1.2.4.4	AI3 custom minimum setting	-100.00	100.00	%	0.00		144	
P1.2.4.5	AI3 custom maximum setting	-100.00	100.00	%	100.00		145	
P1.2.4.6	AI3 signal inversion	0	1		0		151	**0** = Not inverted **1** = Inverted

④ Place jumpers of block X2 appropriately.

Table 6-7: Analog Input 4 — M1 → G1.2.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.5.1 ②	AI4 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.1		152	
P1.2.5.2	AI4 filter time	0.00	10.00	s	0.10		153	**0** = No filtering
P1.2.5.3	AI4 signal range	0	3		0		154	**0** = 0 – 100% ③ **1** = 20 – 100% ③ **2** = -10V – +10V ③ **3** = Custom range ③
P1.2.5.4	AI4 custom minimum setting	-100.00	100.00	%	0.00		155	
P1.2.5.5	AI4 custom maximum setting	-100.00	100.00	%	100.00		156	
P1.2.5.6	AI4 signal inversion	0	1		0		162	**0** = Not inverted **1** = Inverted

③ Place jumpers of block X2 appropriately.

Table 6-8: Free Analog Input — M1 → G1.2.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.6.1	Scaling of current limit	0	5		0		399	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus
P1.2.6.2	Scaling of DC-braking current	0	5		0		400	See P1.2.6.1
P1.2.6.3	Reducing of acc./ dec. times	0	5		0		401	See P1.2.6.1
P1.2.6.4	Reducing of torque supervision limit	0	5		0		402	See P1.2.6.1
P1.2.6.5	Torque limit	0	5		0		485	See P1.2.6.1

Table 6-9: Digital Inputs — M1 → G1.2.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.7.1 ②	Start signal 1	DigIN:01	DigIN:E.10		DigIN:A.1		403	
P1.2.7.2 ②	Start signal 2	DigIN:01	DigIN:E.10		DigIN:A.2		404	
P1.2.7.3 ②	Run enable	DigIN:01	DigIN:E.10		DigIN:0.2		407	Motor start enabled (cc) ③
P1.2.7.4 ②	Reverse	DigIN:01	DigIN:E.10		DigIN:0.1		412	Forward (oc) ③ Reverse (cc) ③
P1.2.7.5 ②	Preset speed 1	DigIN:01	DigIN:E.10		DigIN:0.1		419	
P1.2.7.6 ②	Preset speed 2	DigIN:01	DigIN:E.10		DigIN:0.1		420	
P1.2.7.7 ②	Preset speed 3	DigIN:01	DigIN:E.10		DigIN:0.1		421	
P1.2.7.8 ②	Motor potentiometer reference DOWN	DigIN:01	DigIN:E.10		DigIN:0.1		417	Motor potentiometer reference decreases (cc) ③
P1.2.7.9 ②	Motor potentiometer reference UP	DigIN:01	DigIN:E.10		DigIN:0.1		418	Motor potentiometer. reference increases (cc) ③
P1.2.7.10 ②	Fault reset	DigIN:01	DigIN:E.10		DigIN:A.3		414	All faults reset (cc) ③
P1.2.7.11 ②	External fault (close)	DigIN:01	DigIN:E.10		DigIN:A.5		405	External fault displayed (cc) ③
P1.2.7.12 ②	External fault (open)	DigIN:01	DigIN:E.10		DigIN:0.2		406	External fault displayed (oc) ③
P1.2.7.13 ②	Acc/Dec time selection	DigIN:01	DigIN:E.10		DigIN:A.6		408	Accel./Decel. time 1 (oc) ③ Accel./Decel. time 2 (cc) ③
P1.2.7.14 ②	Acc/Dec prohibit	DigIN:01	DigIN:E.10		DigIN:0.1		415	Accel./Decel. prohibited (cc) ③
P1.2.7.15 ②	DC braking	DigIN:01	DigIN:E.10		DigIN:0.1		416	DC braking active (cc) ③
P1.2.7.16 ②	Jog speed	DigIN:01	DigIN:E.10		DigIN:A.4		413	Jog speed selected for frequency reference (cc) ③
P1.2.7.17 ②	AI1/AI2 selection	DigIN:01	DigIN:E.10		DigIN:0.1		422	
P1.2.7.18 ②	Force to Local control	DigIN:01	DigIN:E.10		DigIN:0.1		410	Force control place to Local
P1.2.7.19 ②	Force to Remote control	DigIN:01	DigIN:E.10		DigIN:0.1		409	Force control place to Remote
P1.2.7.20 ②	Parameter set 1 / set 2 selection	DigIN:01	DigIN:E.10		DigIN:0.1		496	Set 2 (cc) ③ Set 1 (oc) ③
P1.2.7.21 ②	Motor control mode 1/2	DigIN:01	DigIN:E.10		DigIN:0.1		164	Mode 2 (cc) ③ Mode 1 (oc) ③ See P1.6.1 & P1.6.12

③ cc = closed contact.
oc = open contact.

Output Signals — M1 → G1.3

Table 6-10: Delayed Digital Output 1 — M1 → G1.3.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.1.1 ②	Digital output 1 signal selection	DigOUT:0.1	DigOut:E.10		DigOUT:0.1		486	
P1.3.1.2	Digital output 1 function	0	26		1		312	**0** = Not used **1** = Ready **2** = Run **3** = Fault **4** = Fault inverted **5** = FC overheat warning **6** = Ext. fault or warning **7** = Ref. fault or warning **8** = Warning **9** = Reverse **10** = Jogging spd selected **11** = At speed **12** = Mot. regulator active **13** = Freq. limit 1 superv. **14** = Freq. limit 2 superv. **15** = Torque limit superv. **16** = Ref. limit supervision **17** = External brake control **18** = Remote control active **19** = FC temp. limit superv. **20** = Reference inverted **21** = Ext. brake control inverted **22** = Therm. fault or warn. **23** = On/Off control **24** = Fieldbus input data 1 **25** = Fieldbus input data 2 **26** = Fieldbus input data 3
P1.3.1.3	Digital output 1 on delay	0.00	320.00	s	0.00		487	**0.00** = delay not in use
P1.3.1.4	Digital output 1 off delay	0.00	320.00	s	0.00		488	**0.00** = delay not in use

Table 6-11: Delayed Digital Output 2 — M1 → G1.3.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.2.1 ②	Digital output 2 signal selection	DigOUT:0.1	DigOut:E.10		DigOUT:0.1		489	
P1.3.2.2	Digital output 2 function	0	26		1		490	See P1.3.1.2
P1.3.2.3	Digital output 2 on delay	0.00	320.00	s	0.00		491	0.00 = delay not in use
P1.3.2.4	Digital output 2 off delay	0.00	320.00	s	0.00		492	0.00 = delay not in use

Table 6-12: Digital Output Signals — M1 → G1.3.3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.3.1 ②	Ready	DigOUT:01	DigOUT:E.10		DigOUT:A.1		432	
P1.3.3.2 ②	Run	DigOUT:01	DigOUT:E.10		DigOUT:B.1		433	
P1.3.3.3 ②	Fault	DigOUT:01	DigOUT:E.10		DigOUT:B.2		434	
P1.3.3.4 ②	Inverted fault	DigOUT:01	DigOUT:E.10		DigOUT:01		435	
P1.3.3.5 ②	Warning	DigOUT:01	DigOUT:E.10		DigOUT:01		436	
P1.3.3.6 ②	External fault/ warning	DigOUT:01	DigOUT:E.10		DigOUT:01		437	
P1.3.3.7 ②	Reference fault/ warning	DigOUT:01	DigOUT:E.10		DigOUT:01		438	
P1.3.3.8 ②	Overtemperature warning	DigOUT:01	DigOUT:E.10		DigOUT:01		439	
P1.3.3.9 ②	Reverse	DigOUT:01	DigOUT:E.10		DigOUT:01		440	
P1.3.3.10 ②	Unrequested direction	DigOUT:01	DigOUT:E.10		DigOUT:01		441	
P1.3.3.11 ②	At reference speed	DigOUT:01	DigOUT:E.10		DigOUT:01		442	
P1.3.3.12 ②	Jog speed	DigOUT:01	DigOUT:E.10		DigOUT:01		443	
P1.3.3.13 ②	Remote control active	DigOUT:01	DigOUT:E.10		DigOUT:01		444	
P1.3.3.14 ②	External brake control	DigOUT:01	DigOUT:E.10		DigOUT:01		445	
P1.3.3.15 ②	External brake control, inverted	DigOUT:01	DigOUT:E.10		DigOUT:01		446	
P1.3.3.16 ②	Output frequency limit 1 supervision	DigOUT:01	DigOUT:E.10		DigOUT:01		447	
P1.3.3.17 ②	Output frequency limit 2 supervision	DigOUT:01	DigOUT:E.10		DigOUT:01		448	
P1.3.3.18 ②	Reference limit supervision	DigOUT:01	DigOUT:E.10		DigOUT:01		449	
P1.3.3.19 ②	Temperature limit supervision	DigOUT:01	DigOUT:E.10		DigOUT:01		450	
P1.3.3.20 ②	Torque limit supervision	DigOUT:01	DigOUT:E.10		DigOUT:01		451	
P1.3.3.21 ②	Motor thermal protection	DigOUT:01	DigOUT:E.10		DigOUT:01		452	
P1.3.3.22 ②	Analog input supervision limit	DigOUT:01	DigOUT:E.10		DigOUT:01		463	
P1.3.3.23 ②	Motor regulator activation	DigOUT:01	DigOUT:E.10		DigOUT:01		454	
P1.3.3.24 ②	Fieldbus digital input 1	DigOUT:01	DigOUT:E.10		DigOUT:01		455	
P1.3.3.25 ②	Fieldbus digital input 2	DigOUT:01	DigOUT:E.10		DigOUT:01		456	
P1.3.3.26 ②	Fieldbus digital input 3	DigOUT:01	DigOUT:E.10		DigOUT:01		457	

Table 6-12: Digital Output Signals — M1 → G1.3.3, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.3.27 ②	Fieldbus digital input 4	DigOUT:01	DigOUT:E.10		DigOUT:01		169	
P1.3.3.28 ②	Fieldbus digital input 5	DigOUT:01	DigOUT:E.10		DigOUT:01		170	

Table 6-13: Limit Settings — M1 → G1.3.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.4.1	Output frequency limit 1 supervision function	0	3		0		315	**0** = No limit **1** = Low limit supervision **2** = High limit supervision **3** = Brake on control
P1.3.4.2	Output frequency limit 1; Supervised value	0.00	P1.1.2	Hz	0.00		316	
P1.3.4.3	Output frequency limit 2 supervision function	0	4		0		346	**0** = No limit **1** = Low limit supervision **2** = High limit supervision **3** = Brake off control **4** = Brake on/off control
P1.3.4.4	Output frequency limit 2; Supervised value	0.00	P1.1.2	Hz	0.00		347	
P1.3.4.5	Torque limit supervision function	0	3		0		348	**0** = Not used **1** = Low limit supervision **2** = High limit supervision **3** = Brake off control
P1.3.4.6	Torque limit supervision value	-1000.0	1000.0	%	100.0		349	
P1.3.4.7	Reference limit supervision	0	2		0		350	**0** = Not used **1** = Low limit **2** = High limit
P1.3.4.8	Reference limit supervision value	0.0	P1.1.2	Hz	0.0		351	
P1.3.4.9	External brake-off delay	0.0	100.0	s	0.5		352	
P1.3.4.10	External brake-on delay	0.0	100.0	s	1.5		353	
P1.3.4.11	FC temperature supervision function	0	2		0		354	**0** = Not used **1** = Low limit **2** = High limit
P1.3.4.12	FC temperature supervised value	-10	75	°C	0		355	

Table 6-13: Limit Settings — M1 → G1.3.4, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.4.13	On/Off control signal	0	4		0		356	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4
P1.3.4.14	On/Off control low limit	0.00	P1.3.4.15	%	10.00		357	
P1.3.4.15	On/Off control high limit	P1.3.4.14	100.00	%	90.00		358	

Table 6-14: Analog Output 1 — M1 → G1.3.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.5.1 ②	Analog output 1 signal selection	AnOUT:01	AnOUT:E.10		AnOUT:A1		464	
P1.3.5.2	Analog output 1 function	0	15		1		307	**0** = Not used **1** = Output freq. (0 – f_{Max}) **2** = Freq. reference (0 – f_{Max}) **3** = Motor speed (0 – Motor nominal speed) **4** = Motor current (0 – I_{nMotor}) **5** = Motor torque (0 – T_{nMotor}) **6** = Motor power (0 – P_{nMotor}) **7** = Motor voltage (0 – V_{nMotor}) **8** = DC-Bus volt (0 – 1000V) **9** = AI1 **10** = AI2 **11** = Output freq. (f_{min} – f_{Max}) **12** = Motor torque (-2 – +2xT_{Nmot}) **13** = Motor power (-2 – +2xP_{Nmot}) **14** = PT100 temperature **15** = FB digital input 4
P1.3.5.3	Analog output 1 filter time	0.00	10.00	s	1.00		308	**0** = No filtering
P1.3.5.4	Analog output 1 inversion	0	1		0		309	**0** = Not inverted **1** = Inverted
P1.3.5.5	Analog output 1 minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P1.3.5.6	Analog output 1 scale	10	1000	%	100		311	**100** = No scaling
P1.3.5.7	I_{out} offset	-100.00	100.00	%	0.00		375	

Table 6-15: Analog Output 2 — M1 → G1.3.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.6.1 ②	Analog output 2 signal selection	AnOUT:01	AnOUT:E.10		AnOUT:01		471	
P1.3.6.2	Analog output 2 function	0	15		4		472	See P1.3.5.2
P1.3.6.3	Analog output 2 filter time	0.00	10.00	s	1.00		473	**0** = No filtering
P1.3.6.4	Analog output 2 inversion	0	1		0		474	**0** = Not inverted **1** = Inverted
P1.3.6.5	Analog output 2 minimum	0	1		0		475	**0** = 0 mA **1** = 4 mA
P1.3.6.6	Analog output 2 scale	10	1000	%	100		476	**100** = No scaling
P1.3.6.7	Analog output 2 offset	-100.00	100.00	%	0.00		477	

Table 6-16: Analog Output 3 — M1 → G1.3.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.7.1 ②	Analog output 3 signal selection	AnOUT:01	AnOUT:E.10		AnOUT:01		478	
P1.3.7.2	Analog output 3 function	0	15		5		479	See P1.3.5.2
P1.3.7.3	Analog output 3 filter time	0.00	10.00	s	1.00		480	**0** = No filtering
P1.3.7.4	Analog output 3 inversion	0	1		0		481	**0** = Not inverted **1** = Inverted
P1.3.7.5	Analog output 3 minimum	0	1		0		482	**0** = 0 mA **1** = 4 mA
P1.3.7.6	Analog output 3 scale	10	1000	%	100		483	**100** = No scaling
P1.3.7.7	Analog output 3 offset	-100.00	100.00	%	0.00		484	

Drive Control Parameters — M1 → G1.4

Table 6-17: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.1	Ramp 1 shape	0.0	10.0	s	0.0		500	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.2	Ramp 2 shape	0.0	10.0	s	0.0		501	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.3	Acceleration time 2	0.1	3000.0	s	10.0		502	
P1.4.4	Deceleration time 2	0.1	3000.0	s	10.0		503	
P1.4.5 ①	Brake chopper	0	4		0		504	**0** = Disabled **1** = Used when running **2** = External brake chopper **3** = Used when stopped/ running **4** = Used when running (no testing)

Table 6-17: Drive Control Parameters — M1 → G1.4, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.6	Start mode	0	1		0		505	**0** = Ramp **1** = Flying start
P1.4.7	Stop mode	0	3		1		506	**0** = Coasting **1** = Ramp **2** = Ramp+Run enable coast **3** = Coast+Run enable ramp
P1.4.8	DC braking current	0.4 x I_H	2 x I_H	A	I_H		507	
P1.4.9	DC braking time at stop	0.00	600.00	s	0.00		508	**0.00** = DC brake is off at stop
P1.4.10	Frequency to start DC braking during ramp stop	0.10	10.00	Hz	1.50		515	
P1.4.11	DC braking time at start	0.00	600.00	s	0.00		516	**0.00** = DC brake is off at start
P1.4.12	Flux brake	0	1		0		520	**0** = Off **1** = On
P1.4.13	Flux braking current	0.4 x I_H	2 x I_H	A	I_H		519	

Skip Frequencies — M1 → G1.5

Table 6-18: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.5.1	Skip frequency range 1 low limit	0.00	P1.5.2	Hz	0.00		509	
P1.5.2	Skip frequency range 1 high limit	P1.5.1	320.00	Hz	0.00		510	**0.00** = No prohibit range 1
P1.5.3	Skip frequency range 2 low limit	0.00	P1.5.4	Hz	0.00		511	
P1.5.4	Skip frequency range 2 high limit	P1.5.3	320.00	Hz	0.00		512	**0.00** = No prohibit range 2
P1.5.5	Skip frequency range 3 low limit	0.00	P1.5.6	Hz	0.00		513	
P1.5.6	Skip frequency range 3 high limit	P1.5.5	320.00	Hz	0.00		514	**0.00** = No prohibit range 3
P1.5.7	Prohibit acc./dec. ramp	0.1	10.0		1.0		518	Multiplier for ramp time in prohibit frequency range, e.g. 0.1 = 10% of normal ramp time

Motor Control Parameters — M1 → G1.6

Table 6-19: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.1 ①	Motor control mode	0	3		0		600	**0** = Frequency control **1** = Speed control **2** = Torque control
P1.6.2 ①	V/Hz optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P1.6.3 ①	V/Hz ratio selection	0	3		0		108	**0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optimiz.
P1.6.4 ①	Field weakening point	8.00	320.00	Hz	60.00		602	
P1.6.5 ①	Voltage at field weakening point	10.00	200.00	%	100.00		603	n% x V_{nMotor}
P1.6.6 ①	V/Hz curve midpoint frequency	0.00	P1.6.4	Hz	60.00		604	
P1.6.7 ①	V/Hz curve midpoint voltage	0.00	P1.6.5	%	100.00		605	n% x V_{nMotor}
P1.6.8 ①	Output voltage at zero frequency	0.00	40.00	%	0.00		606	n% x V_{nMotor}
P1.6.9	Switching frequency	1.0	Varies	kHz	Varies		601	See **Table 8-12** for exact values
P1.6.10	Overvoltage controller	0	2		1		607	**0** = Not used **1** = Used (no ramping) **2** = Used (ramping)
P1.6.11	Undervoltage controller	0	1		1		608	**0** = Not used **1** = Used
P1.6.12	Motor control mode 2	0	2		2		521	**0** = Frequency control **1** = Speed control **2** = Torque control
P1.6.13	Speed controller P gain (open loop)	0	32767		3000		637	
P1.6.14	Speed controller I gain (open loop)	0	32767		300		638	
P1.6.15	Load Drooping	0.00	100.00		0.01		620	Drooping % of nominal speed at nominal torque
P1.6.16	Identification	0	2		0		631	**0** = Not used **1** = OL V/Hz Ratio **2** = OL V/Hz+Boost

Protections — M1 → G1.7

Table 6-20: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.1	Response to 4 mA reference fault	0	5		0		700	**0** = No response **1** = Warning **2** = Warning+Previous Freq. **3** = Warning+Preset Freq P1.7.2 **4** = Fault, stop per P1.4.7 **5** = Fault, stop by coasting
P1.7.2	4 mA reference fault frequency	0.00	P1.1.2	Hz	0.00		728	
P1.7.3	Response to external fault	0	3		2		701	**0** = No response **1** = Warning **2** = Fault, stop per P1.4.7 **3** = Fault, stop by coasting
P1.7.4	Input phase supervision	0	3		0		730	See P1.7.3
P1.7.5	Response to undervoltage fault	0	1		0		727	**0** = Fault Stored **1** = No History
P1.7.6	Output phase supervision	0	3		2		702	See P1.7.3
P1.7.7	Ground fault protection	0	3		2		703	See P1.7.3
P1.7.8	Thermal protection of the motor	0	3		2		704	See P1.7.3
P1.7.9	Motor ambient temperature factor	-100.0	100.0	%	0.0		705	
P1.7.10	MTP cooling factor at zero speed	0.0	150.0	%	40.0		706	As a % of I_{nMotor}
P1.7.11	MTP time constant	1	200	min	45		707	
P1.7.12	Motor duty cycle	0	100	%	100		708	
P1.7.13	Stall protection	0	3		0		709	See P1.7.3
P1.7.14	Stall current	0.1	I_{nMotor} x 2	A	I_L		710	
P1.7.15	Stall time limit	1.00	120.00	s	15.00		711	
P1.7.16	Stall frequency limit	1.00	P1.1.2	Hz	25.00		712	
P1.7.17	Underload protection	0	3		0		713	See P1.7.3
P1.7.18	Underload protect. f_{nom} torque	10.0	150.0	%	50.0		714	
P1.7.19	Underload protect. f_0 torque	5.0	150.0	%	10.0		715	
P1.7.20	Underload protection time limit	2.00	600.00	s	20.00		716	

Table 6-20: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.21	Response to thermistor fault	0	3		2		732	See P1.7.3
P1.7.22	Response to fieldbus fault	0	3		2		733	See P1.7.3
P1.7.23	Response to slot fault	0	3		2		734	See P1.7.3
P1.7.24	No. of PT100 numbers	0	3		0		739	
P1.7.25	Response to PT100 fault	0	3		0		740	See P1.7.3
P1.7.26	PT100 warning limit	-30.0	200.0	°C	120.0		741	
P1.7.27	PT100 fault limit	-30.0	200.0	°C	130.0		742	

Auto Restart Parameters — M1 → G1.8

Table 6-21: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.8.1	Wait time	0.10	10.00	s	0.50		717	
P1.8.2	Trial time	0.00	60.00	s	30.00		718	
P1.8.3	Start mode	0	2		0		719	**0** = Ramp **1** = Flying start **2** = Start per P1.4.6
P1.8.4	Number of tries after undervoltage trip	0	10		0		720	
P1.8.5	Number of tries after overvoltage trip	0	10		0		721	
P1.8.6	Number of tries after overcurrent trip	0	3		0		722	
P1.8.7	Number of tries after 4 mA trip	0	10		0		723	
P1.8.8	Number of tries after motor temp fault trip	0	10		0		726	
P1.8.9	Number of tries after external fault trip	0	10		0		725	
P1.8.10	Number of tries after underload fault trip	0	10		0		738	

Fieldbus Parameters — M1 → G1.9

Table 6-22: Fieldbus Parameters — M1 → G1.9

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.9.1	Fieldbus min scale	0.00	320.00	Hz	0.00		850	
P1.9.2	Fieldbus max scale	0.00	320.00	Hz	0.00		851	
P1.9.3	Fieldbus data out 1 selection	0	10000		1		852	Monitoring data chosen with parameter ID
P1.9.4	Fieldbus data out 2 selection	0	10000		2		853	Monitoring data chosen with parameter ID
P1.9.5	Fieldbus data out 3 selection	0	10000		3		854	Monitoring data chosen with parameter ID
P1.9.6	Fieldbus data out 4 selection	0	10000		4		855	Monitoring data chosen with parameter ID
P1.9.7	Fieldbus data out 5 selection	0	10000		5		856	Monitoring data chosen with parameter ID
P1.9.8	Fieldbus data out 6 selection	0	10000		6		857	Monitoring data chosen with parameter ID
P1.9.9	Fieldbus data out 7 selection	0	10000		7		858	Monitoring data chosen with parameter ID
P1.9.10	Fieldbus data out 8 selection	0	10000		37		859	Monitoring data chosen with parameter ID

Torque Control Parameters — M1 → G1.10

Table 6-23: Torque Control Parameters — M1 → G1.10

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.10.1	Torque limit	0.0	400.0	%	400.0		609	
P1.10.2	Torque limit control P-gain	0	32000		3000		610	
P1.10.3	Torque limit control I-gain	0	32000		200		611	
P1.10.4	Torque reference selection	0	8		0		641	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = AI1 joystick **6** = AI2 joystick **7** = Torque reference from keypad, R2.4 **8** = Fieldbus
P1.10.5	Torque reference max.	-300.0	300.0	%	100.0		642	
P1.10.6	Torque reference min.	-300.0	300.0	%	0.0		643	
P1.10.7	Torque speed limit	0	2		1		644	**0** = Max. frequency **1** = Selected freq. reference **2** = Preset speed 7

Table 6-23: Torque Control Parameters — M1 → G1.10, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.10.8	Minimum frequency for open loop torque control	0.00	P1.1.1	Hz	3.00		636	
P1.10.9	Torque controller P gain	0	32000		150		639	
P1.10.10	Torque controller I gain	0	32000		10		640	

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 6-24: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
R2.1	Keypad reference	P1.1.1	P1.1.2	Hz				
P2.2	Keypad direction	0	1		0		123	**0** = Forward **1** = Reverse
P2.3	Stop button active	0	1		1		114	**0** = Stop enabled only in keypad operation **1** = Stop button always enabled
P2.4	Torque reference 2	P1.10.6	P1.10.5	%				

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in Chapter 5 of the *SVX9000 User Manual*.

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See the *SVX9000 User Manual*, Chapter 5 — Menu information item M7, for more information.

Table 6-25: Monitoring Menu

Code	Parameter	Unit	ID	Description
V7.1	Output frequency	Hz	1	Output frequency to motor
V7.2	Frequency reference	Hz	25	Frequency
V7.3	Motor speed	rpm	2	Calculated motor speed in rpm
V7.4	Motor current	A	3	Motor current
V7.5	Motor torque	%	4	Calculated torque as a percentage of nominal torque
V7.6	Motor power	%	5	Calculated motor shaft power
V7.7	Motor voltage	V	6	Calculated motor voltage
V7.8	DC-Bus voltage	V	7	DC-Bus voltage
V7.9	Unit temperature	°C	8	Heatsink temperature
V7.10	Motor temperature	%	9	Calculated motor temperature
V7.11	Analog input 1	V/mA	13	Analog input AI1
V7.12	Analog input 2	V/mA	14	Analog input AI2
V7.13	DIN1, DIN2, DIN3	—	15	Digital input status
V7.14	DIN4, DIN5, DIN6	—	16	Digital input status
V7.15	Analog I_{out}	mA	26	Analog output AO1
V7.16	Analog input 3	V/mA	27	Analog input AI3
V7.17	Analog input 4	V/mA	28	Analog input AI4
V7.18	Torque reference	%	18	
V7.19	PT100 temperature	°C	42	Highest temperature of PT100 inputs, needs option board (OPTB8)
G7.20	Multimonitor		—	Displays three selectable monitoring values

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See Chapter 5 of the *SVX9000 User Manual* for more information.

Table 6-26: Operate Menu Items

Code	Parameter	Unit	Description
O.1	Output frequency	Hz	Output frequency to motor
O.2	Frequency reference	Hz	Frequency
O.3	Motor speed	rpm	Calculated motor speed in rpm
O.4	Motor current	A	Motor current
O.5	Motor torque	%	Calculated torque as a percentage of nominal torque
O.6	Motor power	%	Calculated motor shaft power
O.7	Motor voltage	V	Calculated motor voltage
O.8	DC-Bus voltage	V	DC-Bus voltage
O.9	Unit temperature	°C	Heatsink temperature
O.10	Motor temperature	%	Calculated motor temperature
O.11	Torque reference	%	Motor torque reference setting
R1	Keypad reference	Hz	Keypad frequency reference setting

Chapter 7 — Pump and Fan Control Application

Introduction

The Pump and Fan Control Application of the Cutler-Hammer SVX9000 drive by Eaton Electrical can be used to control one main adjustable speed drive (SVX9000) and up to four auxiliary fixed speed (starter/contactor) drives. The PID controller of the main drive adjusts its speed and provides control signals to start and stop the auxiliary drives to control the total flow. In addition to the eight parameter groups provided as standard, a parameter group for multi-pump and fan control functions is available.

The application has two control places on the I/O terminals. Place A is the pump and fan control and place B is the direct frequency reference. The control place is selected with input DIN6.

As its name implies, the Pump and Fan Control Application is used to control the operation of pumps and fans. It can be used, for example, to decrease the delivery pressure in booster stations if the measured input pressure falls below a limit specified by the user.

The application utilizes external contactors for switching the motors connected to the SVX9000 and the fixed speed auxiliary drives. The autochange feature provides the capability of changing the starting order of the auxiliary drives. Autochange between 2 drives (main adjustable speed drive + 1 auxiliary fixed speed drive) is set as default, see **Page 7-4**.

- All inputs and outputs are freely programmable.

Additional functions:

- Analog input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Two sets of ramp times and S-shape ramp programming
- Programmable start/stop and reverse logic
- DC-brake at start and stop
- Three skip frequency areas
- Programmable V/Hz curve and switching frequency
- Auto restart
- Motor thermal and stall protection: fully programmable; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Sleep function

Details of the parameters shown in this section are available in **Chapter 8** of this Manual, listed by parameter ID number.

Control Input/Output

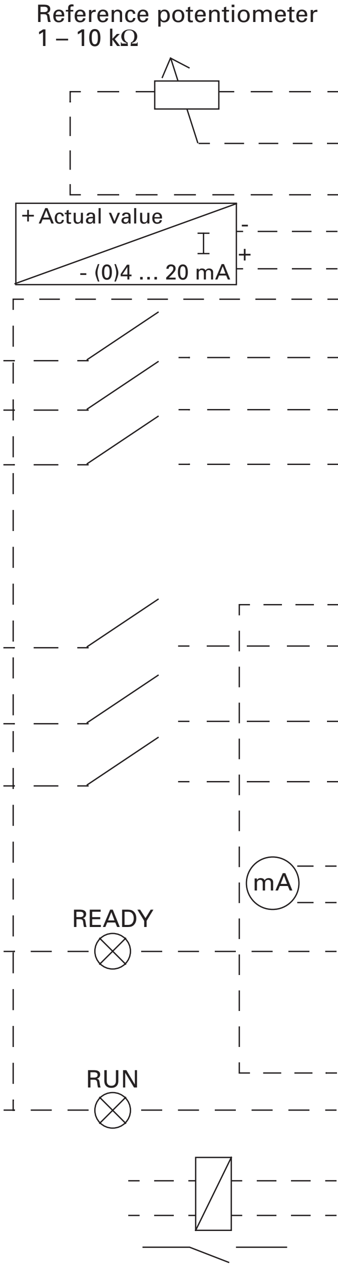
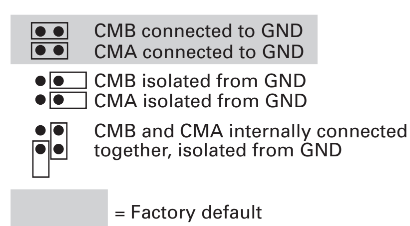


Table 7-1: Pump and Fan Control Application Default I/O Configuration

Terminal		Signal	Description
OPTA9			
1	+10V$_{ref}$	Reference output	Voltage for potentiometer, etc.
2	AI1+	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 20 mA	Current input frequency reference
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Start/Stop Control place A (PID controller)	Contact closed = start
9	DIN2	External fault input (programmable)	Contact open = no fault Contact closed = fault
10	DIN3	Fault reset (programmable)	Contact closed = fault reset
11	CMA	Common for DIN 1 – DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see terminal 6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	Start/Stop Control place B (direct frequency reference)	Contact closed = start
15	DIN5	Jog speed selection (programmable)	Contact closed = jog speed active
16	DIN6	Control place A/B selection	Contact open = control place A is active Contact closed = control place B is active
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable Open collector, I ≤ 50 mA, V ≤ 48V DC
OPTA2			
21	RO1	Relay output 1 RUN	Programmable
22	RO1		
23	RO1		
24	RO2	Relay output 2 FAULT	Programmable
25	RO2		
26	RO2		

Note: For more information on jumper selections, see the *SVX9000 User Manual*, Chapter 4.

Jumper Block X3: CMA and CMB Grounding



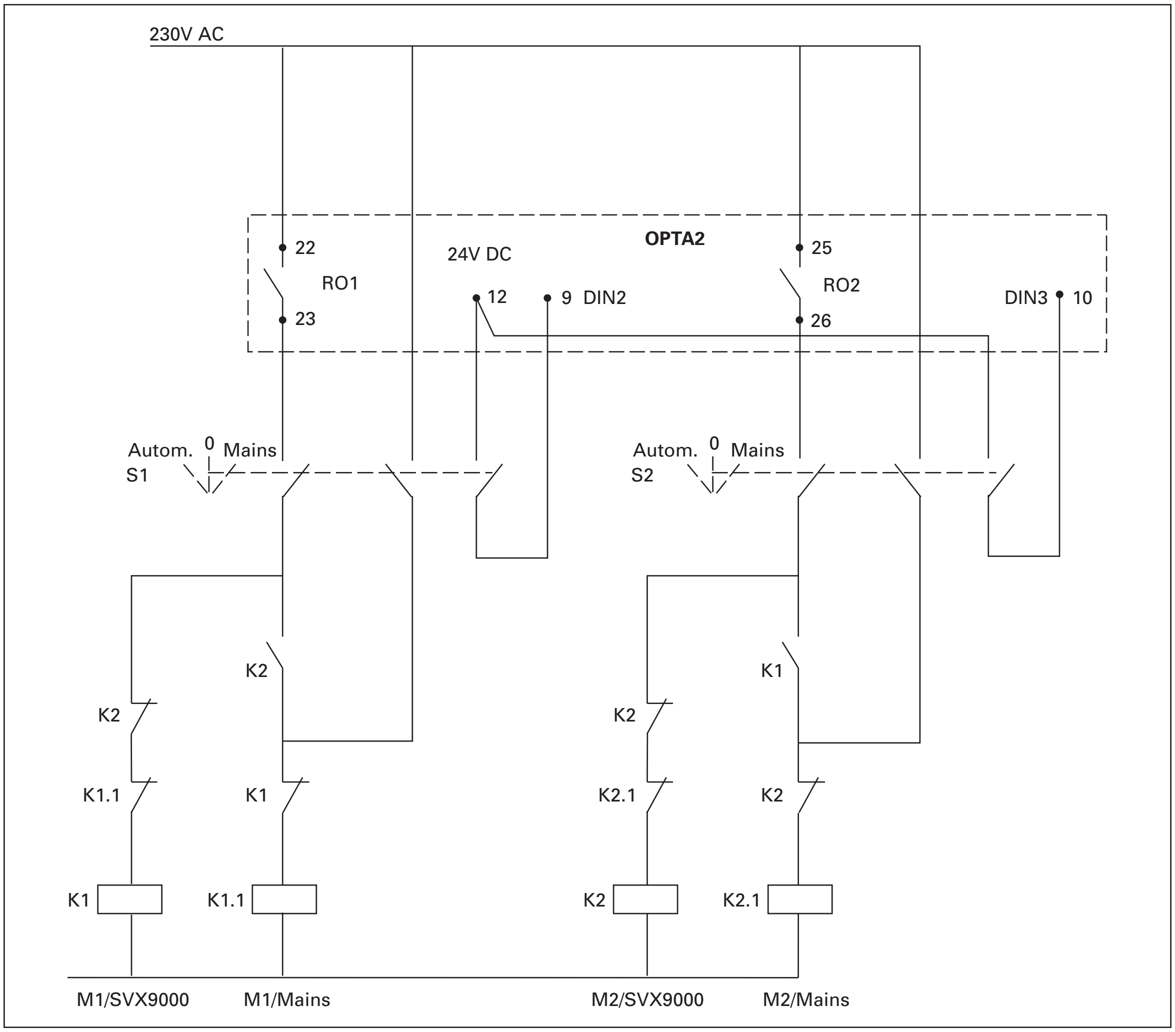


Figure 7-1: Two Pump Autochange System — Main Control Diagram

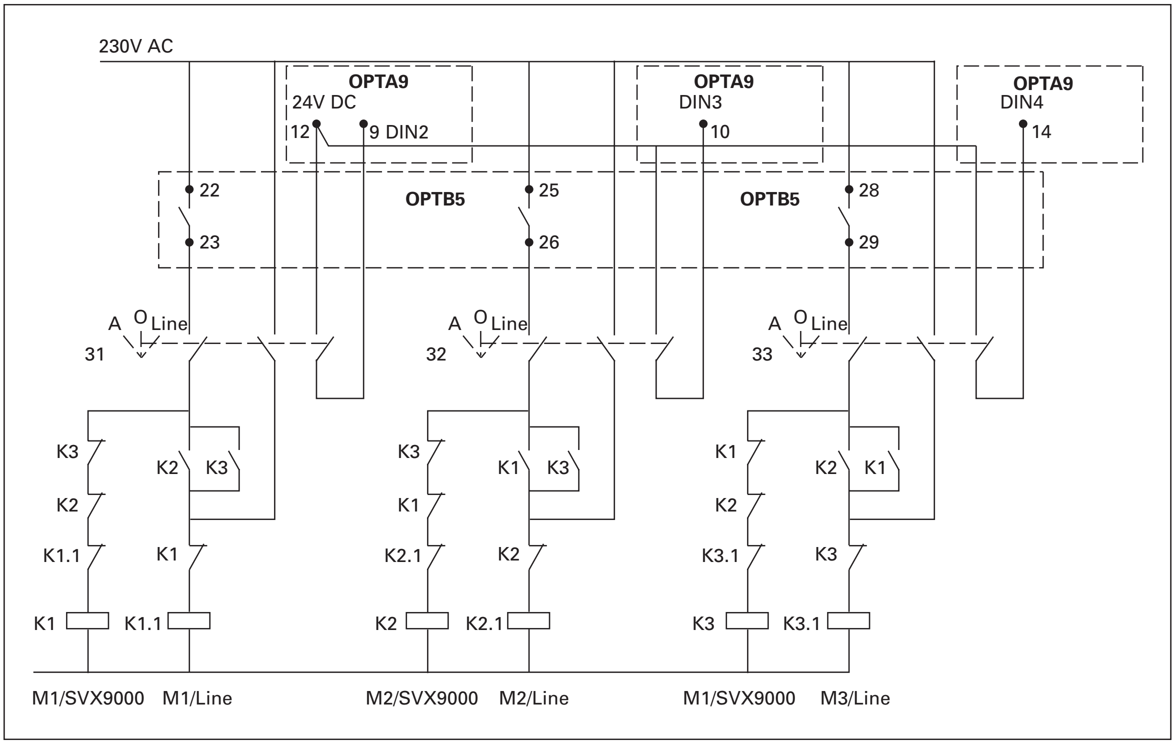


Figure 7-2: Three Pump Autochange System — Main Control Diagram

Operation and Key Parameters

Automatic Changing Between Drives (Autochange, P1.9.24)

The *Autochange function* allows the starting and stopping order of drives controlled by the pump and fan automatic control system to be changed at settable intervals. The motor controlled by the SVX9000 can also be included in the automatic changing and locking sequence (P1.9.25). The Autochange function makes it possible to equalize the run times of the motors and pumps.

- Apply the Autochange function with P1.9.24, *Autochange*.
- The autochange takes place when the time set with P1.9.26, *Autochange interval,* has expired and the capacity used is below the level defined with P1.9.28, *Autochange frequency limit*.
- The running drives are stopped and re-started in the new sequence.
- External contactors controlled through the relay outputs of the SVX9000 connect the motors to the SVX9000 or to the utility line. If the motor controlled by the SVX9000 is included in the autochange sequence, it is always controlled through the relay output activated first. The other relays activated later control the auxiliary fixed speed drives (see **Figures 7-3** and **7-4**).

P1.9.24 — Autochange

0 Autochange not used
1 Autochange used

The automatic change of starting and stopping order is activated and applied to either the auxiliary fixed speed drives only or the auxiliary fixed speed drives **and** the motor controlled by the SVX9000, depending on the setting of P1.9.25, *Automatics selection*. By default, the Autochange is activated for 2 drives. See **Figures 7-1** and **7-3**.

P1.9.25 — Autochange/Interlockings automatics selection

0 Automatics (autochange/interlockings) applied to auxiliary fixed speed drives only

The motor controlled by the SVX9000 remains the same. Therefore, a utility line contactor is needed for one auxiliary fixed speed drive motor only.

1 All drives included in the autochange/interlockings sequence

The motor controlled by the SVX9000 is included in the automatics and a contactor is needed for each motor to connect it to either the utility line or the SVX9000.

P1.9.26 – Autochange interval

After the expiration of the time defined with this parameter, the autochange function takes place if the capacity used lies below the level defined with P1.9.28 (*Autochange frequency limit*) and P1.9.27 (*Maximum number of auxiliary drives*). Should the capacity exceed the value of P1.9.28, the autochange will not take place before the capacity goes below this limit.

- The time count is activated only if the Start/Stop request is active at control place A.
- The time count is reset after the autochange has taken place or on removal of Start request at control place A

P1.9.27 — Maximum number of auxiliary drives

P1.9.28 — Autochange frequency limit

These parameters define the level below which the capacity used must remain so that the autochange can take place.

This level is defined as follows:

- If the number of running auxiliary drives is smaller than the value of P1.9.27, the autochange function can take place.
- If the number of running auxiliary drives is equal to the value of P1.9.27 and the frequency of the SVX9000 is below the value of P1.9.28, the autochange can take place.
- If the value of P1.9.28 is 0.0 Hz, the autochange can take place only in the rest position (Stop and Sleep) regardless of the value of P1.9.27.

Interlock Selection (P1.9.23)

This parameter is used to activate the interlock inputs. The interlocking signals come from the motor contactors. The signals (functions) are connected to digital inputs which are programmed as interlock inputs using the corresponding parameters. The pump and fan control automatics only control the motors with active interlock data.

- The interlock data can be used even when the autochange function is not activated
- If the interlock of an auxiliary drive is deactivated and another unused auxiliary drive is available, the latter will be used without stopping the SVX9000.
- If the interlock of the SVX9000 is deactivated, all the motors will be stopped and restarted with the new setup.
- If the interlock is re-activated in the Run state, the automatics functions according to P1.9.23, *Interlock selection*:

0 Not used
1 Update in stop

Interlocks are used. The new fixed speed drive will be placed last in the autochange line without stopping the system. However, if the autochange order now becomes, for example, [P1 → P3 → P4 → P2], it will be updated in the next Stop (autochange, sleep, stop, etc.).

Example:

[P1 → P3 → P4] → [P2 LOCKED] →[P1 → P3 → P4 → P2] → [SLEEP] → [P1 → P2 → P3 → P4]

2 Stop & Update

Interlocks are used. The automatics will stop all motors immediately and re-start with a new setup.

Example:

[P1 → P2 → P4] → [P3 LOCKED] → [STOP] → [P1 → P2 → P3 → P4]

See **Page 7-7**, Examples.

Examples

Pump and fan automatics with interlocks and no autochange

Situation: One controlled drive and three auxiliary fixed speed drives.

Settings: P1.9.1 = **3**, P1.9.25 = **0**

Interlock feedback signals used, autochange not used.

Settings: P1.9.23 = **1**, P1.9.24 = **0**

The interlock feedback signals come from the digital inputs selected with parameters P1.2.6.17 to P1.2.6.21.

The Auxiliary drive 1 control (P1.3.1.27) is enabled through Interlock 1 (P1.2.6.17), the Auxiliary drive 2 control (P1.3.1.28) through Interlock 2 (P1.2.6.18) etc.

Phases:

1) The system and the motor controlled by the SVX9000 are started.

2) The Auxiliary drive 1 starts when the main drive reaches the starting frequency set (P1.9.2).

3) The SVX9000 decreases speed down to Auxiliary drive 1 Stop frequency (P1.9.3) and starts to rise toward the Start frequency of Auxiliary drive 2, if needed.

4) The Auxiliary drive 2 starts when the main drive has reached the starting frequency set (P1.9.4).

5) The Interlock feedback is removed from Auxiliary drive 2. Because the Auxiliary drive 3 is unused, it will be started to replace the removed Auxiliary drive 2.

6) The SVX9000 increases speed to maximum because no more auxiliary drives are available.

7) The removed Auxiliary drive 2 is reconnected and placed last in the auxiliary drive start order which now is 1-3-2. The SVX9000 decreases speed to the set Stop frequency. The auxiliary drive start order will be updated either immediately or in the next Stop (autochange, sleep, stop, etc.) according to P1.9.23.

8) If still more power is needed, the SVX9000 speed rises up to the maximum frequency placing 100% of the output power at the system's disposal.

When the need of power decreases, the auxiliary drives turn off in the opposite order (2-3-1; after the update 3-2-1).

Pump and fan automatics with interlocks and autochange

The above is also applicable if the autochange function is used. In addition to the changed and updated start order, also the change order of main drives depends on P1.9.23.

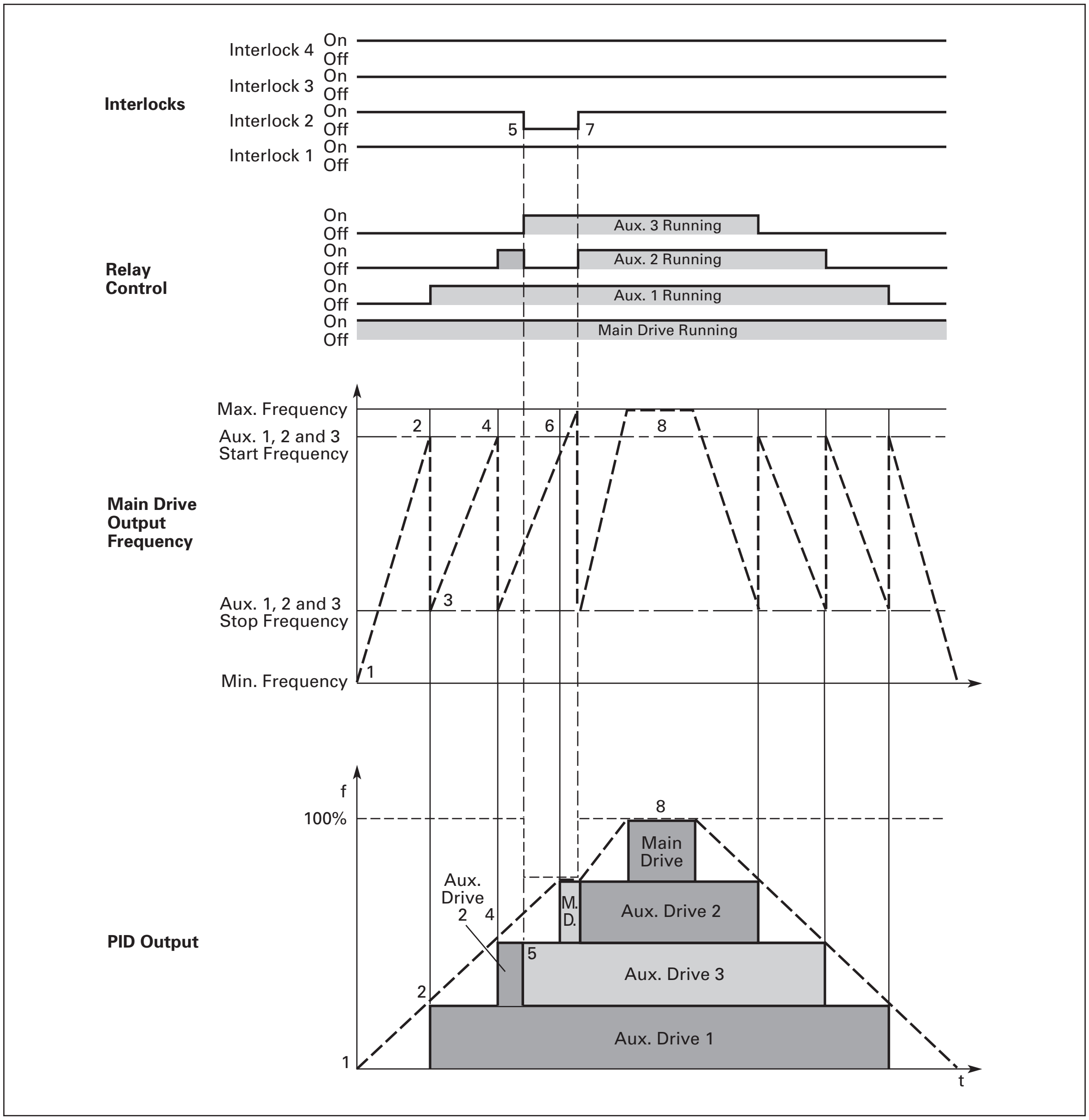


Figure 7-3: Example of the Function of the PFC Application with Three Auxiliary Drives

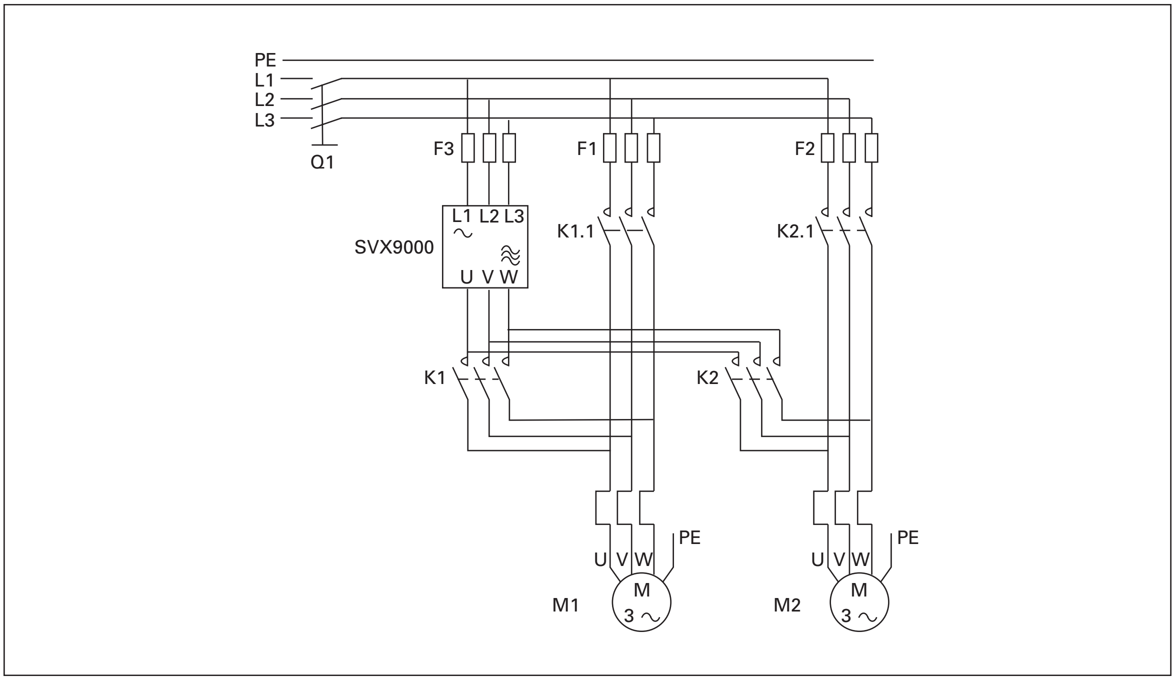


Figure 7-4: Example of Two Pump Autochange, Main Diagram

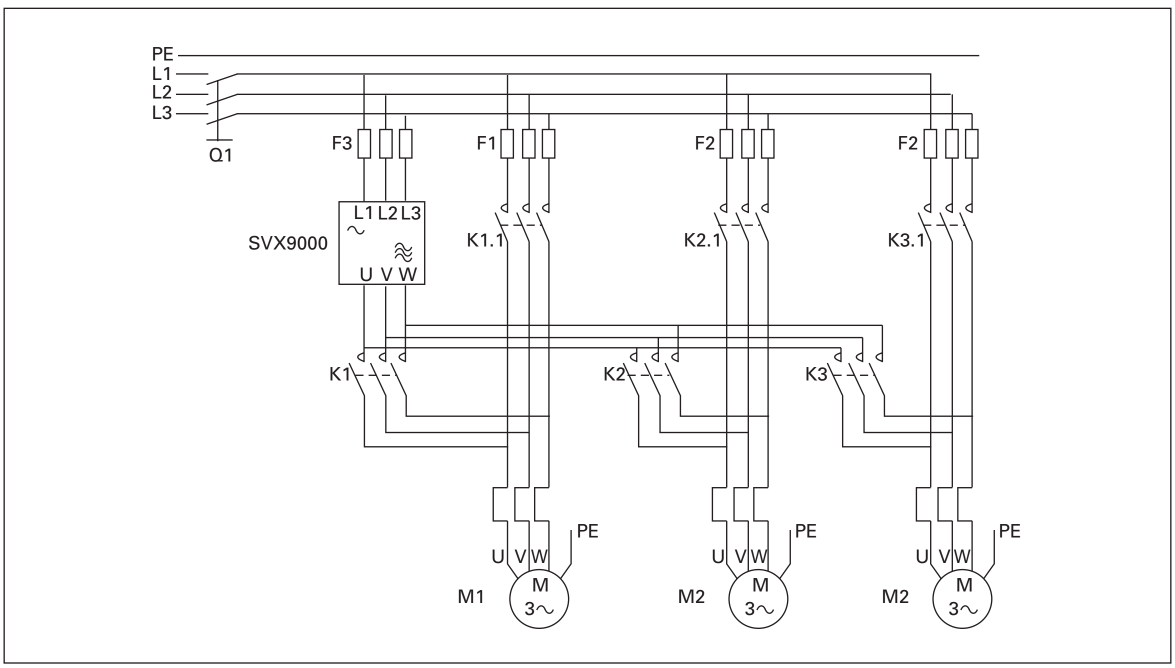


Figure 7-5: Example of Three Pump Autochange, Main Diagram

Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given by ID number in **Chapter 8.**

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min.	=	Minimum value of parameter
Max.	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	User's customized setting
ID	=	ID number of the parameter for reference to **Chapter 8**
①	=	Parameter value can only be changed when the SVX9000 is stopped
②	=	Programmed using *terminal to function* (TTF) method. See **Page 6-3**

Basic Parameters — M1 → G1.1

Table 7-2: Basic Parameters — M1 → G1.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.1	Min frequency	0.00	P1.1.2	Hz	0.00		101	
P1.1.2	Max frequency	P1.1.1	320.00	Hz	60.00		102	**NOTE**: If f_{Max} > the motor synchronous speed, check suitability for motor and drive system
P1.1.3	Acceleration time 1	0.1	3000.0	s	1.0		103	If the PID controller is used, acceleration time 2 (P1.4.3) is automatically used
P1.1.4	Deceleration time 1	0.1	3000.0	s	1.0		104	If the PID controller is used, deceleration time 2 (P1.4.4) is automatically used
P1.1.5	Current limit	0.4 x I_H	2 x I_H	A	I_L		107	I_H is the nominal current rating of the SVX9000
P1.1.6 ①	Nominal voltage of the motor	180	690	V	SVX-2: 230V SVX-4: 460V		110	
P1.1.7 ①	Nominal frequency of the motor	30.00	320.00	Hz	60.00		111	Motor nameplate value
P1.1.8 ①	Nominal speed of the motor	300	20 000	rpm	1775		112	Motor nameplate value — The default applies for a 4-pole motor and a nominal size SVX9000.
P1.1.9 ①	Nominal current of the motor	0.4 x I_H	2 x I_H	A	I_H		113	Motor nameplate value
P1.1.10 ①	Power Factor	0.30	1.00		0.85		120	Motor nameplate value

Table 7-2: Basic Parameters — M1 → G1.1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.11 ①	Local control place	1	3		2		171	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.1.12 ①	Remote control place	1	3		1		172	**1 =** I/O Terminal **2 =** Keypad **3 =** Fieldbus
P1.1.13 ①	Local control reference	0	7		4		173	**0** = AI1 **1** = AI2 **2** = AI3 **3** = AI4 **4** = Keypad reference **5** = Fieldbus reference **6** = Motor potentiometer **7** = PID controller
P1.1.14 ①	Remote control reference	0	7		0		174	**0** = AI1 **1** = AI2 **2** = AI3 **3** = AI4 **4** = Keypad reference **5** = Fieldbus reference **6** = Motor potentiometer **7** = PID controller
P1.1.15 ①	PID controller reference signal (Place A)	0	6		4		332	**0** = AI1 **1** = AI2 **2** = AI3 **3** = AI4 **4** = Keypad reference **5** = Fieldbus reference **6** = Motor potentiometer
P1.1.16	PID controller gain	0.0	1000.0	%	100.0		118	
P1.1.17	PID controller I-time	0.00	320.00	s	1.00		119	
P1.1.18	PID controller D-time	0.00	10.00	s	0.00		132	
P1.1.19	Sleep frequency	P1.1.1	P1.1.2	Hz	10.00		1016	
P1.1.20	Sleep delay	0	3600	s	30		1017	
P1.1.21	Wake up limit	0.00	100.00	%	25.00		1018	
P1.1.22	Wake up action	0	3		0		1019	**0** = Wake-up when below wake up level (P1.1.21) **1** = Wake-up when above wake up level (P1.1.21) **2** = Wake-up when below wake up level (PID ref.) **3** = Wake-up when above wake up level (PID ref.)
P1.1.23	Jog speed reference	0.00	P1.1.2	Hz	10.00		124	

Input Signals — M1 → G1.2

Table 7-3: Basic Input Settings — M1 → G1.2.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.1.1 ①	PID reference 2	0	7		7		371	**0** = AI1 **1** = AI2 **2** = AI3 **3** = AI4 **4** = Keypad PID **5** = Fieldbus reference **6** = Motor potentiometer **7** = Keypad PID 2
P1.2.1.2	PID error value inversion	0	1		0		340	**0** = No inversion **1** = Inversion
P1.2.1.3	PID reference rise time	0.1	100.0		5.0		341	Time for reference to rise from 0% to 100%
P1.2.1.4	PID reference fall time	0.1	100.0		5.0		342	Time for reference to fall from 100% to 0%
P1.2.1.5 ①	PID actual value selection	0	7		0		333	**0** = Actual value 1 **1** = Actual 1 + Actual 2 **2** = Actual 1 – Actual 2 **3** = Actual 1 * Actual 2 **4** = Max (Actual 1, Actual 2) **5** = Min (Actual 1, Actual 2) **6** = Mean (Actual 1, Actual 2) **7** = Sqrt (Act1) + Sqrt (Act2)
P1.2.1.6 ①	Actual value 1 selection	0	5		2		334	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus
P1.2.1.7 ①	Actual value 2 selection	0	5		0		335	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus
P1.2.1.8	Actual value 1 minimum scale	-1600.0	1600.0	%	0.0		336	**0.0** = No minimum scaling
P1.2.1.9	Actual value 1 maximum scale	-1600.0	1600.0	%	100.0		337	**100.0** = No maximum scaling
P1.2.1.10	Actual value 2 minimum scale	-1600.0	1600.0	%	0.0		338	**0.0** = No minimum scaling
P1.2.1.11	Actual value 2 maximum scale	-1600.0	1600.0	%	100.0		339	**100.0** = No maximum scaling
P1.2.1.12	Motor potentiometer ramp time	0.1	2000.0	Hz/s	10.0		331	
P1.2.1.13	Motor potentiometer frequency reference memory reset	0	2		1		367	**0** = No reset **1** = Reset if stopped or powered down **2** = Reset if powered down

Table 7-3: Basic Input Settings — M1 → G1.2.1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.1.14	Motor potentiometer PID reference memory reset	0	2		0		370	**0** = No reset **1** = Reset if stopped or powered down **2** = Reset if powered down
P1.2.1.15	B reference scale, minimum	0.0	P1.2.1.16	Hz	0.0		344	**0.0** = Scaling off **>0.0** = Scaled min. value
P1.2.1.16	B reference scale, maximum	P1.2.1.15	320.0	Hz	0.0		345	**0.0** = Scaling off **>0.0** = Scaled max. value

Table 7-4: Analog Input 1 — M1 → G1.2.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.2.1 ②	AI1 signal selection	AnIN:A.1	AnIN:E.10		AnIN:A.1		377	
P1.2.2.2	AI1 filter time	0.00	10.00	s	0.10		324	**0** = No filtering
P1.2.2.3	AI1 signal range	0	2		0		320	**0** = 0 – 100% ③ **1** = 20 – 100% ③ **2** = Custom range ③
P1.2.2.4	AI1 custom minimum setting	-160.00	160.00	%	0.00		321	
P1.2.2.5	AI1 custom maximum setting	-160.00	160.00	%	100.00		322	
P1.2.2.6	AI1 signal inversion	0.00	320.00	Hz	0.00		323	**0** = Not inverted **1** = Inverted

③ Place jumpers of block X2 appropriately.

Table 7-5: Analog Input 2 — M1 → G1.2.3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.3.1 ②	AI2 signal selection	AnIN:0.1	AnIN:E.10		AnIN:A.2		388	
P1.2.3.2	AI2 filter time	0.00	10.00	s	0.10		329	**0** = No filtering
P1.2.3.3	AI2 signal range	0	2		0		325	**0** = 0 – 100% ④ **1** = 20 – 100% ④ **2** = Custom range ④
P1.2.3.4	AI2 custom minimum setting	-160.00	160.00	%	0.00		326	
P1.2.3.5	AI2 custom maximum setting	-160.00	160.00	%	100.00		327	
P1.2.3.6	AI2 signal inversion	0.00	320.00	Hz	0.00		328	**0** = Not inverted **1** = Inverted

④ Place jumpers of block X2 appropriately.

Table 7-6: Analog Input 3 — M1 → G1.2.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.4.1 ②	AI3 signal selection	AnIN:0.1	AnIN:E.10		AnIN:0.1		141	
P1.2.4.2	AI3 filter time	0.00	10.00	s	0.10		142	**0** = No filtering
P1.2.4.3	AI3 signal range	0	2		0		143	**0** = 0 – 100% ③ **1** = 20 – 100% ③ **2** = Custom range ③
P1.2.4.4	AI3 custom minimum setting	-100.00	100.00	%	0.00		144	
P1.2.4.5	AI3 custom maximum setting	-100.00	100.00	%	100.00		145	
P1.2.4.6	AI3 signal inversion	0	1		0		151	**0** = Not inverted **1** = Inverted

③ Place jumpers of block X2 appropriately.

Table 7-7: Analog Input 4 — M1 → G1.2.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.5.1 ②	AI4 signal selection	AnIN:0.1	AnIN:E.10		AnIN:0.1		152	
P1.2.5.2	AI4 filter time	0.00	10.00	s	0.10		153	**0** = No filtering
P1.2.5.3	AI4 signal range	0	2		0		154	**0** = 0 – 100% ④ **1** = 20 – 100% ④ **2** = Custom range ④
P1.2.5.4	AI4 custom minimum setting	-160.00	160.00	%	0.00		155	
P1.2.5.5	AI4 custom maximum setting	-160.00	160.00	%	100.00		156	
P1.2.5.6	AI4 signal inversion	0	1		0		162	**0** = Not inverted **1** = Inverted

④ Place jumpers of block X2 appropriately.

Table 7-8: Digital Inputs — M1 → G1.2.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.6.1 ②	Start A signal	DigIN:01	DigIN:E.10		DigIN:A.1		423	
P1.2.6.2 ②	Start B signal	DigIN:01	DigIN:E.10		DigIN:A.4		424	
P1.2.6.3 ②	Control A/B select	DigIN:01	DigIN:E.10		DigIN:A.6		425	Control place A (oc) ③ Control place B (cc) ③
P1.2.6.4 ②	External fault (close)	DigIN:01	DigIN:E.10		DigIN:0.1		405	Ext. fault displayed (cc) ③
P1.2.6.5 ②	External fault (open)	DigIN:01	DigIN:E.10		DigIN:0.2		406	Ext. fault displayed (oc) ③
P1.2.6.6 ②	Run enable	DigIN:01	DigIN:E.10		DigIN:0.1		407	Motor start enabled (cc) ③
P1.2.6.7 ②	Acc/Dec time selection	DigIN:01	DigIN:E.10		DigIN:0.1		408	Acc/Dec time 1 (oc) ③ Acc/Dec time 2 (cc) ③
P1.2.6.8 ②	Control from keypad (Force Local)	DigIN:01	DigIN:E.10		DigIN:0.1		410	Force control place to keypad (cc) ③
P1.2.6.9 ②	Control from I/O terminal (Force Remote)	DigIN:01	DigIN:E.10		DigIN:0.1		409	Force control place to I/O terminal (cc) ③
P1.2.6.10 ②	Reverse	DigIN:01	DigIN:E.10		DigIN:0.1		412	Direction forward (oc) ③ Direction reverse (cc) ③
P1.2.6.11 ②	Jog speed	DigIN:01	DigIN:E.10		DigIN:A.5		413	Jog speed selected for frequency reference (cc) ③
P1.2.6.12 ②	Fault reset	DigIN:01	DigIN:E.10		DigIN:0.1		414	All faults reset (cc) ③
P1.2.6.13 ②	Acc/Dec prohibit	DigIN:01	DigIN:E.10		DigIN:0.1		415	Acc/Dec prohibited (cc) ③
P1.2.6.14 ②	DC braking	DigIN:01	DigIN:E.10		DigIN:0.1		416	DC braking active (cc) ③
P1.2.6.15 ②	Motor potentiometer reference DOWN	DigIN:01	DigIN:E.10		DigIN:0.1		417	Motor potentiometer reference decreases (cc) ③
P1.2.6.16 ②	Motor potentiometer reference UP	DigIN:01	DigIN:E.10		DigIN:0.1		418	Motor potentiometer reference increases (cc) ③
P1.2.6.17 ②	Autochange 1 Interlock	DigIN:01	DigIN:E.10		DigIN:A.2		426	Activated if cc
P1.2.6.18 ②	Autochange 2 Interlock	DigIN:01	DigIN:E.10		DigIN:A.3		427	Activated if cc
P1.2.6.19 ②	Autochange 3 Interlock	DigIN:01	DigIN:E.10		DigIN:0.1		428	Activated if cc
P1.2.6.20 ②	Autochange 4 Interlock	DigIN:01	DigIN:E.10		DigIN:0.1		429	Activated if cc
P1.2.6.21 ②	Autochange 5 Interlock	DigIN:01	DigIN:E.10		DigIN:0.1		430	Activated if cc
P1.2.6.22 ②	PID reference 2	DigIN:01	DigIN:E.10		DigIN:0.1		431	Selected with P1.1.15 (oc) ③ Selected with P1.2.1.1 (cc) ③

③ cc = closed contact
oc = open contact

Output Signals — M1 → G1.3

Table 7-9: Digital Output Signals — M1 → G1.3.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.1.1 ②	Ready	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		432	
P1.3.1.2 ②	Run	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		433	
P1.3.1.3 ②	Fault	DigOUT:0.1	DigOUT:E.10		DigOUT:A.1		434	
P1.3.1.4 ②	Inverted fault	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		435	
P1.3.1.5 ②	Warning	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		436	
P1.3.1.6 ②	External fault/ warning	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		437	
P1.3.1.7 ②	Reference fault/ warning	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		438	
P1.3.1.8 ②	Overtemperature warning	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		439	
P1.3.1.9 ②	Reserved	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		440	
P1.3.1.10 ②	Direction difference	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		441	
P1.3.1.11 ②	At reference speed	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		442	
P1.3.1.12 ②	Jog speed	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		443	
P1.3.1.13 ②	Remote control active	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		444	
P1.3.1.14 ②	External brake control	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		445	
P1.3.1.15 ②	External brake control, inverted	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		446	
P1.3.1.16 ②	Output frequency limit 1 supervision	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		447	
P1.3.1.17 ②	Output frequency limit 2 supervision	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		448	
P1.3.1.18 ②	Reference limit supervision	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		449	
P1.3.3.19 ②	Temperature limit supervision	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		450	
P1.3.1.20 ②	Torque limit supervision	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		451	
P1.3.1.21 ②	Motor thermal protection	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		452	
P1.3.1.22 ②	Analog input supervision limit	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		463	
P1.3.1.23 ②	Motor regulator activation	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		454	
P1.3.1.24 ②	Fieldbus digital input 1	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		455	

Table 7-9: Digital Output Signals — M1 → G1.3.1, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.1.25 ②	Fieldbus digital input 2	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		456	
P1.3.1.26 ②	Fieldbus digital input 3	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		457	
P1.3.1.27 ②	Autochange 1/ Aux 1 control	DigOUT:0.1	DigOUT:E.10		DigOUT:B.1		458	
P1.3.1.28 ②	Autochange 2/ Aux 2 control	DigOUT:0.1	DigOUT:E.10		DigOUT:B.2		459	
P1.3.1.29 ②	Autochange 3/ Aux 3 control	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		460	
P1.3.1.30 ②	Autochange 4/ Aux 4 control	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		461	
P1.3.1.31 ②	Autochange 5	DigOUT:0.1	DigOUT:E.10		DigOUT:0.1		462	

Table 7-10: Limit Settings — M1 → G1.3.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.2.1	Output frequency limit 1 supervision	0	2		0		315	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.2.2	Output frequency limit 1; Supervised value	0.00	P1.1.2	Hz	0.00		316	
P1.3.2.3	Output frequency limit 2 supervision	0	2		0		346	**0** = No limit **1** = Low limit supervision **2** = High limit supervision
P1.3.2.4	Output frequency limit 2; Supervised value	0.00	P1.1.2	Hz	0.00		347	
P1.3.2.5	Torque limit supervision	0	2		0		348	**0** = Not used **1** = Low limit supervision **2** = High limit supervision
P1.3.2.6	Torque limit supervision value	0	300.0	%	100.0		349	
P1.3.2.7	Reference limit supervision	0	2		0		350	**0** = Not used **1** = Low limit **2** = High limit
P1.3.2.8	Reference limit supervision value	0.0	100.0	%	0.0		351	
P1.3.2.9	External brake-off delay	0.0	100.0	s	0.5		352	
P1.3.2.10	External brake-on delay	0.0	100.0	s	1.5		353	

Table 7-10: Limit Settings — M1 → G1.3.2, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.2.11	FC temperature supervision	0	2		0		354	**0** = Not used **1** = Low limit **2** = High limit
P1.3.2.12	FC temperature supervised value	-10	75	°C	40		355	
P1.3.2.13	Analog input supervision input	0	1		0		372	**0** = AI1 **1** = AI2
P1.3.2.14	Analog input supervision limit	0	2		0		373	**0** = Not used **1** = Low limit **2** = High limit
P1.3.2.15	Analog input supervision value	0.00	100.00	%	0.00		374	

Table 7-11: Analog Output 1 — M1 → G1.3.3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.3.1	Analog output 1 signal selection	AnOut:0.1	AnOut:E.10		AnOut:A.1		464	
P1.3.3.2	Analog output function	0	14		1		307	**0** = Not used **1** = Output freq. (0 – f_{Max}) **2** = Freq. reference (0 – f_{Max}) **3** = Motor speed (0 – Motor nominal speed) **4** = Motor current (0 – I_{nMotor}) **5** = Motor torque (0 – T_{nMotor}) **6** = Motor power (0 – P_{nMotor}) **7** = Motor voltage (0 – V_{nMotor}) **8** = DC-link volt (0 – 1000V) **9** = PID controller ref. value **10** = PID contr. act. value 1 **11** = PID contr. act. value 2 **12** = PID contr. error value **13** = PID controller output **14** = PT100 temperature
P1.3.3.3	Analog output filter time	0.00	10.00	s	1.00		308	**0.00** = No filtering
P1.3.3.4	Analog output inversion	0	1		0		309	**0** = Not inverted **1** = Inverted
P1.3.3.5	Analog output minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P1.3.3.6	Analog output scale	10	1000	%	100		311	
P1.3.3.7	I_{out} offset	-100.00	100.00	%	0.00		375	

Table 7-12: Analog Output 2 — M1 → G1.3.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.4.1	Analog output 2 signal selection	AnOut:0.1	AnOut:E.10		AnOut:0.1		471	
P1.3.4.2	Analog output function	0	14		0		472	See P1.3.3.2
P1.3.4.3	Analog output filter time	0.00	10.00	s	1.00		473	**0.00** = No filtering
P1.3.4.4	Analog output inversion	0	1		0		474	**0** = Not inverted **1** = Inverted
P1.3.4.5	Analog output minimum	0	1		0		475	**0** = 0 mA **1** = 4 mA
P1.3.4.6	Analog output scale	10	1000	%	100		476	
P1.3.4.7	Analog output offset	-100.00	100.00	%	0.00		477	

Table 7-13: Analog Output 3 — M1 → G1.3.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.5.1	Analog output 3 signal selection	AnOut:0.1	AnOut:E.10		AnOut:0.1		478	
P1.3.5.2	Analog output 3 function	0	14		0		479	See P1.3.3.2
P1.3.5.3	Analog output 3 filter time	0.00	10.00	s	1.00		480	**0.00** = No filtering
P1.3.5.4	Analog output 3 inversion	0	1		0		481	**0** = Not inverted **1** = Inverted
P1.3.5.5	Analog output 3 minimum	0	1		0		482	**0** = 0 mA **1** = 4 mA
P1.3.5.6	Analog output 3 scale	10	1000	%	100		483	
P1.3.5.7	Analog output 3 offset	-100.00	100.00	%	0.00		484	

Drive Control Parameters — M1 → G1.4

Table 7-14: Drive Control Parameters — M1 → G1.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.4.1	Ramp 1 shape	0.0	10.0	s	0.0		500	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.2	Ramp 2 shape	0.0	10.0	s	0.0		501	**0.0** = Linear **>0.0** = S-curve ramp time
P1.4.3	Acceleration time 2	0.1	3000.0	s	10.0		502	
P1.4.4	Deceleration time 2	0.1	3000.0	s	10.0		503	
P1.4.5 ①	Brake chopper	0	4		0		504	**0** = Disabled **1** = Used when running **2** = External brake chopper **3** = Used when stopped/ running **4** = Used when running (no testing)
P1.4.6	Start mode	0	1		0		505	**0** = Ramp **1** = Flying start
P1.4.7	Stop mode	0	3		1		506	**0** = Coasting **1** = Ramp **2** = Ramp+Run enable coast **3** = Coast+Run enable ramp
P1.4.8	DC braking current	0.4 x I_H	2 x I_H	A	I_H		507	
P1.4.9	DC braking time at stop	0.00	600.00	s	0.00		508	**0.00** = DC brake is off at stop
P1.4.10	Frequency to start DC braking during ramp stop	0.10	10.00	Hz	1.50		515	
P1.4.11	DC braking time at start	0.00	600.00	s	0.00		516	**0.00** = DC brake is off at start
P1.4.12	Flux brake	0	1		0		520	**0** = Off **1** = On
P1.4.13	Flux braking current	0.4 x I_H	2 x I_H	A	I_H		519	

Skip Frequencies — M1 → G1.5

Table 7-15: Skip Frequencies — M1 → G1.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.5.1	Skip frequency range 1 low limit	0.00	P1.5.2	Hz	0.00		509	
P1.5.2	Skip frequency range 1 high limit	P1.5.1	320.00	Hz	0.00		510	**0.00** = No prohibit range 1
P1.5.3	Skip frequency range 2 low limit	0.00	P1.5.4	Hz	0.00		511	
P1.5.4	Skip frequency range 2 high limit	P1.5.3	320.00	Hz	0.00		512	**0.00** = No prohibit range 2
P1.5.5	Skip frequency range 3 low limit	0.00	P1.5.6	Hz	0.00		513	
P1.5.6	Skip frequency range 3 high limit	P1.5.5	320.00	Hz	0.00		514	**0.00** = No prohibit range 3
P1.5.7	Prohibit acc./ dec. ramp	0.1	10.0		1.0		518	Multiplier for ramp time in prohibit frequency range, e.g. 0.1 = 10% of normal ramp time

Motor Control Parameters — M1 → G1.6

Table 7-16: Motor Control Parameters — M1 → G1.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.1 ①	Motor control mode	0	1		0		600	**0** = Frequency control **1** = Speed control
P1.6.2 ①	V/Hz optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P1.6.3 ①	V/Hz ratio selection	0	3		0		108	**0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optimiz.
P1.6.4 ①	Field weakening point	8.00	320.00	Hz	60.00		602	
P1.6.5 ①	Voltage at field weakening point	10.00	200.00	%	100.00		603	n% x V_{nMotor}
P1.6.6 ①	V/Hz curve midpoint frequency	0.00	P1.6.4	Hz	60.00		604	
P1.6.7 ①	V/Hz curve midpoint voltage	0.00	P1.6.5	%	100.00		605	n% x V_{nMotor}
P1.6.8 ①	Output voltage at zero frequency	0.00	40.00	%	0.00		606	n% x V_{nMotor}
P1.6.9	Switching frequency	1.0	Varies	kHz	Varies		601	See **Table 8-12** for exact values

Table 7-16: Motor Control Parameters — M1 → G1.6, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.10	Overvoltage controller	0	2		1		607	**0** = Not used **1** = Used (no ramping) **2** = Used (ramping)
P1.6.11	Undervoltage controller	0	1		1		608	**0** = Not used **1** = Used

Protections — M1 → G1.7

Table 7-17: Protections — M1 → G1.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.1	Response to 4 mA reference fault	0	5		4		700	**0** = No response **1** = Warning **2** = Warning+Previous Freq. **3** = Warning+Preset Freq P1.7.2 **4** = Fault, stop per P1.4.7 **5** = Fault, stop by coasting
P1.7.2	4 mA reference fault frequency	0.00	P1.1.2	Hz	0.00		728	
P1.7.3	Response to external fault	0	3		2		701	**0** = No response **1** = Warning **2** = Fault, stop per P1.4.7 **3** = Fault, stop by coasting
P1.7.4	Input phase supervision	0	3		0		730	See P1.7.3
P1.7.5	Response to undervoltage fault	0	1		0		727	**0** = Fault Stored **1** = No History
P1.7.6	Output phase supervision	0	3		2		702	See P1.7.3
P1.7.7	Ground fault protection	0	3		2		703	See P1.7.3
P1.7.8	Thermal protection of the motor	0	3		2		704	See P1.7.3
P1.7.9	Motor ambient temperature factor	-100.0	100.0	%	0.0		705	
P1.7.10	MTP cooling factor at zero speed	0.0	150.0	%	40.0		706	As a % of I_{nMotor}
P1.7.11	MTP time constant	1	200	min	45		707	
P1.7.12	Motor duty cycle	0	100	%	100		708	
P1.7.13	Stall protection	0	3		1		709	See P1.7.3
P1.7.14	Stall current	0.1	I_{nMotor} x 2	A	I_L		710	
P1.7.15	Stall time limit	1.00	120.00	s	15.00		711	

Table 7-17: Protections — M1 → G1.7, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.16	Stall frequency limit	1.00	P1.1.2	Hz	25.00		712	
P1.7.17	Underload protection	0	3		0		713	See P1.7.3
P1.7.18	Underload protect. f_{nom} torque	10.0	150.0	%	50.0		714	
P1.7.19	Underload protect. f_0 torque	5.0	150.0	%	10.0		715	
P1.7.20	Underload protection time limit	2.00	600.00	s	20.00		716	
P1.7.21	Response to thermistor fault	0	3		2		732	See P1.7.3
P1.7.22	Response to fieldbus fault	0	3		2		733	See P1.7.3
P1.7.23	Response to slot fault	0	3		2		734	See P1.7.3
P1.7.24	No. of PT100 inputs	0	3		0		739	
P1.7.25	Response to PT100 fault	0	1		0		740	**0** = Fault stored to history **1** = Fault not stored to history
P1.7.26	PT100 warning limit	-30.0	200.0	°C	120.0		741	
P1.7.27	PT100 fault limit	-30.0	200.0	°C	130.0		742	

Auto Restart Parameters — M1 → G1.8

Table 7-18: Auto Restart Parameters — M1 → G1.8

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.8.1	Wait time	0.10	10.00	s	0.50		717	
P1.8.2	Trial time	0.00	60.00	s	30.00		718	
P1.8.3	Start mode	0	2		0		719	**0** = Ramp **1** = Flying start **2** = Start per P1.4.6
P1.8.4	Number of tries after undervoltage trip	0	10		1		720	
P1.8.5	Number of tries after overvoltage trip	0	10		1		721	
P1.8.6	Number of tries after overcurrent trip	0	3		1		722	
P1.8.7	Number of tries after 4 mA trip	0	10		1		723	
P1.8.8	Number of tries after motor temp fault trip	0	10		1		726	

Table 7-18: Auto Restart Parameters — M1 → G1.8, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.8.9	Number of tries after external fault trip	0	10		0		725	
P1.8.10	Number of tries after underload fault trip	0	10		1		738	

Table 7-19: Pump and Fan Control Parameters — M1 → G1.9

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.9.1	Number of auxiliary drives	0	4		0		1001	
P1.9.2	Start frequency, auxiliary drive 1	P1.9.3	320.00	Hz	61.00		1002	
P1.9.3	Stop frequency, auxiliary drive 1	P1.1.1	P1.9.2	Hz	10.00		1003	
P1.9.4	Start frequency, auxiliary drive 2	P1.9.5	320.00	Hz	61.00		1004	
P1.9.5	Stop frequency, auxiliary drive 2	P1.1.1	P1.9.4	Hz	10.00		1005	
P1.9.6	Start frequency, auxiliary drive 3	P1.9.7	320.00	Hz	61.00		1006	
P1.9.7	Stop frequency, auxiliary drive 3	P1.1.1	P1.9.6	Hz	10.00		1007	
P1.9.8	Start frequency, auxiliary drive 4	P1.9.9	320.00	Hz	61.00		1008	
P1.9.9	Stop frequency, auxiliary drive 4	P1.1.1	P1.9.8	Hz	10.00		1009	
P1.9.10	Start delay, auxiliary drives	0.0	300.0	s	4.0		1010	
P1.9.11	Stop delay, auxiliary drives	0.0	300.0	s	2.0		1011	
P1.9.12	Reference step, auxiliary drive 1	0.0	100.0	%	0.0		1012	
P1.9.13	Reference step, auxiliary drive 2	0.0	100.0	%	0.0		1013	
P1.9.14	Reference step, auxiliary drive 3	0.0	100.0	%	0.0		1014	
P1.9.15	Reference step, auxiliary drive 4	0.0	100.0	%	0.0		1015	
P1.9.16	PID controller bypass	0	1		0		1020	**1** = PID contr. bypassed
P1.9.17	Analog input selection for input pressure measurement	0	5		0		1021	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus signal
P1.9.18	Input pressure high limit	0.0	100.0	%	30.00		1022	

Table 7-19: Pump and Fan Control Parameters — M1 → G1.9, continued

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.9.19	Input pressure low limit	0.0	100.0	%	20.00		1023	
P1.9.20	Output pressure drop	0.0	100.0	%	30.00		1024	
P1.9.21	Frequency drop delay	0.0	300.0	s	0.0		1025	**0.0** = No delay **300.0** = No frequency drop
P1.9.22	Frequency increase delay	0.0	300.0	s	0.0		1026	**0.0** = No delay **300.0** = No frequency increase
P1.9.23	Interlock selection	0	2		1		1032	**0** = Interlocks not used **1** = Set new interlock last; update order after value of P1.9.26 or Stop state **2** = Stop and update order immediately
P1.9.24	Autochange	0	1		1		1027	**0** = Not used **1** = Autochange used
P1.9.25	Autochange and interlock automatics selection	0	1		1		1028	**0** = Auxiliary drives only **1** = All drives
P1.9.26	Autochange interval	0.0	3000.0	h	48.0		1029	**0.0** = TEST = 40 s
P1.9.27	Autochange; maximum number of auxiliary drives	0	4		1		1030	
P1.9.28	Autochange frequency limit	0.00	P1.1.2	Hz	30.00		1031	
P1.9.29	Actual value special display minimum	0.0	3000.0		0.0		1033	
P1.9.30	Actual value special display maximum	0.0	3000.0		10.0		1034	
P1.9.31	Actual value special display decimals	0	4		1		1035	

Keypad Control Parameters — M2

This menu provides the parameters for the setting of the keypad frequency reference, the selection of motor direction when in keypad operation, and when the STOP button is active.

Table 7-20: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
R2.1	Keypad reference	P1.1.1	P1.1.2	Hz				
P2.2	Keypad direction	0	1		0		123	**0** = Forward **1** = Reverse
P2.3	PID reference	0.00	100.00	%	0.00			
P2.4	PID reference 2	0.00	100.00	%	0.00			
P2.5	Stop button active	0	1		1		114	**0** = Stop enabled only in keypad operation **1** = Stop button always enabled

Menus — M3 to M6

Menus M3 to M6 provide information on the Active Faults, Fault History, System Menu settings and the Expander Board setup. These menu items are explained in detail in Chapter 5 of the *SVX9000 User Manual*.

Monitoring Menu — M7

The monitored items are the actual values of parameters and signals as well as the status and measurements of other elements. Monitored items cannot be edited.

See the *SVX9000 User Manual*, Chapter 5 — Menu information item M7, for more information.

Table 7-21: Monitoring Menu

Code	Parameter	Unit	ID	Description
V7.1	Output frequency	Hz	1	Output frequency to motor
V7.2	Frequency reference	Hz	25	Frequency
V7.3	Motor speed	rpm	2	Calculated motor speed in rpm
V7.4	Motor current	A	3	Motor current
V7.5	Motor torque	%	4	Calculated torque as a percentage of nominal torque
V7.6	Motor power	%	5	Calculated motor shaft power
V7.7	Motor voltage	V	6	Calculated motor voltage
V7.8	DC-Bus voltage	V	7	DC-Bus voltage
V7.9	Unit temperature	°C	8	Heatsink temperature
V7.10	Motor temperature	%	9	Calculated motor temperature
V7.11	Analog input 1	V	13	Analog input AI1
V7.12	Analog input 2	mA	14	Analog input AI2
V7.13	DIN1, DIN2, DIN3	—	15	Digital input status
V7.14	DIN4, DIN5, DIN6	—	16	Digital input status
V7.15	Analog I_{out}	mA	26	Analog output AO1
V7.16	Analog input 3		27	Analog input AI3
V7.17	Analog input 4		28	Analog input AI4

Table 7-21: Monitoring Menu, continued

Code	Parameter	Unit	ID	Description
V7.18	PID reference	%	20	% of the maximum frequency
V7.19	PID actual value	%	21	% of the maximum actual value
V7.20	PID error	%	22	% of the maximum error value
V7.21	PID output	%	23	% of the maximum output value
V7.22	Running auxiliary drives		30	Number of running auxiliary drives
V7.23	Special display for actual value		29	See P1.9.29, P1.9.30 and P1.9.31
V7.24	PT100 temperature	°C	42	Highest temperature of used inputs, needs option board (OPTB8)
G7.25	Multimonitor		—	Displays three selectable monitoring values

Operate Menu — M8

The Operate Menu provides an easy to use method of viewing key numerical Monitoring Menu items. It also allows the setting of the keypad frequency reference. See Chapter 5 of the *SVX9000 User Manual* for more information.

Table 7-22: Operate Menu Items

Code	Parameter	Unit	Description
O.1	Output frequency	Hz	Output frequency to motor
O.2	Frequency reference	Hz	Frequency
O.3	Motor speed	rpm	Calculated motor speed in rpm
O.4	Motor current	A	Motor current
O.5	Motor torque	%	Calculated torque as a percentage of nominal torque
O.6	Motor power	%	Calculated motor shaft power
O.7	Motor voltage	V	Calculated motor voltage
O.8	DC-Bus voltage	V	DC-Bus voltage
O.9	Unit temperature	°C	Heatsink temperature
O.10	Motor temperature	%	Calculated motor temperature
O.11	PID reference	%	% of the maximum frequency
O.12	PID actual value	%	% of the maximum actual value
O.13	PID error value	%	% of the maximum error value
O.14	PID output	%	% of the maximum output value
O.15	Running auxiliary drives		Number of running auxiliary drives
O.16	Special display for actual value		See P1.9.29, P1.9.30 and P1.9.31
R1	Keypad reference	Hz	Keypad frequency reference setting

Chapter 8 — Description of Parameters

Introduction

On the following pages you will find the parameter descriptions arranged according to the individual ID number of the parameter. A parameter ID number with a ② footnote (e.g. **418**② **Motor potentiometer UP**) indicates that the *TTF programming method* shall be applied to this parameter (see **Page 6-3**).

Some parameter names are followed by a number code indicating the "All-in-One" applications in which the parameter is included. If **no code** is shown, the parameter is available in **all applications.** See the list of applications below. The parameter numbers under which the parameter appears in different applications are also given.

1 Basic Application
2 Standard Application
3 Local/Remote Control Application
4 Multi-Step Speed Control Application
5 PID Control Application
6 Multi-Purpose Control Application
7 Pump and Fan Control Application

101 Minimum frequency (P1.1, P1.1.1)
102 Maximum frequency (P1.2, P1.1.2)

Defines the frequency limits of the SVX9000. The maximum value for these parameters is 320 Hz. The software will automatically check the values of parameters ID105, ID106, ID315 and ID728.

103 Acceleration time 1 (P1.3, P1.1.3)
104 Deceleration time 1 (P1.4, P1.1.4)

These limits correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (parameter ID102).

105 Preset speed 1 **1246** (P1.20, P1.1.15, P1.1.16)
106 Preset speed 2 **1246** (P1.21, P1.1.16, P1.1.17)

Parameter values are automatically limited between the minimum and maximum frequencies (parameter ID101, ID102). Note the use of the TTF-programming method in the Multi-purpose Control Application. See parameters ID419, ID420 and ID421.

Table 8-1: Preset Speed

Speed	Multi-step speed select 1 (DIN4)	Multi-step speed select 2 (DIN5)
Basic speed	0	0
ID105	1	0
ID106	0	1

107 Current limit (P1.5, P1.1.5)

This parameter determines the maximum motor current from the SVX9000. The parameter value range differs for each power rating.

108 V/Hz ratio selection **234567** (P1.6.3)

Linear:

0 The voltage of the motor changes linearly with the frequency in the constant flux area from 0 Hz to the field weakening point where the nominal voltage is supplied to the motor. A linear V/Hz ratio should be used in constant torque applications. **This default setting should be used if there is no special need for another setting.**

Squared:

1 The voltage of the motor changes following a squared curve form with the frequency in the area from 0 Hz to the field weakening point where the nominal voltage is supplied to the motor. The motor runs under magnetized below the field weakening point and produces less torque and electromechanical noise. A squared V/Hz ratio can be used in applications where the torque demand of the load is proportional to the square of the speed, e.g. in centrifugal fans and pumps.

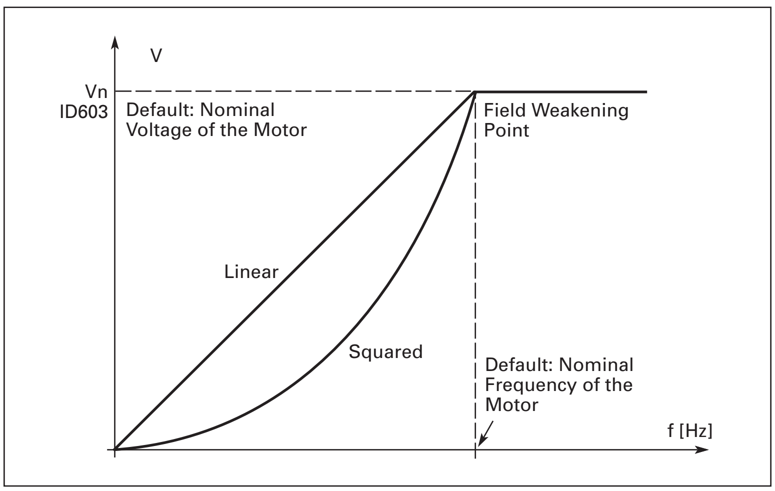


Figure 8-1: Linear and Squared V/Hz Ratio

Programmable V/Hz curve:

2 The V/Hz curve can be programmed with three different points. A programmable V/Hz curve can be used if the other settings do not satisfy the needs of the application.

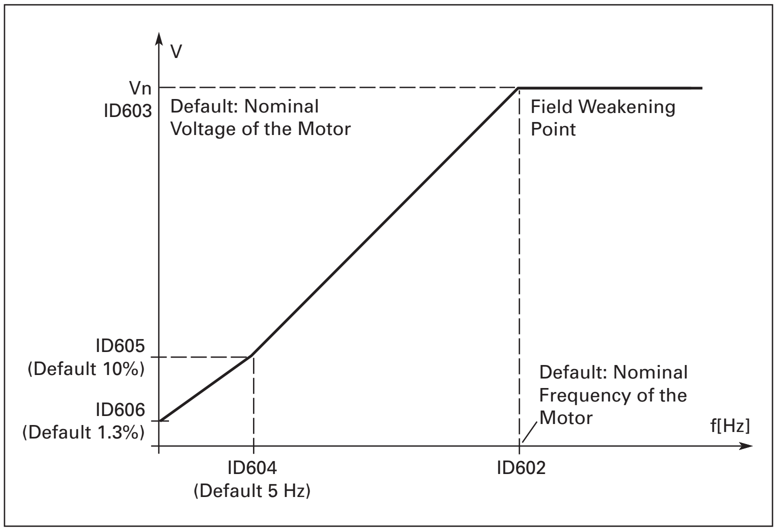


Figure 8-2: Programmable V/Hz Curve

Linear with flux optimization:

3 The SVX9000 starts to search for the minimum motor current in order to save energy, lower the disturbance level and the noise. This function can be used in applications with constant motor load, such as fans, pumps etc.

109 V/Hz optimization (P1.16, P1.6.2)

Automatic torque boost The voltage to the motor changes automatically which makes the motor produce sufficient torque to start and run at low frequencies. The voltage increase depends on the motor type and rating. Automatic torque boost can be used in applications where starting torque due to starting friction is high, e.g. in conveyors.

Example 1:

What changes are required to start the load from 0 Hz?

- First set the motor nominal values (Parameter group 1.1).

Option 1: Activate the Automatic torque boost.

Option 2: Programmable V/Hz curve

To obtain the required torque, the zero point voltage and midpoint voltage/frequency (in parameter group 1.6) need to be set, so that the motor can draw enough current at the low frequencies. First set parameter ID108 to *Programmable V/Hz curve* (value **2**). Increase the zero point voltage (ID606) to get enough current at zero speed. Then set the midpoint voltage (ID605) to 1.4142*ID606 and the midpoint frequency (ID604) to ID606/100%*ID111.

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. Use external cooling for the motor if the temperature tends to rise too high.

110	**Nominal voltage of the motor**		(P1.6, P1.1.6)

Find this value V_n on the motor nameplate. This parameter sets the voltage at the field weakening point (ID603) to 100% * V_{nMotor}.

111	**Nominal frequency of the motor**		(P1.7, P1.1.7)

Find this value f_n on the motor nameplate. This parameter sets the field weakening point (ID602) to the same value.

112	**Nominal speed of the motor**		(P1.8, P1.1.8)

Find this value n_n on the motor nameplate.

113	**Nominal current of the motor**		(P1.9, P1.1.9)

Find this value I_n on the motor nameplate.

118	**PID controller gain**	**57**	(P1.1.16)

This parameter defines the gain of the PID controller. If the value of the parameter is set to 100% a change of 10% in the error value causes the controller output to change by 10%. If the parameter value is set to **0** the PID controller operates as ID-controller. See the examples in ID132.

119	**PID controller I-time**	**57**	(P1.1.17)

This parameter defines the integration time of the PID controller. If this parameter is set to 1.00 second, a change of 10% in the error value causes the controller output to change by 10.00%/s. If the parameter value is set to 0.00 s the PID controller will operate as PD controller. See the examples on in ID132.

120	**Motor Power Factor**		(P1.10, P1.1.10)

Find this value “Power Factor” on the motor nameplate.

124	**Jog speed reference**	**34567**	(P1.1.15, P1.1.16, P1.1.23)

Defines the jog speed selected with the DIN3 digital input when it is programmed for Jog speed. See parameter ID301.

This parameter’s value is automatically limited between minimum and maximum frequency (ID101 and ID102).

126	**Preset speed 3**	**46**	(P1.1.18)
127	**Preset speed 4**	**46**	(P1.1.19)
128	**Preset speed 5**	**46**	(P1.1.20)
129	**Preset speed 6**	**46**	(P1.1.21)
130	**Preset speed 7**	**46**	(P1.1.22)

These parameter values define the Multi-step speeds selected with the DIN3, DIN4, DIN5 and DIN6 digital inputs. See also ID105 and ID106.

These parameter values are automatically limited between minimum and maximum frequency (ID101 and ID102).

Table 8-2: Preset Speeds 3 to 7

Speed	Multi-step speed select 1 (DIN4)	Multi-step speed select 2 (DIN5)	Multi-step speed select 3 (DIN6)	Multi-step speed select 4 (DIN3)
Basic speed	0	0	0	0
P1.1.18 (3)	1	1	0	0
P1.1.19 (4)	0	0	1	0
P1.1.20 (5)	1	0	1	0
P1.1.21 (6)	0	1	1	0
P1.1.22 (7)	1	1	1	0

131 I/O frequency reference selection, place B **3** (P1.1.14)

See the values of ID173.

132 PID controller D-time **57** (P1.1.18)

ID132 defines the derivative time of the PID controller. If this parameter is set to 1.00 second a change of 10% in the error value during 1.00 s causes the controller output to change by 10.00%. If the parameter value is set to 0.00 s the PID controller will operate as PI controller. See examples below.

Example 1:

In order to reduce the error value to zero, with the given values, the SVX9000 output behaves as follows:

Given values:

P1.1.16, P = 0%
P1.1.17, I-time = 1.00 s
P1.1.18, D-time = 0.00 s — Min freq. = 0 Hz
Error value (setpoint – process value) = 10.00% — Max freq. = 60 Hz

In this example, the PID controller operates practically as an I-controller only. According to the given value of P1.1.17 (I-time), the PID output increases by 6 Hz (10% of the difference between the maximum and minimum frequency) every second until the error value is 0.

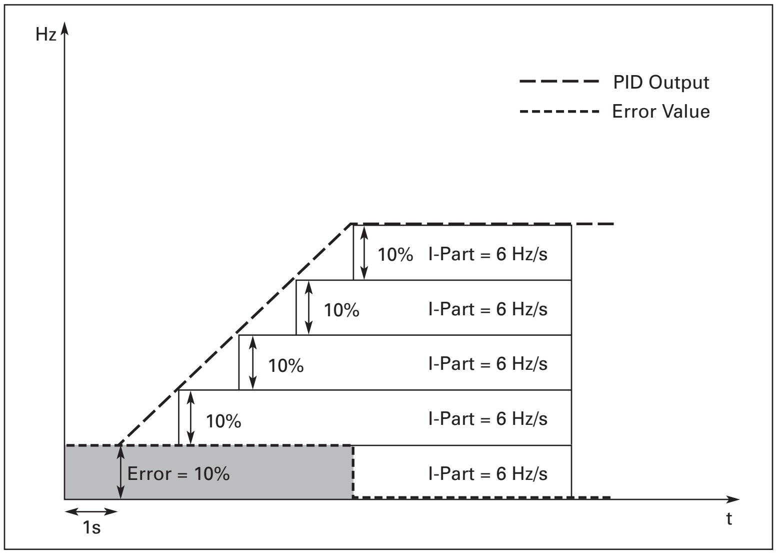


Figure 8-3: PID Controller Function as I-Controller

Example 2:

Given values:

P1.1.16, P = 100%
P1.1.17, I-time = 1.00 s
P1.1.18, D-time = 1.00 s
Error value (setpoint – process value) = ±10%

Min freq. = 0 Hz
Max freq. = 60 Hz

As the power is switched on, the system detects the difference between the setpoint and the actual process value and starts to either raise or decrease (in case the error value is negative) the PID output according to the I-time. Once the difference between the setpoint and the process value has been reduced to 0 the output is reduced by the amount corresponding to the value of P1.1.16.

In case the error value is negative, the frequency converter reacts reducing the output correspondingly. See **Figure 8-4.**

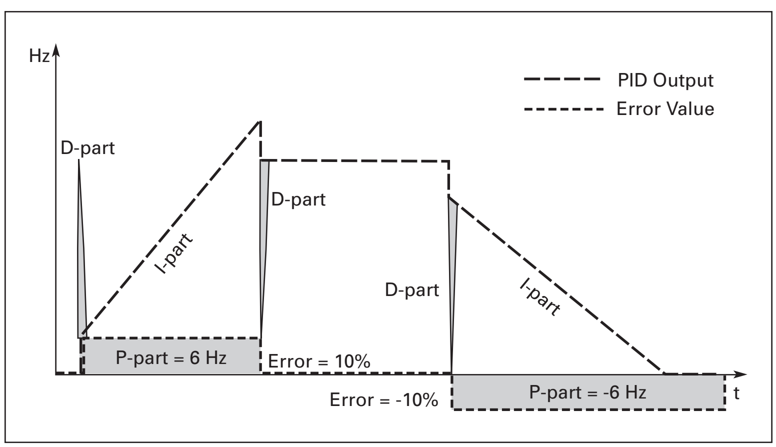


Figure 8-4: PID Output Curve with the Values of Example 2

Example 3:

Given values:

P1.1.16, P = 100%
P1.1.17, I-time = 0.00 s
P1.1.18, D-time = 1.00 s — Min freq. = 0 Hz
Error value (setpoint – process value) = ±10%/s — Max freq. = 60 Hz

As the error value increases, also the PID output increases according to the set values (D-time = 1.00s)

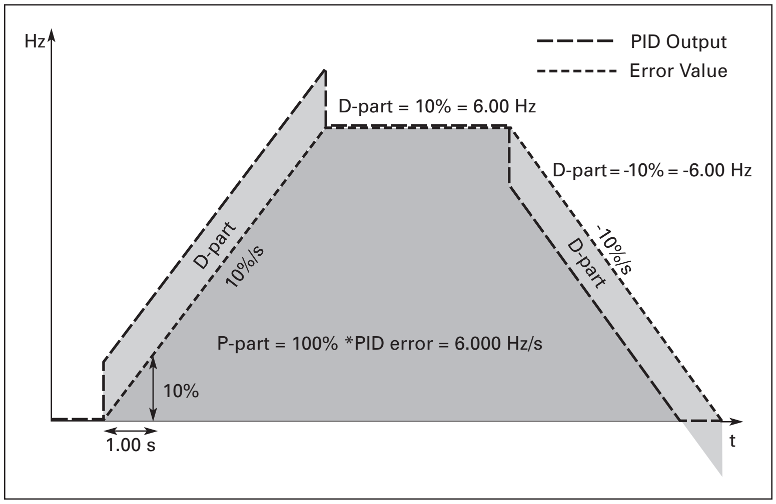


Figure 8-5: PID Output Curve with the Values of Example 3

133	**Preset speed 8**	**4**	(P1.1.23)
134	**Preset speed 9**	**4**	(P1.1.24)
135	**Preset speed 10**	**4**	(P1.1.25)
136	**Preset speed 11**	**4**	(P1.1.26)
137	**Preset speed 12**	**4**	(P1.1.27)
138	**Preset speed 13**	**4**	(P1.1.28)
139	**Preset speed 14**	**4**	(P1.1.29)
140	**Preset speed 15**	**4**	(P1.1.30)

Table 8-3: Multi-Step Speed Selections with Digital Inputs DIN3, DIN4, DIN5 and DIN6

Speed	Multi-step speed select 1 (DIN4)	Multi-step speed select 2 (DIN5)	Multi-step speed select 3 (DIN6)	Multi-step speed select 4 (DIN3)
P1.1.23 (8)	0	0	0	1
P1.1.24 (9)	1	0	0	1
P1.1.25 (10)	0	1	0	1
P1.1.26 (11)	1	1	0	1
P1.1.27 (12)	0	0	1	1
P1.1.28 (13)	1	0	1	1
P1.1.29 (14)	0	1	1	1
P1.1.30 (15)	1	1	1	1

141② **AI3 signal selection** **567** (P1.2.34, P1.2.4.1)

Connect the AI3 signal to the analog input of your choice with this parameter. For more information, see **Page 6-3**, "Terminal to Function" (TTF) programming.

142 **AI3 signal filter time** **567** (P1.2.37, P1.2.4.2)

When this parameter is given a value greater than 0 the function that filters out disturbances from the incoming analog signal is activated. A long filtering time makes the regulation response slower. See ID324.

143 **AI3 signal range** **567** (P1.2.35, P1.2.4.3)

With this parameter you can select the AI3 signal range.

Table 8-4: Selections for ID143

Application			
Select	**5**	**6**	**7**
0	0 – 100%	0 – 100%	0 – 100%
1	20 – 100%	20 – 100%	20 – 100%
2	—	-10 – +10V	Customized
3	—	Customized	

144 **AI3 custom setting minimum** **67** (P1.2.4.4)
145 **AI3 custom setting maximum** **67** (P1.2.4.5)

Set the custom minimum and maximum levels for the AI3 signal from -100 to 100%.

151 **AI3 signal inversion** **567** (P1.2.36, P1.2.4.6)

0 = No inversion
1 = Signal inverted

152② **AI4 signal selection** **567** (P1.2.38, P1.2.5.1)

See ID141.

153 **AI4 signal selection** **567** (P1.2.41, P1.2.5.2)

See ID142.

154 **AI4 signal range** **567** (P1.2.39, P1.2.5.3)

See ID143.

155 **AI4 custom setting minimum** **67** (P1.2.5.4)
156 **AI4 custom setting maximum** **67** (P1.2.5.5)

See ID144 and ID145.

162 **AI4 signal inversion** **567** (P1.2.40, P1.2.5.6)

See ID151.

164 ② **Motor control mode 1/2** **6** (P1.2.7.21)

Contact is open = Motor control mode 1 is selected.
Contact is closed = Motor control mode 2 is selected.

See ID600 and ID521.

165 **AI1 joystick offset** **6** (P1.2.2.11)

Define the frequency zero point as follows: With this parameter being displayed, place the potentiometer at the assumed zero point and press ENTER on the keypad. Note: This will not change the reference scaling. Press the RESET button to change the parameter value back to 0.00%.

166 **AI2 joystick offset** **6** (P1.2.3.11)

See ID165.

171 / 172 **Local & Remote Control Place** (P1.13, P1.1.11) / (P1.14, P1.1.12)

The active control place can be changed by pressing the LOC/REM button on the keypad.

There are two different places which the SVX9000 can be controlled from, Local and Remote. For each control place the actual control source is selected with this parameter, a different symbol will appear on the alphanumeric display:

Table 8-5: Selections for IDs 171 and 172

Control source	Symbol
I/O terminals	I/O Term
Keypad	Keypad
Fieldbus	Bus/comm

173 / 174 **Local & Remote reference selection** **234567** (P1.1.13) / (P1.15, P1.1.14, P1.1.15)

Defines which frequency reference source is selected when controlled from the keypad.

Table 8-6: Selections for Parameters ID173 and ID174

Application Select	2 – 4	5	6	7
0	Analog voltage ref. Terminals 2 – 3	Analog voltage ref. Terminals 2 – 3	Analog voltage ref. Terminals 2 – 3	Analog voltage ref. Terminals 2 – 3
1	Analog current ref. Terminals 4 – 5	Analog current ref. Terminals 4 – 5	Analog current ref. Terminals 4 – 5	Analog current ref. Terminals 4 – 5
2	Keypad reference (Menu M2)	AI3	AI1+AI2	AI3
3	Fieldbus reference	AI4	AI1 – AI2	AI4
4	Motor potentiometer (App #3 only)	Keypad reference (Menu M3)	AI2 – AI1	Keypad reference (Menu M3)
5	—	Fieldbus reference	AI1 x AI2	Fieldbus reference
6	—	Potentiometer ref.	AI1 joystick	Potentiometer ref.
7	—	PID controller ref.	AI2 joystick	PID controller ref.
8	—	—	Keypad reference (Menu M3)	—
9	—	—	Fieldbus reference	—
10	—	—	Potentiometer reference; controlled with DIN5 (TRUE = increase) and DIN6 (TRUE = decrease)	—
11	—	—	AI1 or AI2, whichever is lower	—
12	—	—	AI1 or AI2, whichever is greater	—
13	—	—	max. frequency (recommended in torque control only)	—
14	—	—	AI1/AI2 selection	—

300 Start/Stop logic selection 2346 (P1.2.1, P1.2.1.1)

0 DIN1: closed contact = start forward
DIN2: closed contact = start reverse

① The first selected direction has the highest priority.

② When the DIN1 contact opens the direction of rotation starts to change.

③ If Start forward (DIN1) and Start reverse (DIN2) signals are active simultaneously the Start forward signal (DIN1) has priority.

1 DIN1: closed contact = start open contact = stop
DIN2: closed contact = reverse open contact = forward, see **Figure 8-6.**

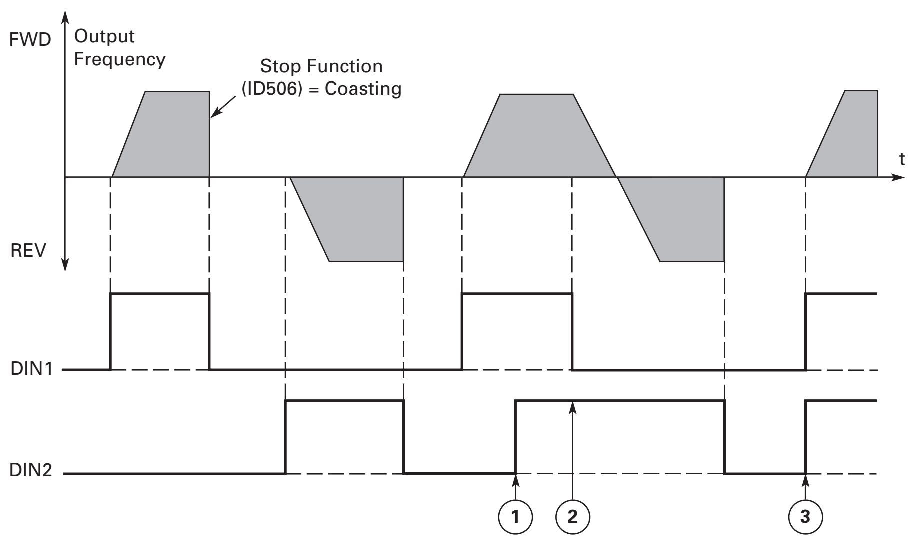


Figure 8-6: Start Forward/Start Reverse

2 DIN1: closed contact = start — open contact = stop
DIN2: closed contact = start enabled — open contact = start disabled and drive stopped if running, see **Figure 8-7.**

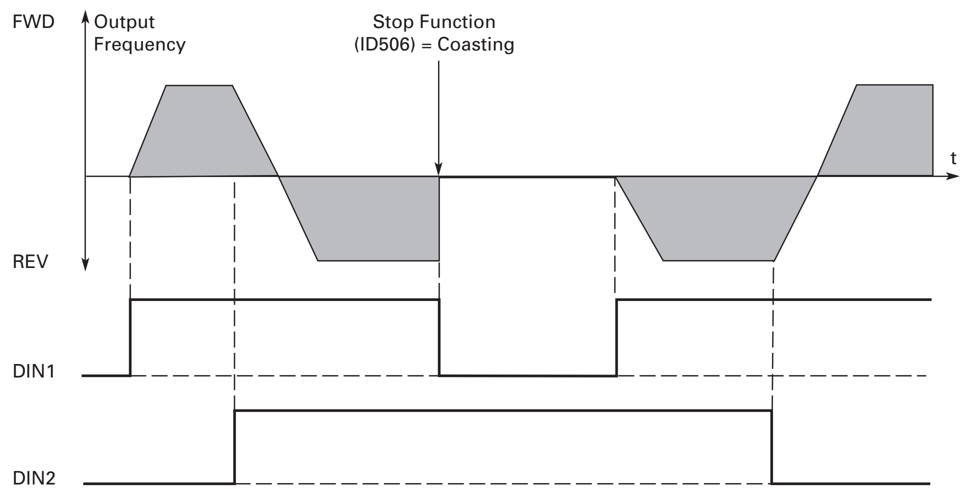


Figure 8-7: Start, Stop and Reverse

3 3-wire connection (pulse control):
DIN1: closed contact = start pulse
DIN2: open contact = stop pulse
(DIN3 can be programmed for reverse command), see **Figure 8-8.**

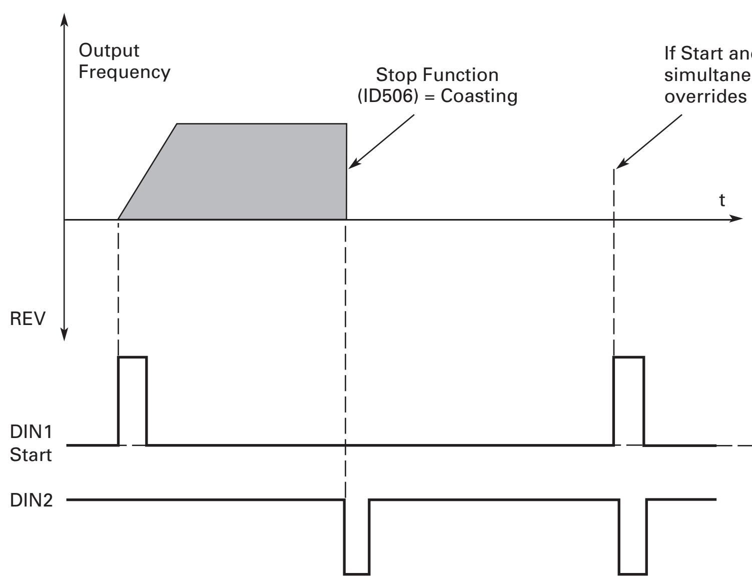


Figure 8-8: Start Pulse/Stop Pulse

The selections including the text "**Rising edge required to start**" shall be used to exclude the possibility of an unintentional start when, for example, power is connected, re-connected after a power failure, after a fault reset, after the drive is stopped by Run Enable (Run Enable = False) or when the control place is changed. The Start/Stop contact must be opened before the motor can be started.

Applications 2 and 4:

4	DIN1: closed contact = start forward **(Rising edge required to start)** DIN2: closed contact = start reverse **(Rising edge required to start)**
5	DIN1: closed contact = start **(Rising edge required to start)** open contact = stop DIN2: closed contact = reverse — open contact = forward
6	DIN1: closed contact = start **(Rising edge required to start)** open contact = stop DIN2: closed contact = start enabled — open contact = start disabled and drive stopped if running

Application 3 and 6:

4	DIN1: closed contact = start forward DIN2: closed contact = reference increases (motor potentiometer reference; this parameter is automatically set to 4 if ID174 is set to 3 or 4).
5	DIN1: closed contact = start forward **(Rising edge required to start)** DIN2: closed contact = start reverse **(Rising edge required to start)**
6	DIN1: closed contact = start **(Rising edge required to start)** open contact = stop DIN2: closed contact = reverse — open contact = forward
7	DIN1: closed contact = start **(Rising edge required to start)** open contact = stop DIN2: closed contact = start enabled — open contact = start disabled and drive stopped if running

Application 3:

8	DIN1: closed contact = start forward **(Rising edge required to start)** DIN2: closed contact = reference increases (motor potentiometer reference; this parameter is automatically set to 4 if ID174 is set to 3 or 4).

301 DIN3 function 12345 (P1.19, P1.2.2)

0	Not used
1	External fault, closing contact = Fault is shown and motor is stopped when the input is active
2	External fault, opening contact = Fault is shown and motor is stopped when the input is not active
3	Run enable: contact open = Motor start disabled and the motor is stopped contact closed = Motor start enabled

Application 1:

4	Run enable: contact open = Motor start enabled contact closed = Motor start disabled and the motor is stopped

Applications 2 to 5:

4	Acc./Dec. time select: contact open = Acceleration/deceleration time 1 selected contact closed = Acceleration/deceleration time 2 selected
5	Closing contact: Force control place to I/O terminal
6	Closing contact: Force control place to keypad
7	Closing contact: Force control place to fieldbus

When the control place is forced to change, the values of Start/Stop, Direction and Reference valid in the respective control place are used (reference according to parameters ID173 and ID174).

Note: When DIN3 opens the control place is selected.

Applications 2 to 5:

8	Reverse: contact open = Forward contact closed = Reverse **Note:** Can be used for reversing if ID300 has a value of 3.

Applications 3 to 5:

9	Jog speed, contact closed = Jog speed selected for frequency reference
10	Fault reset, contact closed = Resets all faults
11	Acc./dec. operation prohibited, contact closed = Stops acceleration or deceleration until the contact is opened
12	DC-braking command, contact closed = In Stop mode, the DC-braking operates until the contact is opened, see **Figure 8-9.**

Application 3 and 5:

13	Motor potentiometer down, contact closed = Reference decreases until the contact is opened

Application 4:

13	Preset speed

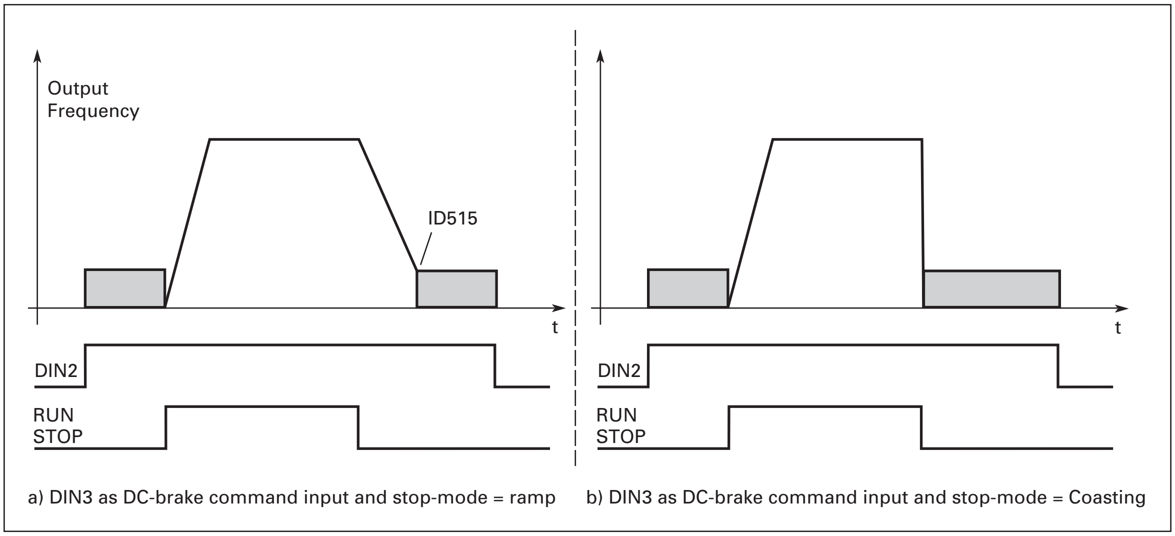


Figure 8-9: DIN3 as DC-Brake Command Input

a) Stop mode = Ramp, b) Stop mode = coasting

302 Reference offset for current input **12** (P1.17, P1.2.3)

0 No offset: 0 – 20 mA

1 Offset: 4 mA ("living zero") provides supervision of zero level signal. In the Standard Application, the response to reference fault can be programmed with ID700.

303 Reference scaling, minimum value **2346** (P1.2.4, P1.2.16, P1.2.15, P1.2.2.6)

304 Reference scaling, maximum value **2346** (P1.2.5, P1.2.17, P1.2.16, P1.2.2.7)

Setting value limits: 0 ≤ ID303 ≤ ID304 ≤ ID102. If ID303 = 0 scaling is set off. The minimum and maximum frequencies are used for scaling.

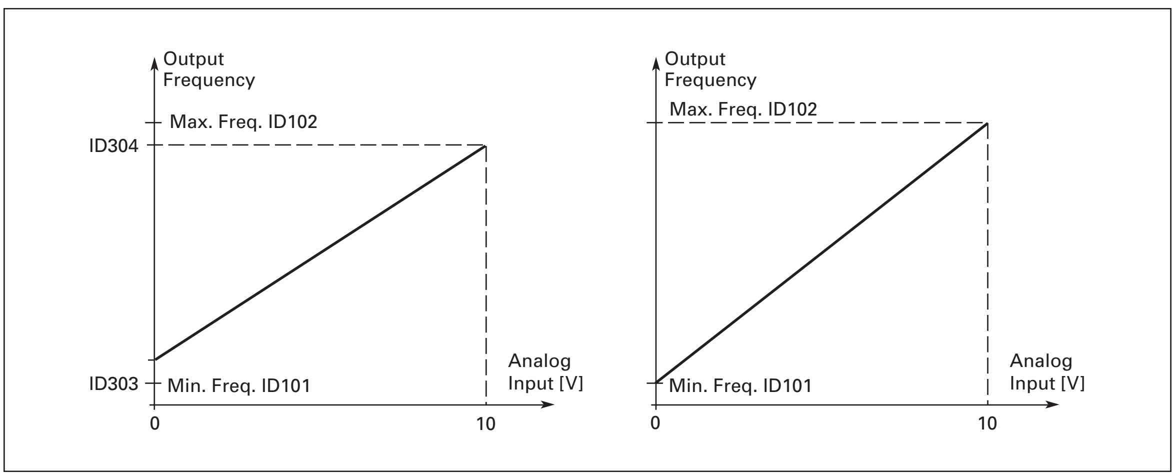


Figure 8-10: With and Without Reference Scaling

Left: Reference scaling, Right: No scaling used (ID303 = 0)

305 Reference inversion **2** (P1.2.6)

Inverts reference signal: max. ref. signal = Min. set freq.
Min. ref. signal = max. set freq.

0 No inversion
1 Reference inverted

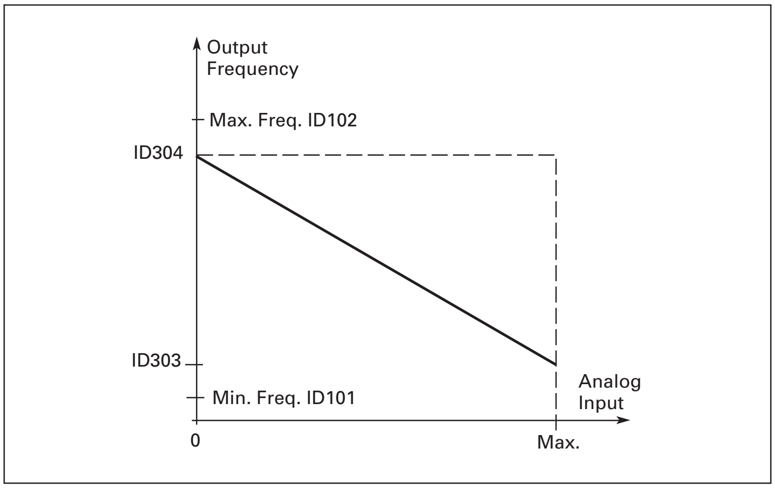


Figure 8-11: Reference Inversion

306 Reference filter time **2** (P1.2.7)

Filters out disturbances from the incoming analog V_{in} signal. A long filtering time makes regulation response slower.

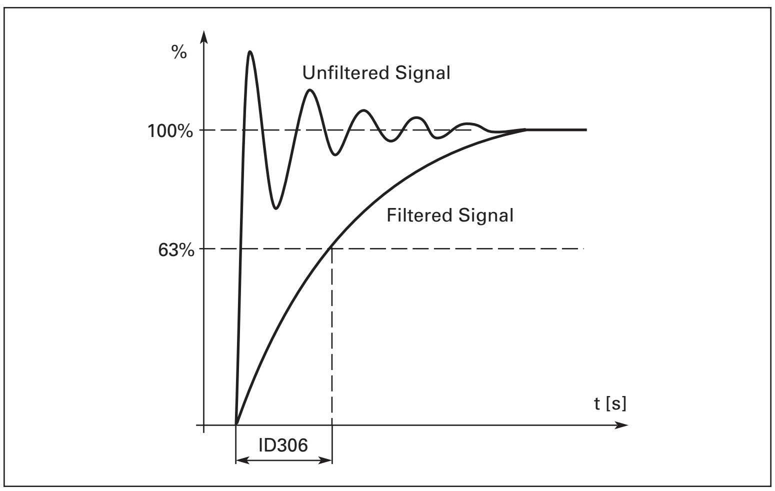


Figure 8-12: Reference Filtering

307 Analog output function (P1.18, P1.3.2, P1.3.5.2, P1.3.3.2)

This parameter selects the desired function for the analog output signal. See the specific parameters for the values available in each respective application.

308 Analog output filter time 234567 (P1.3.3, P1.3.5.3, P1.3.3.3)

Defines the filtering time for the analog output signal. Setting this parameter value to **0.00** will deactivate filtering.

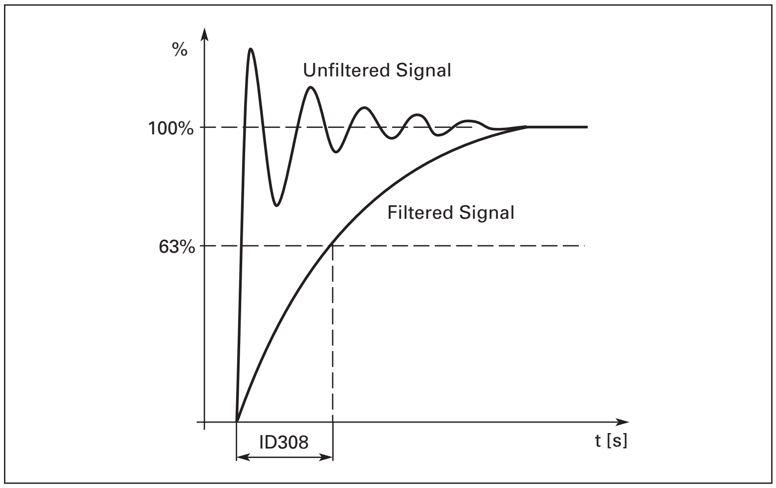


Figure 8-13: Analog Output Filtering

309 Analog output inversion 234567 (P1.3.4, P1.3.5.4, P1.3.3.4)

Inverts the analog output signal:

Maximum output signal = Minimum set value
Minimum output signal = maximum set value

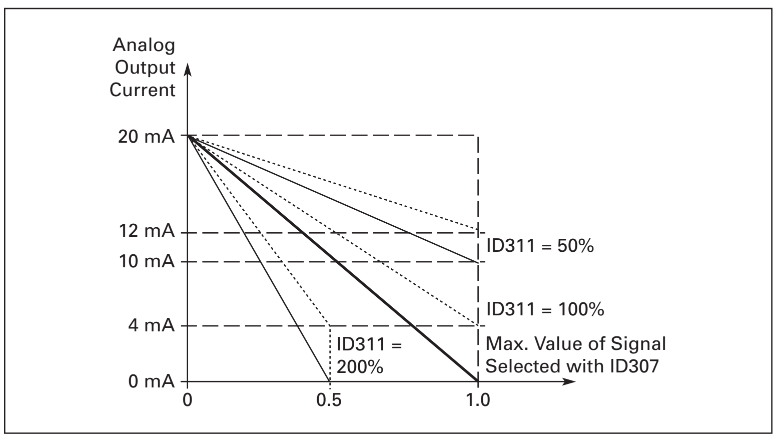


Figure 8-14: Analog Output Invert

310 Analog output minimum 234567 (P1.3.5, P1.3.5.5, P1.3.3.5)

Defines the signal minimum to be either 0 mA or 4 mA ("living zero"). Note the difference in analog output scaling in parameter ID311 (**Figure 8-15**).

0 Set minimum value to 0 mA
1 Set minimum value to 4 mA

311 Analog output scale **234567** (P1.3.6, P1.3.5.6, P1.3.3.6)

Scaling factor for analog output.

Table 8-7: Analog Output Scaling

Signal	**Max. value of the signal**
Output frequency	Max frequency (ID102)
Freq. Reference	Max frequency (ID102)
Motor speed	Motor nom. speed $1xn_{mMotor}$
Output current	Motor nom. current $1xI_{nMotor}$
Motor torque	Motor nom. torque $1xT_{nMotor}$
Motor power	Motor nom. power $1xP_{nMotor}$
Motor voltage	100% x V_{nMotor}
DC-link voltage PI-ref. value PI act. value 1 PI act. value 2 PI error value PI output	1000 V 100% x ref. value max. 100% x actual value max. 100% x actual value max. 100% x error value max. 100% x output max.

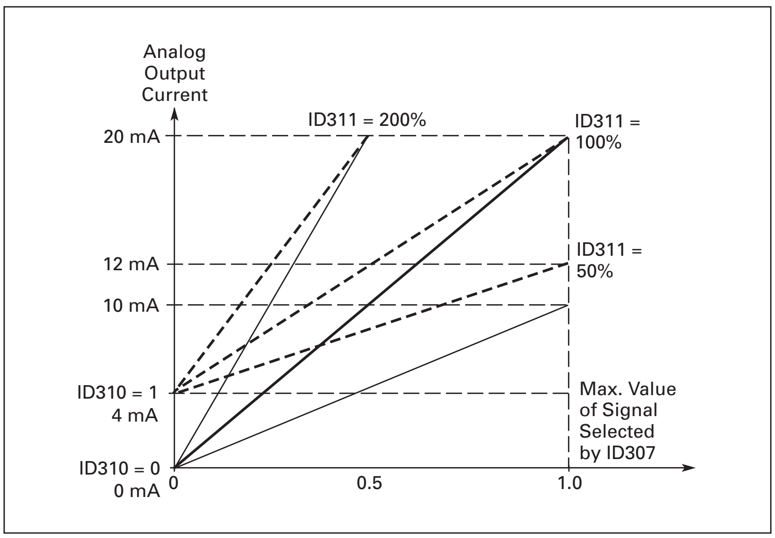


Figure 8-15: Analog Output Scaling

312 Digital output function **23456** (P1.3.7, P1.3.1.2)
313 Relay output 1 function **2345** (P1.3.8)
314 Relay output 2 function **2345** (P1.3.9)

Table 8-8: Output Signals Via DO1 and Output Relays RO1 and RO2

Setting value	Signal content
0 = Not used	Out of operation
Digital output DO1 sinks current and programmable relay (RO1, RO2) is activated when:	
1 = Ready	The SVX9000 is ready to operate
2 = Run	The SVX9000 is operating (motor is running)
3 = Fault	A fault trip has occurred
4 = Fault inverted	A fault trip not occurred
5 = Overheat warning	The heat-sink temperature exceeds +70°C
6 = External fault or warning	Fault or warning depending on ID701
7 = Reference fault or warning	Fault or warning depending on par. ID700 • if analog reference is 4 – 20 mA and signal is <4 mA
8 = Warning	Always if a warning exists
9 = Reversed	The reverse command has been selected
10 = Preset speed 1 (Application **2**) **10** = Jog speed (Applications **3456**)	The preset speed has been selected with digital input The jog speed has been selected with digital input
11 = At speed	The output frequency has reached the set reference
12 = Motor regulator activated	Overvoltage or overcurrent regulator was activated
13 = Output frequency limit supervision	The output frequency is outside the set supervision low limit/high limit (ID315 and ID316)
14 = Control from I/O terminals (Application **2**) **14** = Output frequency limit 2 supervision (Applications **3456**)	I/O control mode selected The output frequency goes outside the set supervision low limit/high limit (ID346 and ID347)
15 = Thermistor fault or warning (Application **2**) **15** = Torque limit supervision (Applications **3456**)	The thermistor input of option board indicates overtemperature. Fault or warning depending on ID732. The motor torque is beyond the set supervision low limit/ high limit (ID348 and ID349).
16 = Fieldbus input data (Application **2**) **16** = Reference limit supervision (Applications **3456**)	Fieldbus input data to DO/RO. Active reference goes beyond the set supervision low limit/ high limit (ID350 and ID351)
17 = External brake control (Applications **3456**)	External brake ON/OFF control with programmable delay (ID352 and ID353)
18 = Control from I/O terminals (Applications **3456**)	External control mode
19 = Frequency converter temperature limit supervision (Applications **3456**)	Frequency converter heatsink temperature goes beyond the set supervision limits (ID354 and ID355).
20 = Unrequested rotation direction (Applications **345**) **20** = Reference inverted (Application **6**)	Rotation direction is different from the requested one.
21 = External brake control inverted (Applications **3456**)	External brake ON/OFF control (ID352 and ID353); Output active when brake control is OFF

Table 8-8: Output Signals Via DO1 and Output Relays RO1 and RO2, continued

Setting value	Signal content
22 = Thermistor fault or warning (Applications **3456**)	The thermistor input of option board indicates overtemperature. Fault or warning depending on ID732.
23 = Fieldbus input data (Application **5**) **23** = On/Off control (Application **6**)	Fieldbus input data to DO/RO. Selects the analog input to be monitored. (ID356, ID357, ID358 and ID463)
24 = Fieldbus input data 1 (Application **6**)	Fieldbus data to DO/RO
25 = Fieldbus input data 2 (Application **6**)	Fieldbus data to DO/RO
26 = Fieldbus input data 3 (Application **6**)	Fieldbus data to DO/RO

315 Output frequency limit supervision function **234567** (P1.3.10, P1.3.4.1, P1.3.2.1)

- **0** No supervision
- **1** Low limit supervision
- **2** High limit supervision
- **3** Brake-on control (Application **6** only, see **Page A-1**.)

If the output frequency goes under/over the set limit (ID316) this function generates a warning message via the digital output DO1 or via the relay outputs RO1 or RO2 depending on the settings of parameters ID312 to ID314.

316 Output frequency limit supervision value **234567** (P1.3.11, P1.3.4.2, P1.3.2.2)

Selects the frequency value supervised by parameter ID315. See **Figure 8-16.**

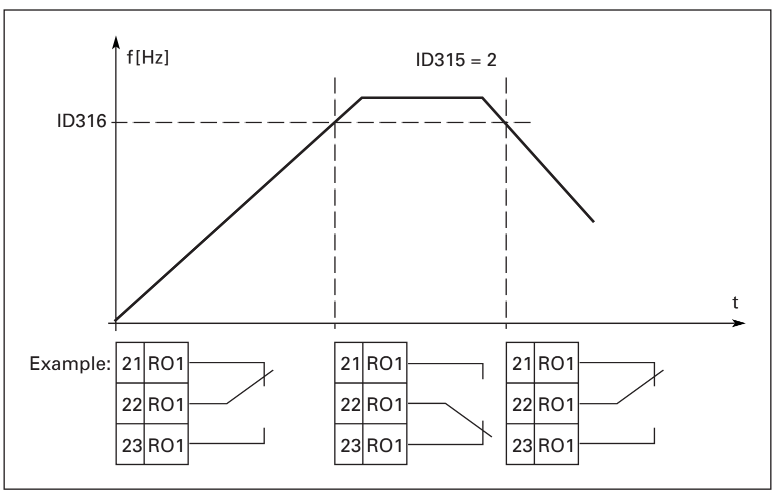


Figure 8-16: Output Frequency Supervision

319 DIN2 function **5** (P1.2.1)

This parameter has 14 selections. If digital input DIN2 is not used, set this value to **0**.

0	Not used
1	External fault: Contact closed = Fault is displayed and the motor stopped when the input is active
2	External fault: Contact open = Fault is displayed and the motor stopped when the input is not active
3	Run enable: Contact open = Start of motor disabled Contact closed = Start of motor enabled
4	Acceleration or deceleration time selection: Contact open = Acceleration/Deceleration time 1 selected Contact closed = Acceleration/Deceleration time 2 selected
5	Closing contact: Force control place to keypad
6	Not used
7	Closing contact: Force control place to I/O terminals When the control place is forced to change, the values of Start/Stop, Direction and the Reference valid in the respective control place, are used. **Note:** When DIN2 opens the control place is selected according to keypad control place selection.
8	Reverse: Contact open = Forward Contact closed = Reverse **Note:** If several inputs are programmed to reverse, one active contact is enough to set the direction to reverse.
9	Jog speed (see ID124) Contact closed = Jog speed selected for frequency reference
10	Fault reset Contact closed = All faults reset
11	Acceleration/Deceleration prohibited Contact closed = No acceleration or deceleration possible until the contact is opened
12	DC braking command: Contact closed = In Stop mode, the DC braking operates until the contact is opened. See **Figure 8-17**.
13	Motor potentiometer UP: Contact closed = Reference increases until the contact is opened.

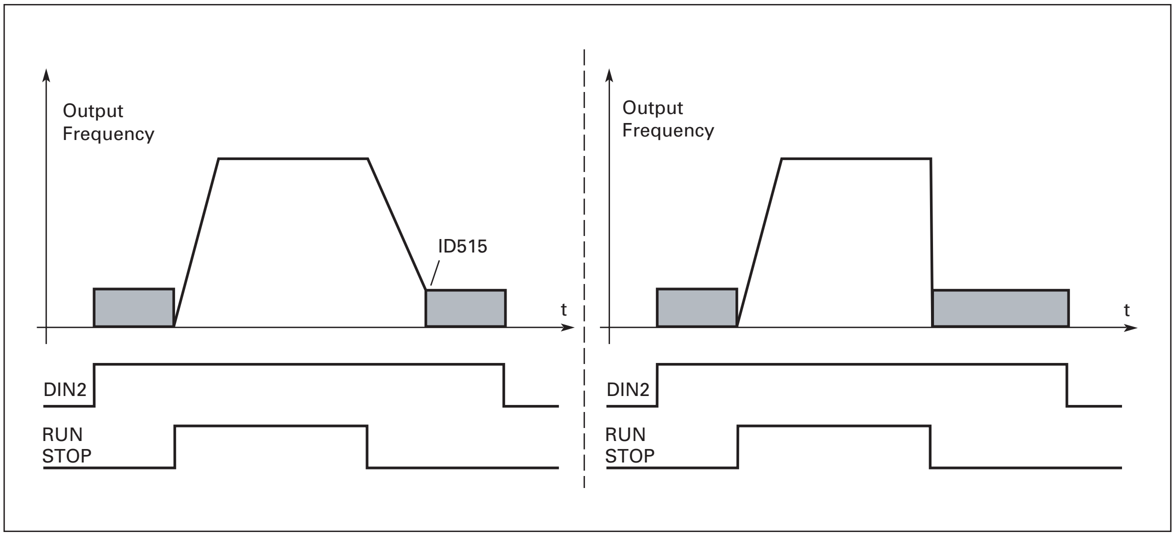


Figure 8-17: DC Braking Command (Selection 12) Selected for DIN2

320 AI1 signal range **34567** (P1.2.4, P1.2.13, P1.2.2.3)

Table 8-9: Selections for Parameter ID320

Application			
Select	**3, 4, 5**	**6**	**7**
0	0 – 100%	0 – 100%	0 – 100%
1	20 – 100%	20 – 100%	20 – 100%
2	Customized	-10 – +10V	Customized
3	—	Customized	—

For selection “Customized”, see ID321 and ID322.

321 AI1 custom setting minimum **34567** (P1.2.5, P1.2.14, P1.2.2.4)
322 AI1 custom setting maximum **34567** (P1.2.6, P1.2.15, P1.2.2.5)

These parameters set the analog input signal for any input signal span within 0 – 100% in Applications 3, 4 and 6 and within 0 – 160% in Applications 5 and 7.

323 AI1 signal inversion 3457 (P1.2.7, P1.2.16, P1.2.2.6)

If this parameter = **0** no inversion of analog V_{in} signal takes place.

Note: In Application 3, AI1 is place B frequency reference if parameter ID131 = 0 (default).

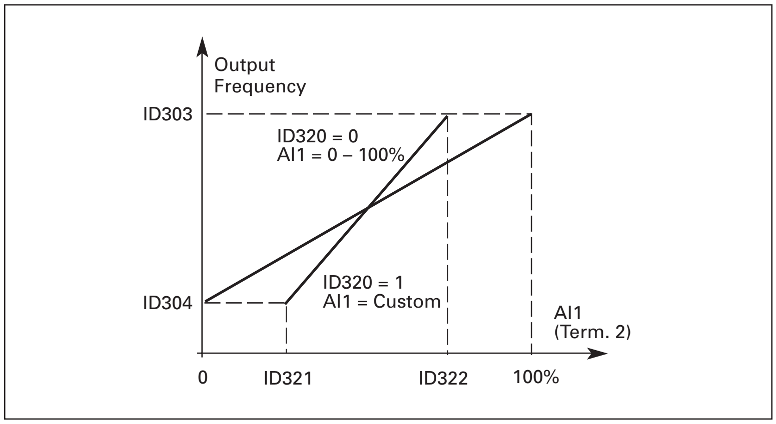


Figure 8-18: AI1 No Signal Inversion

If this parameter = **1** inversion of analog signal takes place.
max. AI1 signal = minimum set speed
min. AI1 signal = maximum set speed

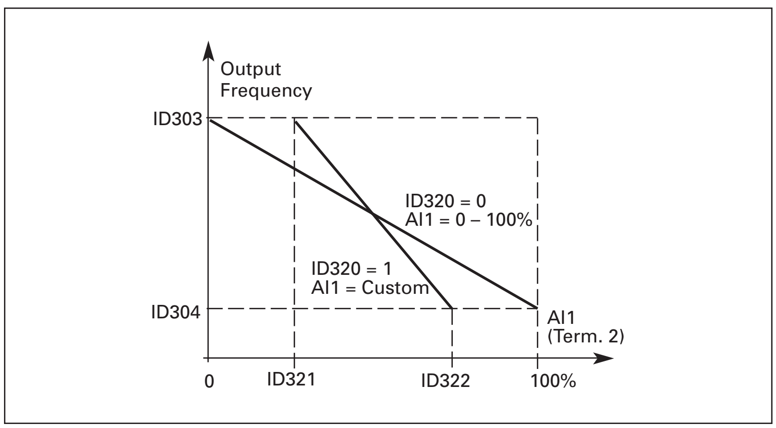


Figure 8-19: AI1 Signal Inversion

324 AI1 signal filter time 34567 (P1.2.8, P1.2.17, P1.2.2.2)

When this parameter is given a value greater than 0 the function that filters out disturbances from the incoming analog signal is activated.

A long filtering time makes the regulation response slower. See **Figure 8-20**.

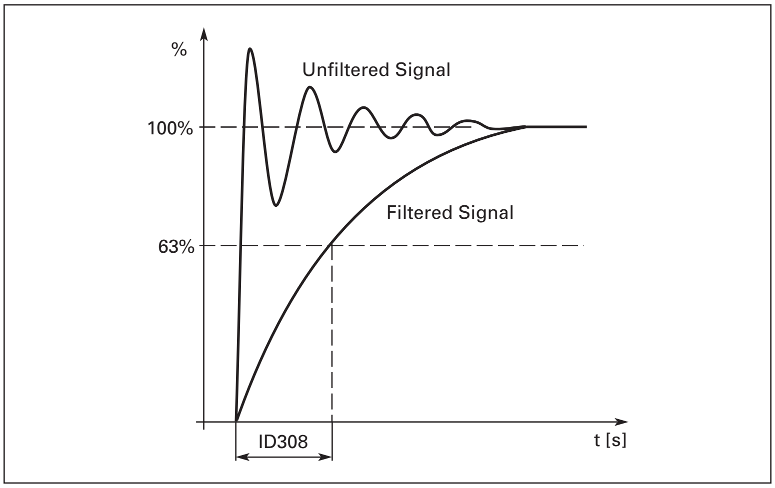


Figure 8-20: AI1 No Signal Filtering

325 Analog input AI2 signal range 34567 (P1.2.10, P1.2.19, P1.2.3.3)

Table 8-10: Selections for Parameter ID325

Application Select	3, 4	5	6	7
0	0 – 20 mA	0 – 20 mA	0 – 100%	0 – 100%
1	4 – 20 mA	4 mA/ 20…100%	20 – 100%	20 – 100%
2	Customized	Customized	-10 – +10V	Customized
3	—	—	Customized	—

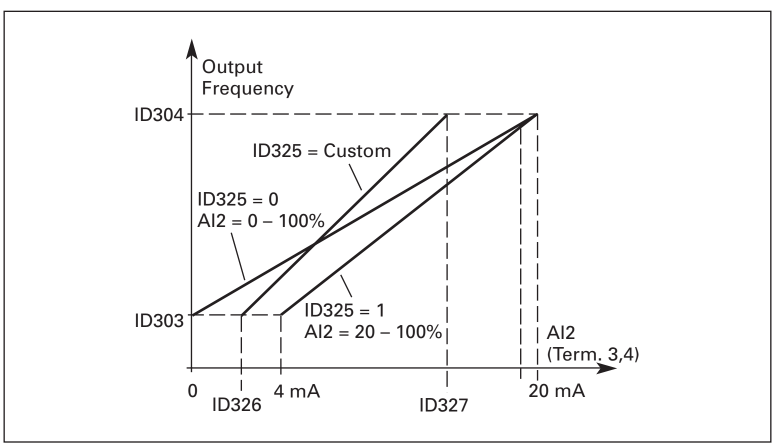


Figure 8-21: Analog Input AI2 Scaling

326 Analog input AI2 custom setting min. **34567** (P1.2.11, P1.2.20, P1.2.3.4)

327 Analog input AI2 custom setting max. **34567** (P1.2.12, P1.2.21, P1.2.3.5)

These parameters set AI2 for any input signal span within 0 – 100% in Applications 3, 4 and 6 and within 0 – 160% in Applications 5 and 7.

328 Analog input AI2 inversion **3457** (P1.2.13, P1.2.22, P1.2.3.6)

See ID323.

Note: In Application 3, AI2 is the place A frequency reference, if ID174 = 1 (default)

329 Analog input AI2 (I_{in}) filter time **34567** (P1.2.14, P1.2.23, P1.2.3.2)

See ID324.

330 DIN5 function **5** (P1.2.3)

The digital input DIN5 has 14 possible functions. If it is not used, set the value to **0.** The selections are the same as in parameter ID319 except:

13 Enable PID reference 2:
Contact open = PID controller reference selected with parameter ID332
Contact closed = PID controller keypad reference 2 selected

331 Motor potentiometer ramp time **3567** (P1.2.24, P1.2.22, P1.2.1.2, P1.2.1.12)

Defines the speed of change of the motor potentiometer value.

332 PID controller reference signal (Place A) **57** (P1.1.15)

Defines which frequency reference place is selected for the PID controller.

Table 8-11: Selections for Parameter ID332

Application		
Select	**5**	**7**
0	AI1; terminals 2 – 3	AI1; terminals 2 – 3
1	AI2; terminals 4 – 5	AI2; terminals 4 – 5
2	PID ref. from keypad	AI3
3	Fieldbus reference	AI4
4	Motor potentiometer reference	PID ref. from keypad
5	—	Fieldbus reference
6	—	Motor potentiometer reference

333 PID controller actual value selection **57** (P1.2.5, P1.2.1.5)

This parameter selects the PID controller actual value.

0 Actual value 1
1 Actual value 1 + Actual value 2
2 Actual value 1 – Actual value 2
3 Actual value 1 * Actual value 2
4 Greater one of Actual value 1 and Actual value 2
5 Smaller one of Actual value 1 and Actual value 2
6 Mean value of Actual value 1 and Actual value 2
7 Square root of Actual value 1 + Square root of Actual value 2

334 Actual value 1 selection **57** (P1.2.6, P1.2.1.6)
335 Actual value 2 selection **57** (P1.2.7, P1.2.1.7)

0 Not used
1 AI1 (control board)
2 AI2 (control board)
3 AI3
4 AI4
5 Fieldbus (*Actual value 1*: FBProcessDataIN2; *Actual value 2*: FBProcessDataIN3)

Application 5:

6 Motor torque
7 Motor speed
8 Motor current
9 Motor power
10 Actual speed from encoder (for Actual value 1 only)

336 Actual value 1 minimum scale **57** (P1.2.8, P1.2.1.8)

Sets the minimum scaling point for Actual value 1. See **Figure 8-22.**

337 Actual value 1 maximum scale **57** (P1.2.9, P1.2.1.9)

Sets the maximum scaling point for Actual value 1. See **Figure 8-22.**

338 Actual value 2 minimum scale **57** (P1.2.10, P1.2.1.10)

Sets the minimum scaling point for Actual value 2. See **Figure 8-22.**

339 Actual value 2 maximum scale **57** (P1.2.11, P1.2.1.11)

Sets the maximum scaling point for Actual value 2. See **Figure 8-22.**

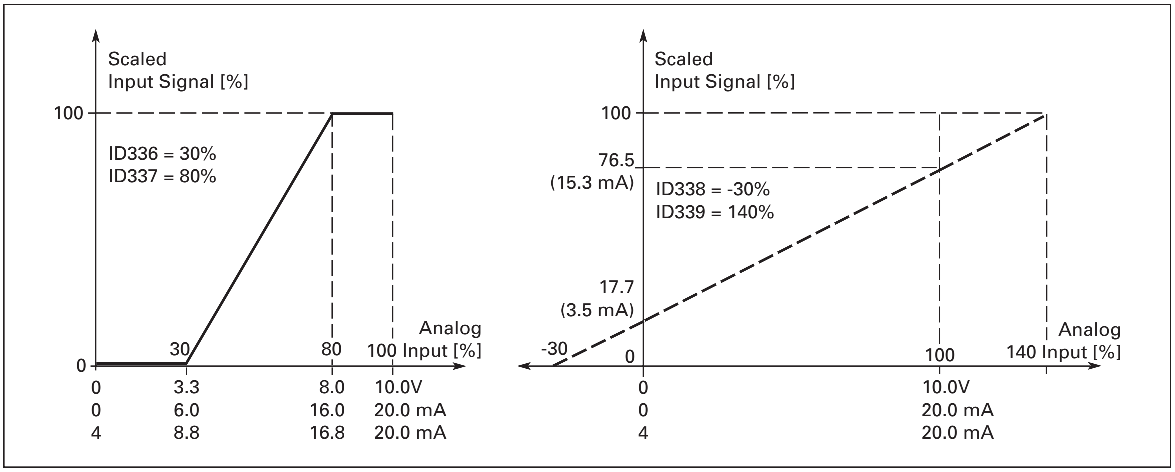


Figure 8-22: Examples of Actual Value Signal Scaling

340 PID error value inversion 57 (P1.2.29, P1.2.1.2)

This parameter allows you to invert the error value of the PID controller (and thus the operation of the PID controller).

0 No inversion

1 Inverted

341 PID reference rise time 57 (P1.2.30, P1.2.1.3)

Defines the time during which the PID controller reference rises from 0% to 100%.

342 PID reference fall time 57 (P1.2.31, P1.2.1.4)

Defines the time during which the PID controller reference falls from 100% to 0%.

344 Reference scaling minimum value, place B **57** (P1.2.32, P1.2.1.15)

345 Reference scaling maximum value, place B **57** (P1.2.33, P1.2.1.16)

You can choose a scaling range for the frequency reference from control place B between the Minimum and Maximum frequency.

If no scaling is desired set the parameter value to **0.0.**

In **Figure 8-23**, input AI1 with signal range 0 – 100% is selected for Place B reference.

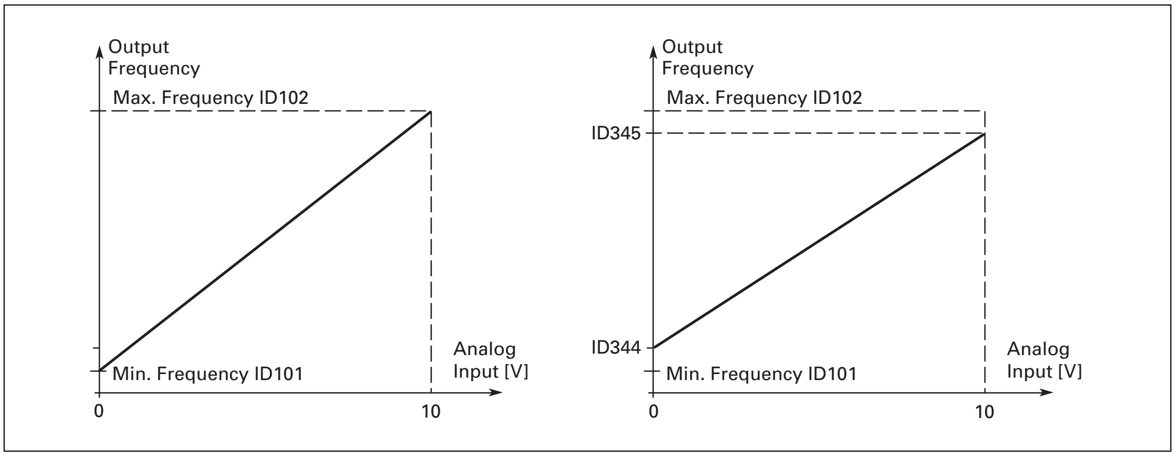


Figure 8-23: Control Place B with and without Reference Scaling
Left: ID344 = 0 (No reference scaling), Right: reference scaling

346 Output freq. limit 2 supervision function **34567** (P1.3.12, P1.3.4.3, P1.3.2.3)

0 No supervision
1 Low limit supervision
2 High limit supervision
3 Brake-on control (Application 6 only, see **Page A-1.**)
4 Brake-on/off control (Application 6 only, see **Page A-1.**)

If the output frequency goes under/over the set limit (ID347) this function generates a warning message via the digital output DO1 or relay outputs RO1 or RO2 depending on:

1) the settings of ID312 to ID314 (Applications 3, 4, 5) or …

2) to which output the supervision signals (ID447 and ID448) are connected (Applications 6 and 7).

347 Output frequency limit 2 supervision value **34567** (P1.3.13, P1.3.4.4, P1.3.2.4)

Selects the frequency value supervised by ID346. See **Figure 8-16.**

348 Torque limit, supervision function 34567 (P1.3.14, P1.3.4.5, P1.3.2.5)

0 No supervision
1 Low limit supervision
2 High limit supervision
3 Brake-on control (Application 6 only, see **Page A-1**.)

If the calculated torque value falls below or exceeds the set limit (ID349) this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on:

1) the settings of ID312 to ID314 (Applications 3, 4, 5) or …

2) to which output the supervision signal (ID451) is connected (Applications 6 and 7).

349 Torque limit, supervision value 34567 (P1.3.15, P1.3.4.6, P1.3.2.6)

Set here the torque value to be supervised by ID348.

Applications 3 and 4:

The torque supervision value can be reduced below the setpoint with the external free analog input signal, see ID361 and ID362.

350 Reference limit, supervision function 34567 (P1.3.16, P1.3.4.7, P1.3.2.7)

0 No supervision
1 Low limit supervision
2 High limit supervision

If the reference value falls below or exceeds the set limit (ID351), this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on:

1) the settings of ID312 to ID314 (Applications 3, 4, 5) or …

2) to which output the supervision signal (ID451) is connected (Applications 6 and 7).

The supervised reference is the current active reference. It can be the place A or B reference depending on DIN6 input, or the keypad reference if the keypad is the active control place.

351 Reference limit, supervision value 34567 (P1.3.17, P1.3.4.8, P1.3.2.8)

The frequency value to be supervised by ID350.

352 External brake-off delay 34567 (P1.3.18, P1.3.4.9, P1.3.2.9)

353 External brake-on delay 34567 (P1.3.19, P1.3.4.10, P1.3.2.10)

The function of the external brake can be timed to the start and stop control signals with these parameters. See **Figure 8-24** and **Page A-1**.

The brake control signal can be programmed via digital output DO1 or one of the relay outputs RO1 and RO2, see ID312 to ID314 (Applications 3, 4, 5) or ID445 (Applications 6 and 7).

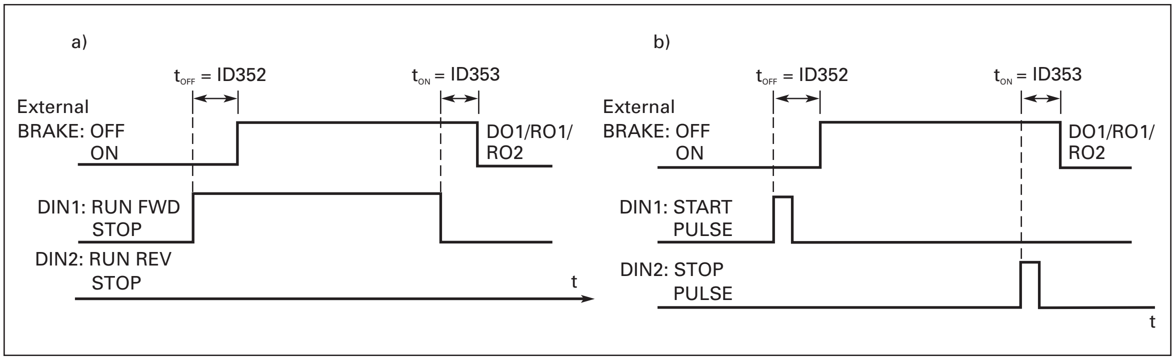


Figure 8-24: External Brake Control

a) Start/Stop Logic Selection, ID300 = 0, 1 or 2
b) Start/Stop Logic Selection, ID300 = 3

354 Frequency converter temperature limit supervision 34567 (P1.3.20, P1.3.4.11, P1.3.2.11)

0 No supervision
1 Low limit supervision
2 High limit supervision

If the temperature of the SVX9000 falls below or exceeds the set limit (ID355), this function generates a warning message via digital output DO1 or relay outputs RO1 or RO2 depending on:

1) the settings of ID312 to ID314 (Applications 3, 4, 5) or …

2) to which output the supervision signal (ID451) is connected (Applications 6 and 7).

355 Frequency converter temperature limit value 34567 (P1.3.21, P1.3.4.12, P1.3.2.12)

This temperature value is supervised by ID354.

356 On/Off control signal 6 (P1.3.4.13)

With this parameter, you can select the analog input to be monitored.

0 Not used
1 AI1
2 AI2
3 AI3

357 On/Off control low limit 6 (P1.3.4.14)

358 On/Off control high limit 6 (P1.3.4.15)

These parameters set the low and high limits of the signal selected with ID356. See **Figure 8-25.**

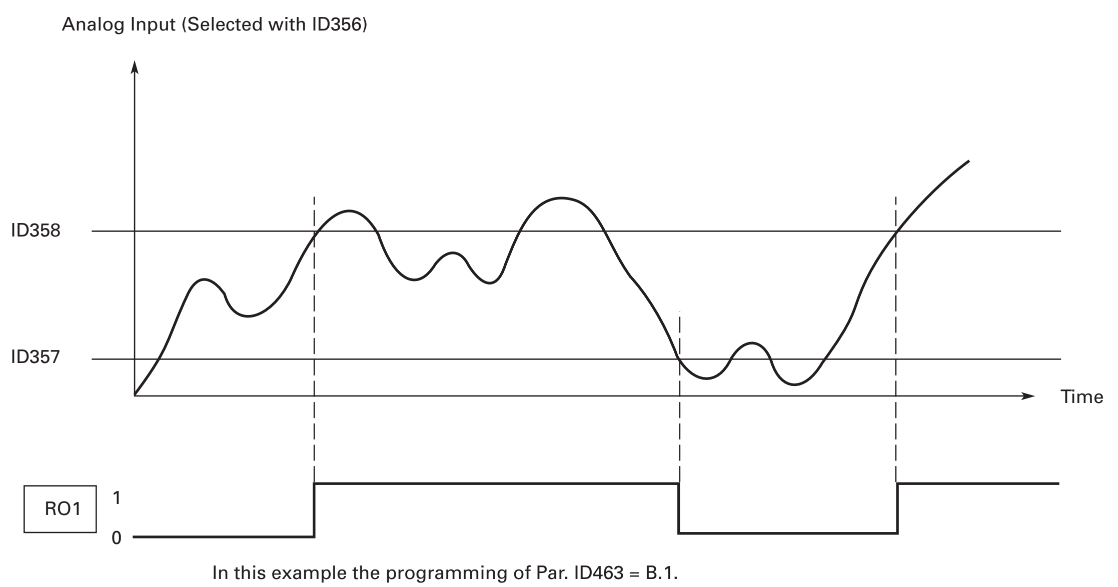


Figure 8-25: An Example of On/Off-Control

359 PID controller minimum limit 5 (P1.2.27)

360 PID controller maximum limit 5 (P1.2.28)

With these parameters, you can set the minimum and maximum limits for the PID controller output.

Limit setting: -1000.0% (of f_{Max}) < ID359 < ID360 < 1000.0% (of f_{Max}).

These limits are of importance for example when you define the gain, I-time and D-time for the PID controller.

361 Free analog input, signal selection 34 (P1.2.20, P1.2.17)

Selection of input signal for the free analog input (an input not used for a reference signal):

0 Not in use

1 Voltage signal V_{in}

2 Current signal I_{in}

362 Free analog input, function 34 (P1.2.21, P1.2.18)

This parameter is used for selecting a function for the free analog input signal:

0 Function is not in use

1 Reduces motor current limit (ID107)

This signal will adjust the maximum motor current between 0 and maximum limit set with ID107. See **Figure 8-26.**

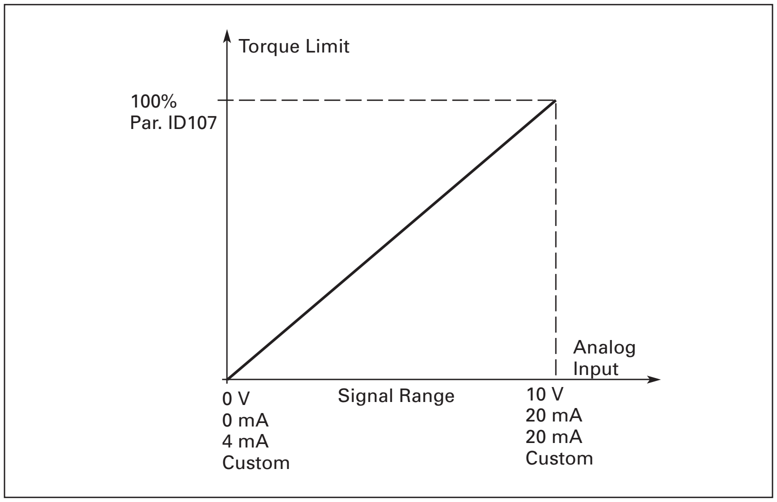


Figure 8-26: Scaling of Max. Motor Current

2 Reduces DC braking current

DC braking current can be reduced with the free analog input signal between current 0.4 x I_H and the current set with ID507. See **Figure 8-27.**

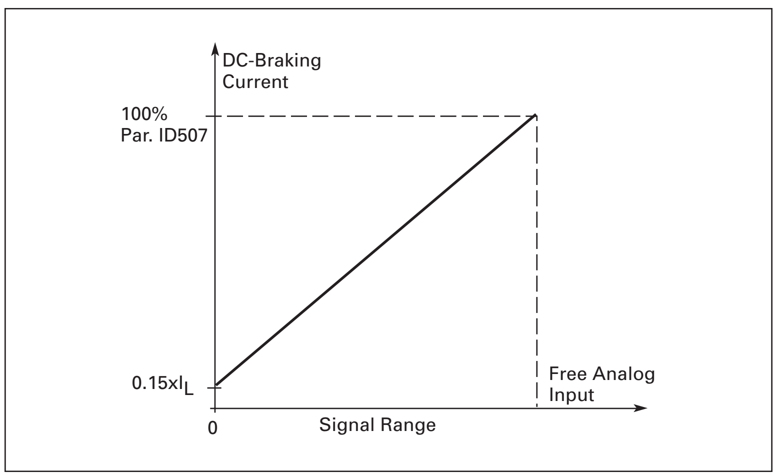


Figure 8-27: Reduction of DC Braking Current

3 Reduces acceleration and deceleration times

Acceleration and deceleration times can be reduced with the free analog input signal according to the following formulas:

Reduced time = set acc./decel. time (ID103, ID104; ID502, ID503) divided by the factor R in **Figure 8-28.**

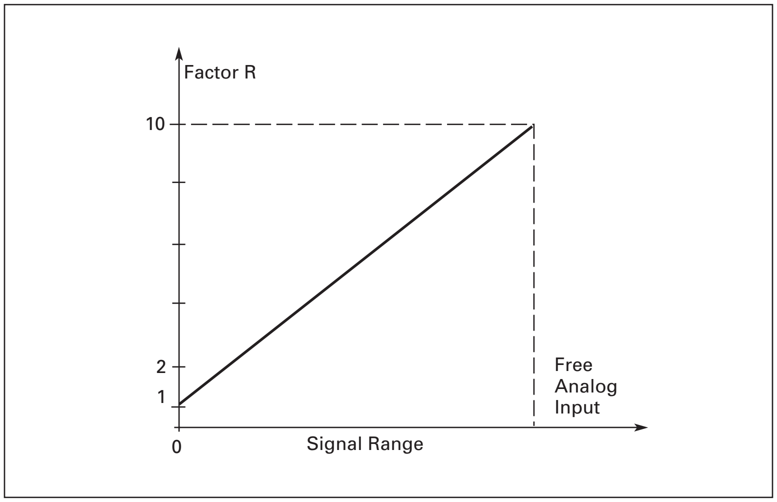


Figure 8-28: Reduction of Acceleration and Deceleration Times

4 Reduces torque supervision limit

Set supervision limit can be reduced with the free analog input signal between 0 and set supervision limit (ID349), see **Figure 8-29.**

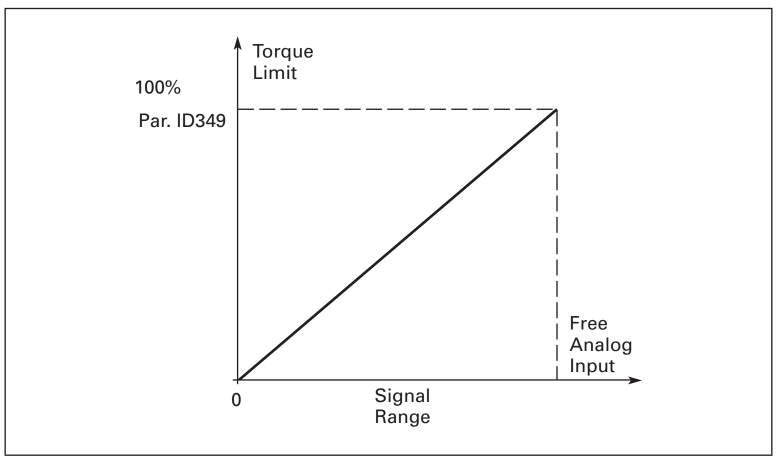


Figure 8-29: Reduction of Torque Supervision Limit

363 Start/Stop logic selection, place B **3** (P1.2.15)

0 DIN4: closed contact = start forward
DIN5: closed contact = start reverse

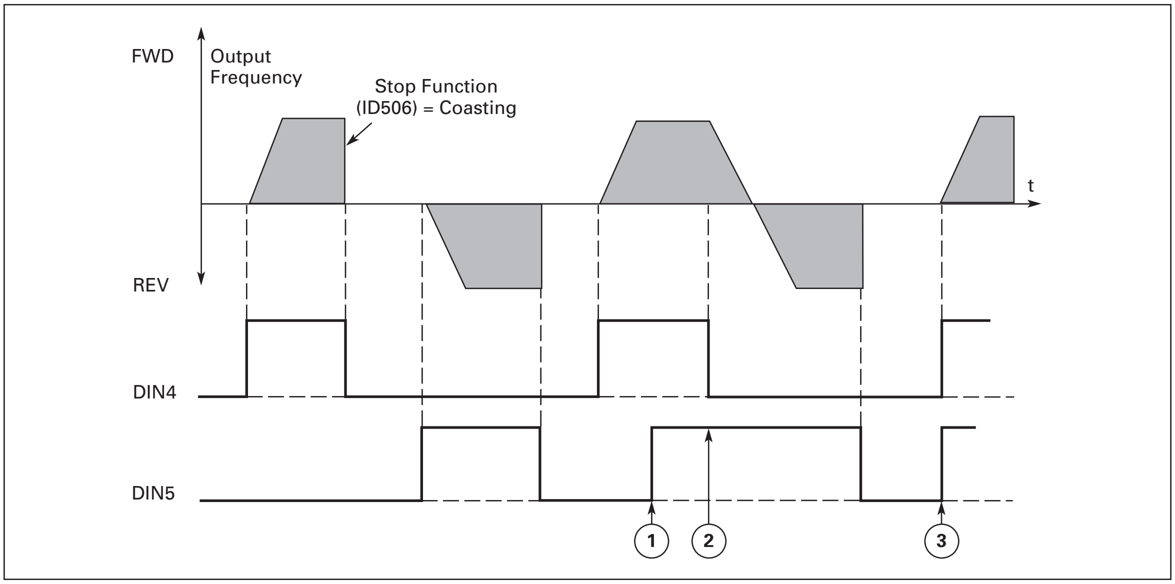


Figure 8-30: Place B Start Forward/Start Reverse

① The first selected direction has the highest priority.
② When the DIN4 contact opens the direction of rotation starts to change.
③ If Start forward (DIN4) and Start reverse (DIN5) signals are active simultaneously the Start forward signal (DIN4) has priority.

1 DIN4: closed contact = start — open contact = stop
DIN5: closed contact = reverse — open contact = forward

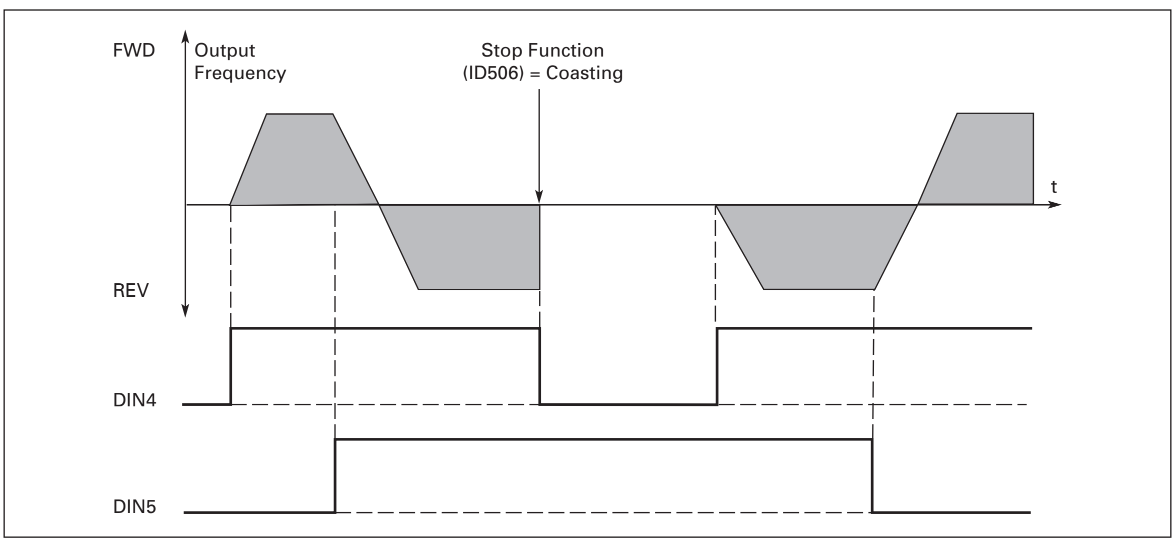


Figure 8-31: Place B Start, Stop, Reverse

2 DIN4: closed contact = start — open contact = stop
DIN5: closed contact = start enabled —
open contact = start disabled and drive stopped if running

3 3-wire connection (pulse control):
DIN4: closed contact = start pulse
DIN5: open contact = stop pulse
(DIN3 can be programmed for reverse command) See **Figure 8-32.**

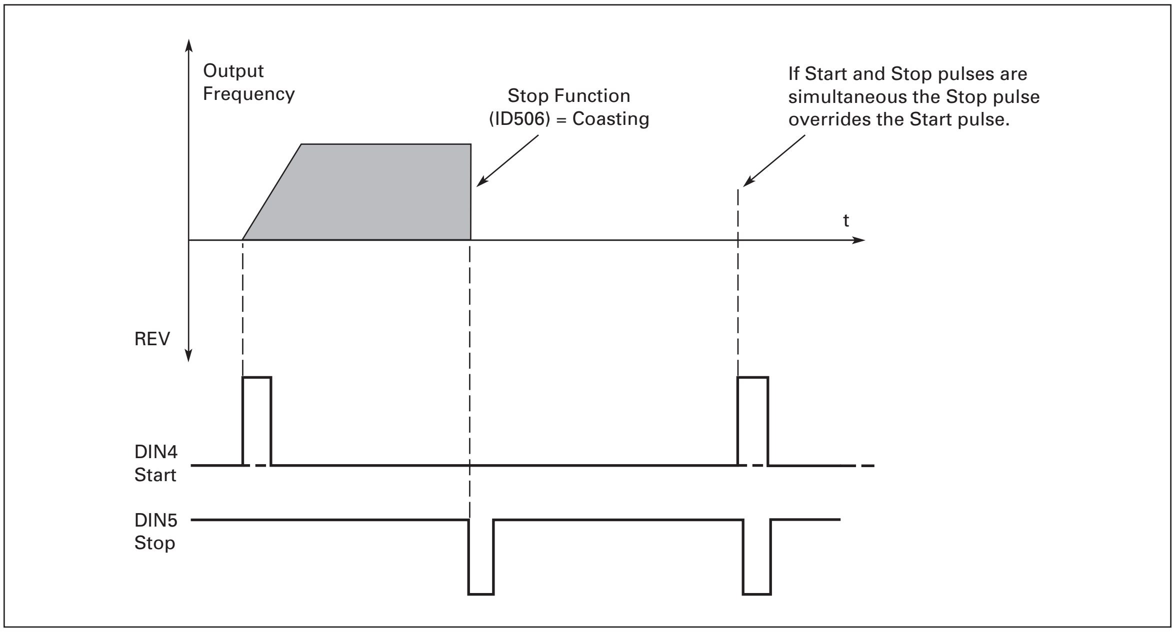


Figure 8-32: Place B Start Pulse/Stop Pulse

Selections **4** to **6** are used to exclude the possibility of an unintentional start when, for example, power is connected, re-connected after a power failure, after a fault reset, after the SVX9000 is stopped by Run Enable (Run Enable = False) or when the control place is changed. The Start/Stop contact must be opened before the motor can be started.

4 DIN4: closed contact = start forward **(Rising edge required to start)**
DIN5: closed contact = start reverse **(Rising edge required to start)**

5 DIN4: closed contact = start **(Rising edge required to start)** —
open contact = stop
DIN5: closed contact = reverse — open contact = forward

6 DIN4: closed contact = start **(Rising edge required to start)** —
open contact = stop
DIN5: closed contact = start enabled —
open contact = start disabled and drive stopped if running

364 Reference scaling, minimum value, place B 3 (P1.2.18)

365 Reference scaling, maximum value, place B 3 (P1.2.19)

See parameters ID303 and ID304 above.

367 Motor potentiometer memory reset (Frequency reference) **3567** (P1.2.23, P1.2.25, P1.2.1.3, P1.2.1.13)

0 No reset
1 Memory reset in stop and power down
2 Memory reset in power down

370 Motor potentiometer memory reset (PID reference) **57** (P1.2.26, P1.2.1.14)

0 No reset
1 Memory reset in stop and power down
2 Memory reset in power down

371 PID reference 2 (Place A additional reference) **7** (P1.2.1.1)

If the *PID reference 2 enable* input function ID330 = TRUE, this parameter defines which reference place is selected as PID controller reference.

0 AI1 reference (terminals 2 and 3, e.g. potentiometer)
1 AI2 reference (terminals 5 and 6, e.g. transducer)
2 AI3 reference
3 AI4 reference
4 PID reference 1 from keypad
5 Reference from Fieldbus (FBProcessDataIN3)
6 Motor potentiometer
7 PID reference 2 from keypad

If value **6** is selected for this parameter, the functions *Motor potentiometer DOWN* and *Motor potentiometer UP* must be connected to digital inputs (ID417 and ID418).

372 Supervised analog input **7** (P1.3.2.13)

0 Analog reference from AI1 (terminals 2 and 3, e.g. potentiometer)
1 Analog reference from AI2 (terminals 4 and 5, e.g. transducer)

373 Analog input limit supervision **7** (P1.3.2.14)

If the value of the selected analog input goes under/over the set limit (ID374), this function generates a warning message through the digital output or a relay output depending on to which output the supervision function (ID463) is connected.

0 No supervision
1 Low limit supervision
2 High limit supervision

374 Analog input supervised value **7** (P1.3.2.15)

The value of the selected analog input to be supervised by ID373.

375 Analog output offset **67** (P1.3.5.7, 1.3.3.7)

Add -100.0 to 100.0% to the analog output.

376 PID sum point reference (Place A direct reference) **5** (P1.2.4)

Defines which reference source is added to PID controller output if PID controller is used.

0	No additional reference (Direct PID output value)
1	PID output + AI1 reference from terminals 2 and 3 (e.g. potentiometer)
2	PID output + AI2 reference from terminals 4 and 5 (e.g. transducer)
3	PID output + AI3 reference
4	PID output + AI4 reference
5	PID output + PID keypad reference
6	PID output + Fieldbus reference (FBSpeedReference)
7	PID output + Motor potentiometer reference

If value **7** is selected for this parameter, the values of ID319 and ID301 are automatically set to 13. See **Figure 8-33.**

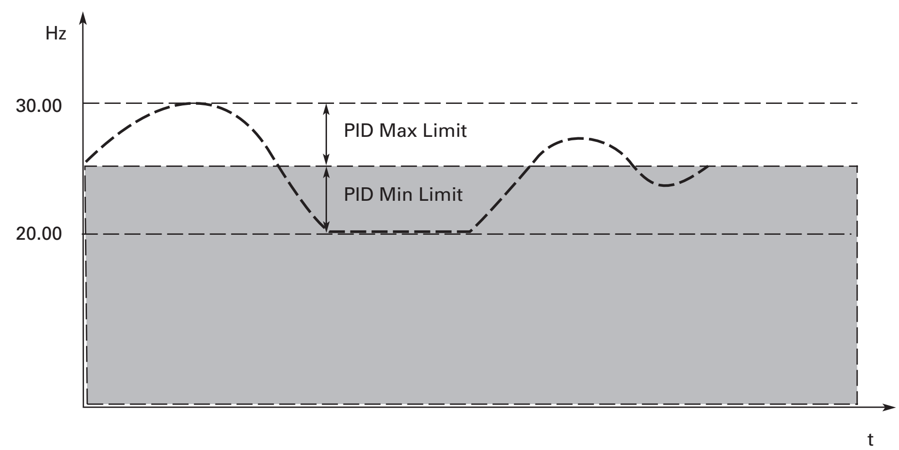


Figure 8-33: PID Sum Point Reference

Note: The maximum and minimum limits illustrated in the picture limit only the PID output, no other outputs are affected.

377 ② **AI1 signal selection** **234567** (P1.2.8, P1.2.3, P1.2.12, P1.2.2.1)

Connect the AI1 signal to the analog input of your choice with this parameter. For more information about the TTF programming method, see **Page 6-3**.

384 AI1 joystick hysteresis 6 (P1.2.2.8)

This parameter defines the joystick hysteresis between 0 and 20%. When the joystick or potentiometer control is turned from reverse to forward, the output frequency falls linearly to the selected minimum frequency (joystick/potentiometer in middle position) and stays there until the joystick/potentiometer is turned towards the forward command. How much the joystick/potentiometer must be turned to start the increase of the frequency towards the selected maximum frequency, is dependent on the amount of joystick hysteresis defined with this parameter.

If the value of this parameter is 0, the frequency starts to increase linearly immediately when the joystick/potentiometer is turned towards the forward command from the middle position. When the control is changed from forward to reverse, the frequency follows the same pattern the other way round. See **Figure 8-34**.

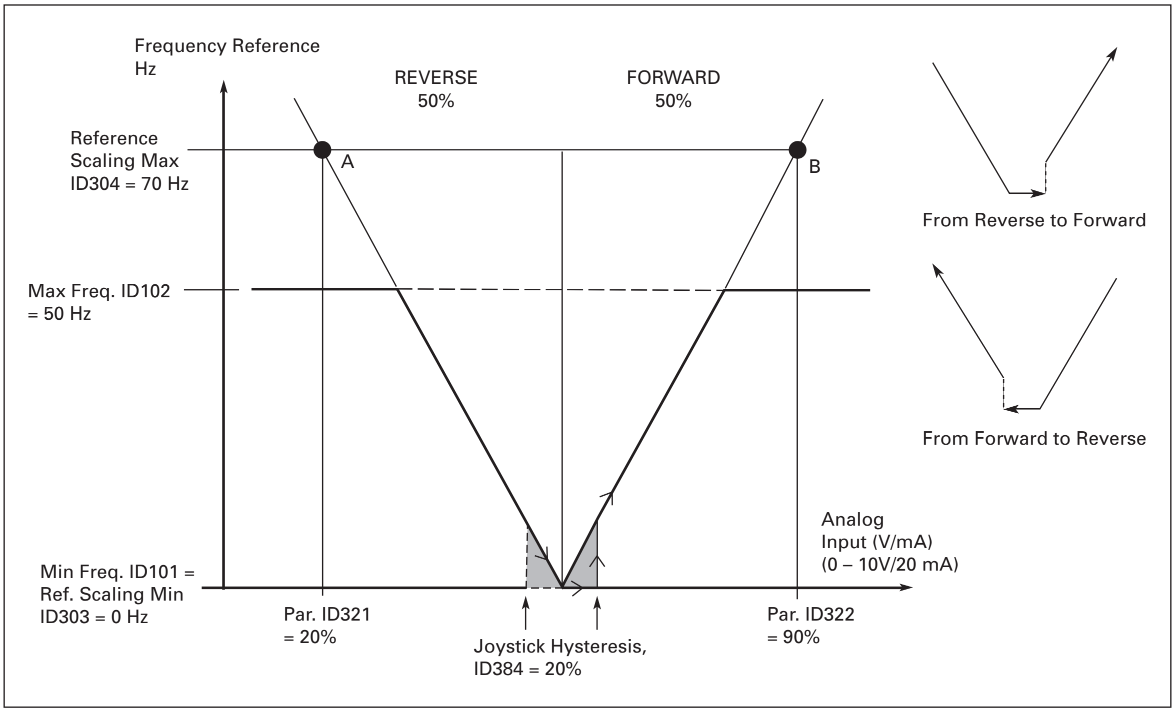


Figure 8-34: An Example of Joystick Hysteresis

In this example, the value of ID385 (Sleep limit) = 0

385 AI1 sleep limit 6 (P1.2.2.9)

The SVX9000 is automatically stopped if the AI signal level falls below the Sleep limit defined with this parameter. See **Figure 8-35**.

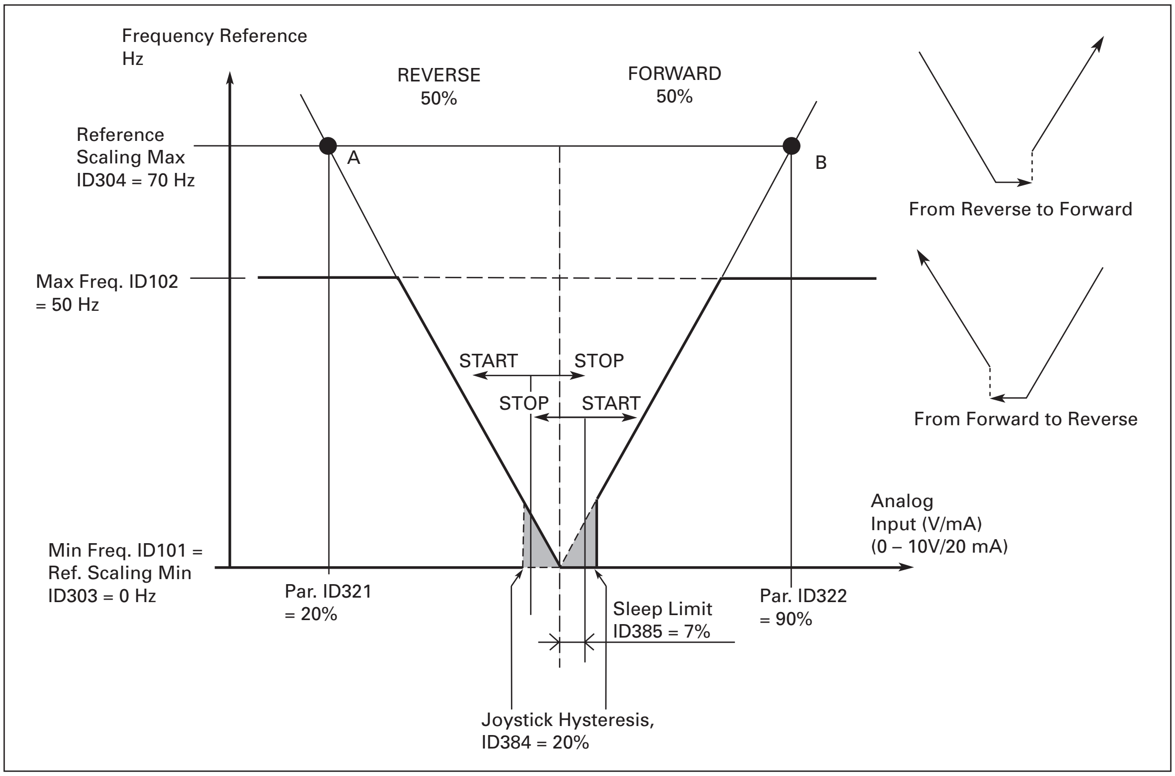


Figure 8-35: Example of Sleep Limit Function

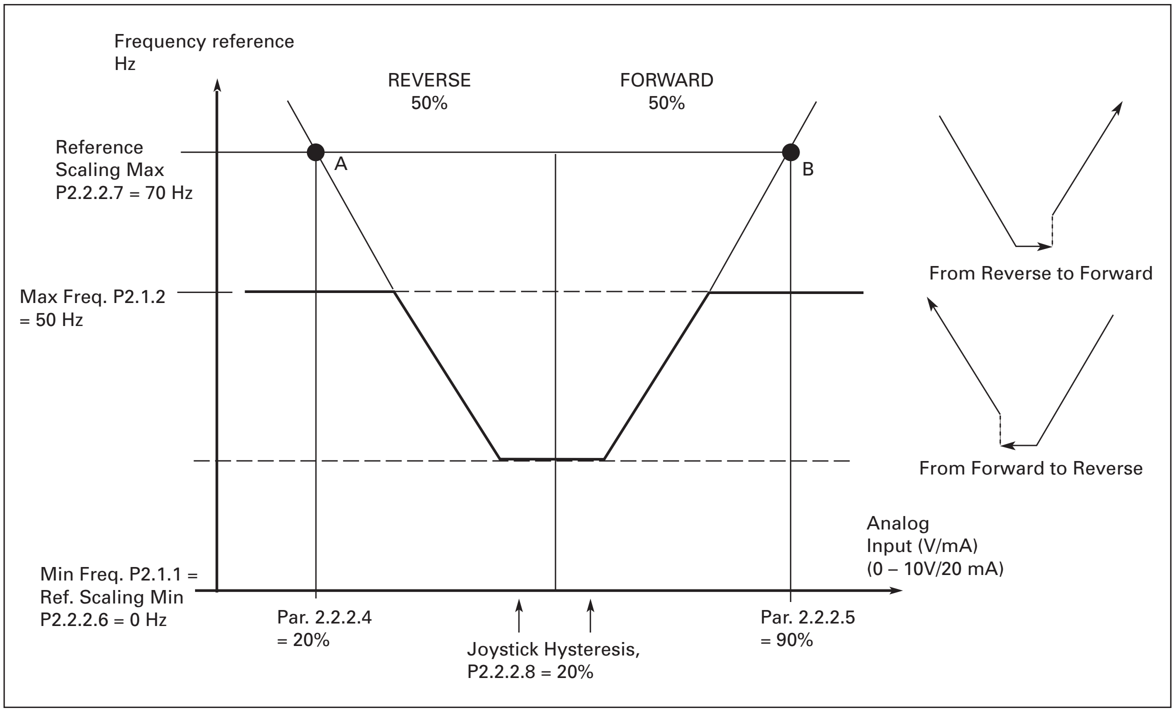


Figure 8-36: Joystick Hysteresis with Minimum Frequency at 35 Hz

386 AI1 sleep delay **6** (P1.2.2.10)

This parameter defines the time the analog input signal has to stay under the Sleep limit determined with parameter ID385 in order to stop the SVX9000.

388 ② **AI2 signal selection** **234567** (P1.2.9, P1.2.18, P1.2.3.1)

Connect the AI2 signal to the analog input of your choice with this parameter. For more information about the TTF programming method, see **Page 6-3**.

393	**AI2 reference scaling, minimum value**	**6**	(P1.2.3.6)
394	**AI2 reference scaling, maximum value**	**6**	(P1.2.3.7)

See ID303 and ID304.

395	**AI2 joystick hysteresis**	**6**	(P1.2.3.8)

See ID384.

396	**AI2 sleep limit**	**6**	(P1.2.3.9)

See ID385.

397	**AI2 sleep delay**	**6**	(P1.2.3.10)

See ID386.

399	**Scaling of current limit**	**6**	(P1.2.6.1)

0	Not used
1	AI1
2	AI2
3	AI3
4	AI4
5	Fieldbus (FBProcessDataIN2)

This signal will adjust the maximum motor current between 0 and max. limit set with ID107.

400	**Scaling of DC-braking current**	**6**	(P1.2.6.2)

See ID399 for the selections.

DC-braking current can be reduced with the free analog input signal between current 0.4 x I_H and the current set with parameter ID507. See **Figure 8-37.**

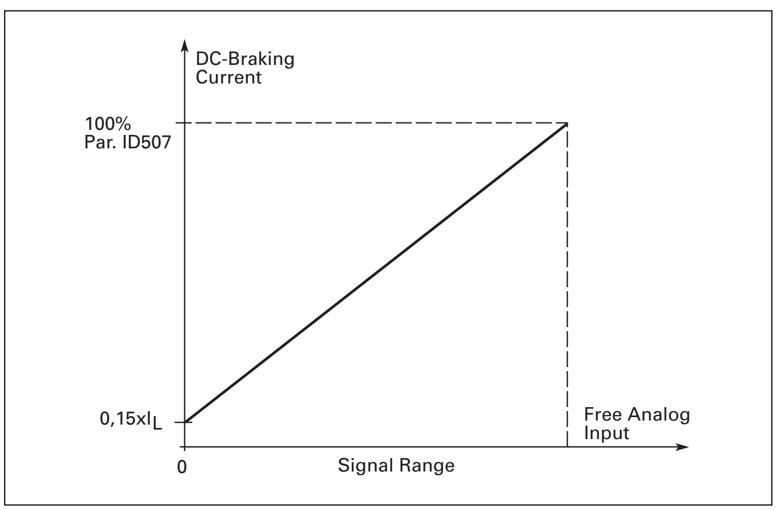


Figure 8-37: Scaling of DC-Braking Current

401 Reducing of acceleration and deceleration times **6** (P1.2.6.3)

See ID399.

Acceleration and deceleration times can be reduced with the free analog input signal according to the following formulas:

Reduced time = set acc./deceler. time (par. ID103, 104; ID502, ID503) divided by the factor R from **Figure 8-38.**

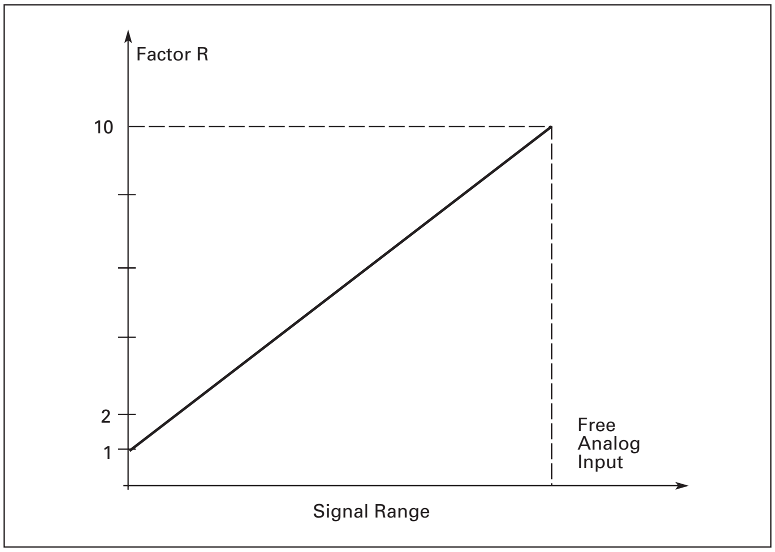


Figure 8-38: Reducing Acceleration and Deceleration Times

402 Reducing of torque supervision limit **6** (P1.2.6.4)

See ID399.

The set torque supervision limit can be reduced with the free analog input signal between 0 and the set supervision limit, ID349. See **Figure 8-39.**

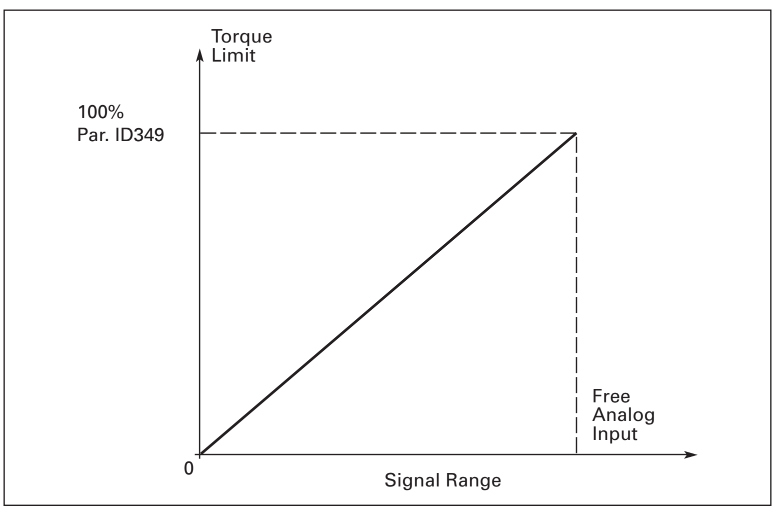


Figure 8-39: Reducing Torque Supervision Limit

403 ② **Start signal 1** **6** (P1.2.7.1)

Signal selection 1 for the start/stop logic.
Default programming A.1.

404 ② **Start signal 2** **6** (P1.2.7.2)

Signal selection 2 for the start/stop logic.
Default programming A.2.

405 ② **External fault (close)** **67** (P1.2.7.11, P1.2.6.4)

Contact closed: Fault is displayed and motor stopped

406 ② **External fault (open)** **67** (P1.2.7.12, P1.2.6.5)

Contact open: Fault is displayed and motor stopped

407 ② **Run enable** **67** (P1.2.7.3, P1.2.6.6)

Contact open: Start of motor disabled
Contact closed: Start of motor enabled

408 ② **Acceleration/Deceleration time selection** **67** (P1.2.7.13, P1.2.6.7)

Contact open: Acceleration/Deceleration time 1 selected
Contact closed: Acceleration/Deceleration time 2 selected
Set Acceleration/Deceleration times with parameters ID103 and ID104.

409 ② **Control from I/O terminal** **67** (P1.2.6.9)

Contact closed: Force control place to I/O terminal

410 ② **Control from keypad** **67** (P1.2.7.18, P1.2.6.8)

Contact closed: Force control place to keypad

412 ② **Reverse** **67** (P1.2.7.4, P.2.6.10)

Contact open: Direction forward
Contact closed: Direction reverse

413 ② **Jog speed** **67** (P1.2.7.16, P1.2.6.11)

Contact closed: Jog speed selected for frequency reference
See parameter ID124.
Default programming: A.4.

414 ② **Fault reset** **67** (P1.2.7.10, P1.2.6.12)

Contact closed: All faults are reset.

415 ② **Acceleration/Deceleration prohibited** **67** (P1.2.7.14, P1.2.6.13)

Contact closed: No acceleration or deceleration possible until the contact is opened.

416 ② **DC-braking** **67** (P1.2.7.15, P1.2.6.14)

Contact closed: In STOP mode, the DC braking operates until the contact is opened.

417 ② **Motor potentiometer DOWN** **67** (P1.2.7.8, P1.2.6.15)

Contact closed: Motor potentiometer reference DECREASES until the contact is opened.

418 ② **Motor potentiometer UP** **67** (P1.2.7.9, P1.2.6.16)

Contact closed: Motor potentiometer reference INCREASES until the contact is opened.

419 ② **Preset speed 1** **6** (P1.2.7.5)
420 ② **Preset speed 2** **6** (P1.2.7.6)
421 ② **Preset speed 3** **6** (P1.2.7.7)

Parameter values are automatically limited between the minimum and maximum frequencies (ID101 and ID102).

422 ② **AI1/AI2 selection** **6** (P1.2.7.17)

This parameter is used to select either AI1 or AI2 signal as the frequency reference.

423 ② **Start A signal** **7** (P1.2.6.1)

Start command from control place A.
Default programming: A.1

424 ② **Start B signal** **7** (P1.2.6.2)

Start command from control place B.
Default programming: A.4

425 ② **Control place A/B selection** **7** (P1.2.6.3)

Contact open: Control place A
Contact closed: Control place B
Default programming: A.6

426 ② **Autochange 1 interlock** **7** (P1.2.6.17)

Contact closed: Interlock of autochange drive 1 or auxiliary drive 1 activated.
Default programming: A.2.

427 ② **Autochange 2 interlock** **7** (P1.2.6.18)

Contact closed: Interlock of autochange drive 2 or auxiliary drive 2 activated.
Default programming: A.3.

428 ② **Autochange 3 interlock** **7** (P1.2.7.17)

Contact closed: Interlock of autochange drive 3 or auxiliary drive 3 activated.

429 ② **Autochange 4 interlock** **7** (P1.2.6.20)

Contact closed: Interlock of autochange drive 4 or auxiliary drive 4 activated.

430 ② **Autochange 5 interlock** **7** (P1.2.6.21)

Contact closed: Interlock of autochange drive 5 activated.

431 ② **PID reference 2** **7** (P1.2.6.22)

Contact open: PID controller reference selected with parameter ID332.
Contact closed: PID controller keypad reference 2 selected with par. ID371.

432 ② **Ready** **67** (P.3.3.1, P1.3.1.1)

The SVX9000 is ready to operate.

433 ② **Run** **67** (P1.3.3.2, P1.3.1.2)

The SVX900 is operating (the motor is running).

434 ② **Fault** **67** (P1.3.3.3, P1.3.1.3)

A fault trip has occurred.
Default programming: A.1 for Application 7 and B.2 for Application 6.

435 ② **Inverted fault** **67** (P1.3.3.4, P1.3.1.4)

No fault trip has occurred.

436 ② **Warning** **67** (P1.3.3.5, P1.3.1.5)

General warning signal.

437 ② **External fault or warning** **67** (P1.3.3.6, P1.3.1.6)

Fault or warning depending on par. ID701.

438 ② **Reference fault or warning** **67** (P1.3.3.7, P1.3.1.7)

Fault or warning depending on parameter ID700.

439 ② **Overtemperature warning** **67** (P1.3.3.8, P1.3.1.8)

The heatsink temperature exceeds +70°C.

440 ② **Reverse** **67** (P1.3.3.9, P1.3.1.9)

The Reverse command has been selected.

441 ② **Unrequested direction** **67** (P1.3.3.10, P1.3.1.10)

Motor rotation direction is different from the requested one.

442 ② **At speed** **67** (P1.3.3.11, P1.3.1.11)

The output frequency has reached the set reference.

443 ② **Jog speed** **67** (P1.3.3.12, P1.3.1.12)

Jog speed selected.

444 ② **External control place** **67** (P1.3.3.13, P1.3.1.13)

Control from I/O terminal is selected.

445 ② **External brake control** **67** (P1.3.3.14, P1.3.1.14)

External brake ON/OFF control with programmable delay.

446 ② **External brake control, inverted** **67** (P1.3.3.15, P1.3.1.15)

External brake ON/OFF control; Output active when brake control is OFF.

447 ② **Output frequency limit 1 supervision** **67** (P1.3.3.16, P1.3.1.16)

The output frequency is outside the set supervision low limit/high limit (see ID315 and ID316)

448 ② **Output frequency limit 2 supervision** **67** (P1.3.3.17, P1.3.1.17)

The output frequency is outside the set supervision low limit/high limit (see ID346 and ID347)

449 ② **Reference limit supervision** **67** (P1.3.3.18, P1.3.1.18)

Active reference is beyond the set supervision low limit/high limit (see ID350 and ID351).

450 ② **Temperature limit supervision** **67** (P1.3.3.19, P1.3.1.19)

The SVX9000 heatsink temperature is beyond the set supervision limits (see ID354 and ID355).

451 ② **Torque limit supervision** **67** (P1.3.3.20, P1.3.1.20)

The motor torque is beyond the set supervision limits (see parameters ID348 and ID349).

452 ② **Motor thermal protection** **67** (P1.3.3.21, P1.3.1.21)

Motor thermistor initiates an overtemperature signal which can be tied to a digital output.

Note: This parameter will not work unless you have an OPTA3 or OPTB2 (thermistor relay) option board connected.

454 ② **Motor regulator activation** **67** (P1.3.3.23, P1.3.1.23)

Overvoltage or overcurrent regulator has been activated.

455 ② **Fieldbus input data 1 (FBFixedControlWord, bit 3)** **67** (P1.3.3.24, P1.3.1.24)

456 ② **Fieldbus input data 2 (FBFixedControlWord, bit 4)** **67** (P1.3.3.25, P.3.1.25)

457 ② **Fieldbus input data 3 (FBFixedControlWord, bit 5)** **67** (P1.3.3.26, P1.3.1.26)

The data from the fieldbus (FBFixedControlWord) can be tied to digital outputs.

458 ② **Autochange 1/Auxiliary drive 1 control** **7** (P1.3.1.27)

Control signal for autochange/auxiliary drive 1.

Default programming: B.1

459 ② **Autochange 2/Auxiliary drive 2 control** **7** (P1.3.1.28)

Control signal for autochange/auxiliary drive 2.

Default programming: B.2

460 ② **Autochange 3/Auxiliary drive 3 control** **7** (P1.3.1.29)

Control signal for autochange/auxiliary drive 3. If three (or more) auxiliary drives are used, we recommend the use of a relay output to connect drive 3. Since the OPTA2 board only has two relay outputs it is advisable to purchase an I/O expander board with extra relay outputs (e.g. OPTB5).

461 ② **Autochange 4/Auxiliary drive 4 control** **7** (P1.3.1.30)

Control signal for autochange/auxiliary drive 4. If three (or more) auxiliary drives are used, we recommend the use of relay outputs to connect drives 3 and 4. Since the OPTA2 board only has two relay outputs it is advisable to purchase an I/O expander board with extra relay outputs (e.g. OPTB5).

462 ② **Autochange 5 control** **7** (P1.3.1.31)

Control signal for autochange drive 5.

463 ② **Analog input supervision limit** **67** (P1.3.3.22, P1.3.1.22)

The selected analog input signal is beyond the set supervision limits (see ID372, ID373 and ID374).

464 ② **Analog output 1 signal selection** **234567** (P1.3.1, P1.3.5.1, P1.3.3.1)

Connect the AO1 signal to the analog output of your choice with this parameter. For more information about the TTF programming method, see **Page 6-3**.

471 ② **Analog output 2 signal selection** **234567** (P1.3.12, P1.3.22, P1.3.6.1, P1.3.4.1)

Connect the AO2 signal to the analog output of your choice with this parameter. For more information about the TTF programming method, see **Page 6-3**.

472 **Analog output 2 function** **234567** (P1.3.13, P1.3.23, P1.3.6.2, P1.3.4.2)
473 **Analog output 2 filter time** **234567** (P1.3.14, P1.3.24, P1.3.6.3, P1.3.4.3)
474 **Analog output 2 inversion** **234567** (P1.3.15, P1.3.25, P1.3.6.4, P1.3.4.4)
475 **Analog output 2 minimum** **234567** (P1.3.16, P1.3.26, P1.3.6.5, P1.3.4.5)
476 **Analog output 2 scaling** **234567** (P1.3.17, P1.3.27, P1.3.6.6, P1.3.4.6)

For more information on these five parameters, see the corresponding parameters for the analog output 1, ID307 to ID311.

477 **Analog output 2 offset** **67** (P1.3.6.7, P1.3.4.7)

Add -100.0 to 100.0% to the analog output.

478 ② **Analog output 3, signal selection** **67** (P1.3.7.1, P1.3.5.1)

See ID464.

479 **Analog output 3, function** **67** (P1.3.7.2, P1.3.5.2)

See ID307.

480 **Analog output 3, filter time** **67** (P1.3.7.3, P1.3.5.3)

See ID308.

481 **Analog output 3 inversion** **67** (P1.3.7.4, P1.3.5.4)

See ID309.

482 **Analog output 3 minimum** **67** (P1.3.7.5, P1.3.5.5)

See ID310.

483 **Analog output 3 scaling** **67** (P1.3.7.6, P1.3.5.6)

See ID311.

484 Analog output 3 offset **67** (P1.3.7.7, P1.3.5.7)

See ID375.

485 Torque limit **6** (P1.2.6.5)

See ID399 for the selections.

486 ② **Digital output 1 signal selection 6** **6** (P1.3.1.1)

Connect the delayed DO1 signal to the digital output of your choice with this parameter. For more information about the TTF programming method, see **Page 6-3.**

487 Digital output 1 on-delay **6** (P1.3.1.3)
488 Digital output 1 off-delay **6** (P1.3.1.4)

With these parameters you can set on- and off-delays for digital outputs.

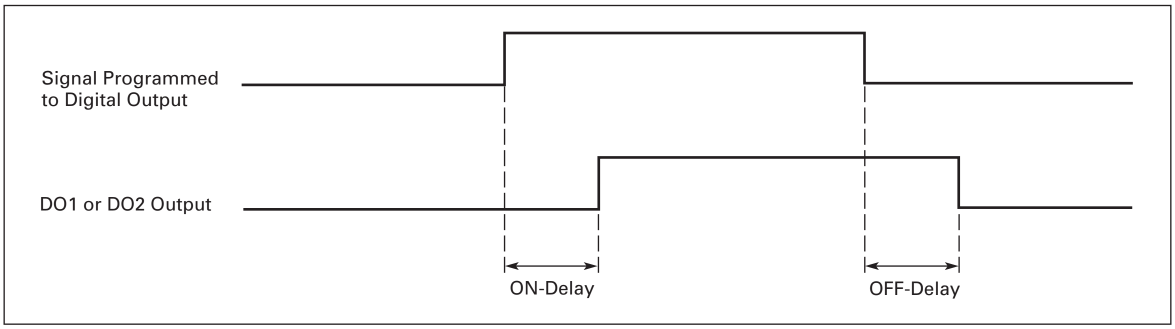


Figure 8-40: Digital Outputs 1 and 2, On- and Off-Delays

489 ② **Digital output 2 signal selection** **6** (P1.3.2.1)

See ID486.

490 Digital output 2 function **6** (P1.3.2.2)

See ID312.

491 Digital output 2 on-delay **6** (P1.3.2.3)

See ID487.

492 Digital output 2 off-delay **6** (P1.3.1.4)

See ID488.

493 Adjust input 6 (P1.2.1.4)

With this parameter you can select the signal, according to which the frequency reference to the motor is fine adjusted.

0 Not used
1 Analog input 1
2 Analog input 2
3 Analog input 3
4 Analog input 4
5 Signal from fieldbus (FBProcessDataIN)

494 Adjust minimum 6 (P1.2.1.5)
495 Adjust maximum 6 (P1.2.1.6)

These parameters define the minimum and maximum of adjusted signals. See **Figure 8-41.**

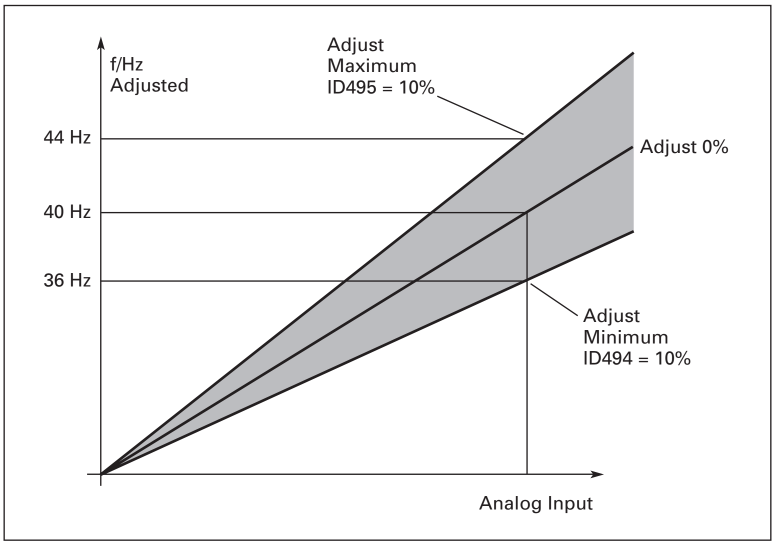


Figure 8-41: An Example of Adjust Input

496 ② **Parameter Set 1/Set 2 selection 6 (P1.2.7.20)**

With this parameter you can select between Parameter Set 1 and Set 2. The input for this function can be selected from any slot. The procedure of selecting between the sets is explained in the *SVX9000 User Manual*, Chapter 5, System Menu (S5.3).

Digital input = FALSE:
- The active set is saved to set 2
- Set 1 is loaded as the active set

Digital input = TRUE:
- The active set is saved to set 1
- Set 2 is loaded as the active set

Note: The parameter values can be changed in the active set only.

498 Start pulse memory 3 (P1.2.24)

Giving a value to this parameter determines if the present RUN status is copied when the control place is changed from A to B or vice versa.

0 The RUN status is not copied

1 The RUN status is copied

In order for this parameter to have effect, parameters ID300 and ID363 must have been set the value **3.**

500 Acceleration/Deceleration ramp 1 shape 234567 (P1.4.1)

501 Acceleration/Deceleration ramp 2 shape 234567 (P1.4.2)

The start and end of the acceleration and deceleration ramps can be smoothed with these parameters. Setting a value of **0.0** gives a linear ramp shape which causes acceleration and deceleration to react immediately to the changes in the reference signal.

Setting a value from 0.1 – 10 seconds for this parameter produces an S-shaped acceleration/deceleration. The acceleration time is determined with ID103 and ID104 (ID502 and ID503).

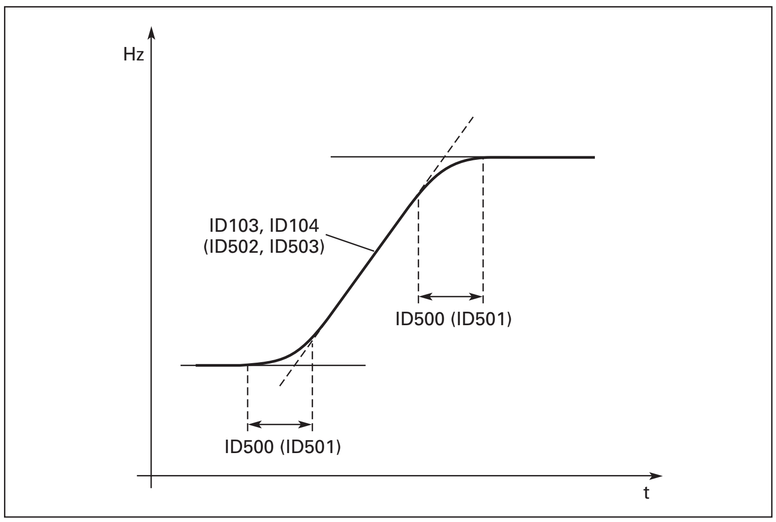


Figure 8-42: Acceleration/Deceleration (S-shaped)

502 Acceleration time 2 234567 (P1.4.3)

503 Deceleration time 2 234567 (P1.4.4)

These values correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (ID102). These parameters provide the possibility to set two different acceleration/deceleration time sets for one application. The active set can be selected with the programmable signal DIN3 (ID301).

504 Brake chopper **234567** (P1.4.5)

0 No brake chopper used

1 Brake chopper in use and tested when running. Can be tested also in READY state

2 External brake chopper (no testing)

3 Used and tested in READY state and when running

4 Used when running (no testing)

When the SVX9000 is decelerating the motor, the energy stored in the inertia of the motor and the load is fed into an external brake resistor. This enables the SVX9000 to decelerate the load with a torque equal to that of acceleration (provided that the correct brake resistor has been selected). See the separate Brake resistor installation Manual.

505 Start Function (P1.4.6)

Ramp:

0 The SVX9000 starts from 0 Hz and accelerates to the set reference frequency within the set acceleration time. (Load inertia or starting friction may cause prolonged acceleration times.)

Flying start:

1 The SV9000 is able to start into a running motor by applying a small torque to motor and searching for the frequency corresponding to the speed the motor is running at. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. Thereafter, the output frequency will be increased/decreased to the set reference value according to the set acceleration/deceleration parameters.

Use this mode if the motor is coasting when the start command is given. With the flying start it is possible to ride through short utility voltage interruptions.

506 Stop Function (P1.4.7)

Coasting:

0 The motor coasts to a halt without any control from the SVX9000, after the Stop command.

Ramp:

1 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

Normal stop: Ramp/ Run Enable stop: coasting

2 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. However, when Run Enable is selected, the motor coasts to a halt without any control from the SVX9000.

Normal stop: Coasting/ Run Enable stop: ramping

3 The motor coasts to a halt without any control from the SVX9000. However, when Run Enable signal is selected, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

507 DC-braking current 234567 (P1.4.8)

Defines the current injected into the motor during DC-braking.

508 DC-braking time at stop 234567 (P1.4.9)

Determines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping. The function of the DC-brake depends on the stop function, ID506.

0.0 DC-brake is not used

>0.0 DC-brake is in use and its function depends on the Stop function, (ID506). The DC-braking time is determined with this parameter.

Par. ID506 = 0; Stop function = Coasting:

After the stop command, the motor coasts to a stop without control of the SVX9000.

With DC-injection, the motor can be electrically stopped in the shortest possible time, without using an optional external braking resistor.

The braking time is scaled according to the frequency when the DC-braking starts. If the frequency is ≥ the nominal frequency of the motor, the set value of parameter ID508 determines the braking time. When the frequency is ≤10% of the nominal, the braking time is 10% of the set value of parameter ID508.

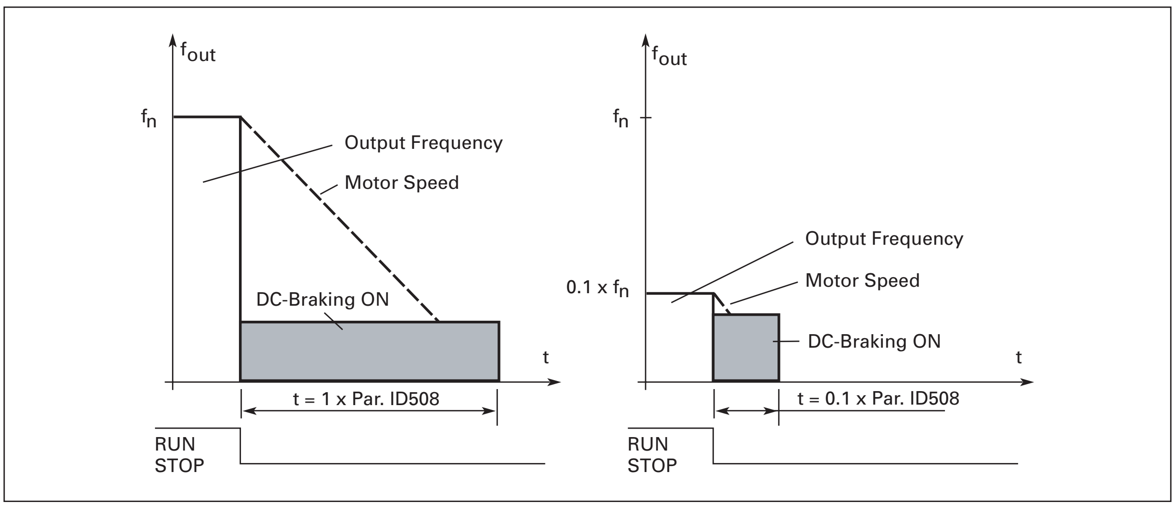


Figure 8-43: DC-Braking Time when Stop Mode = Coasting

Par. ID506 = 1; Stop function = Ramp:

After the Stop command, the speed of the motor is reduced according to the set deceleration parameters, as fast as possible, to the speed defined with parameter ID515, where the DC-braking starts.

The braking time is defined with parameter ID508. If high inertia exists, it is recommended to use an external braking resistor for faster deceleration. See **Figure 8-44.**

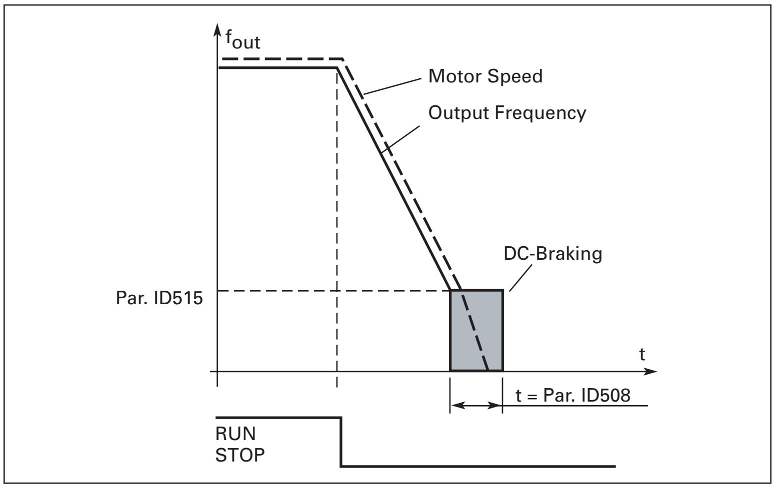


Figure 8-44: DC-Braking Time when Stop Mode = Ramp

509 Prohibit frequency area 1; Low limit **234567** (P1.5.1)

510 Prohibit frequency area 1; High limit **234567** (P1.5.2)

511 Prohibit frequency area 2; Low limit **34567** (P1.5.3)

512 Prohibit frequency area 2; High limit **34567** (P1.5.4)

513 Prohibit frequency area 3; Low limit **34567** (P1.5.5)

514 Prohibit frequency area 3; High limit **34567** (P1.5.6)

In some systems it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters limits are set for the “skip frequency” regions. See **Figure 8-45.**

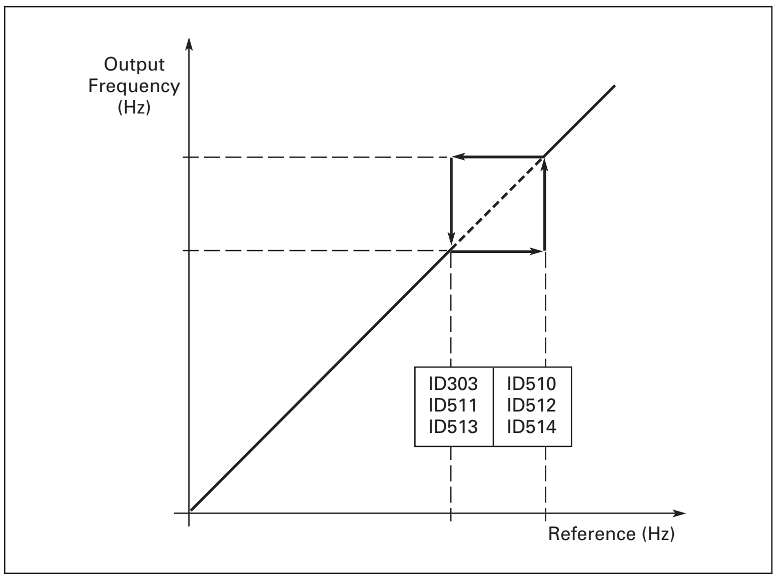


Figure 8-45: Example of Prohibit Frequency Area Setting

515 DC-braking frequency at stop **234567** (P1.4.10)

The output frequency at which the DC-braking is applied. See **Figure 8-45.**

516 DC-braking time at start **234567** (P1.4.11)

DC-brake is activated when the start command is given. This parameter defines the time before the brake is released. After the brake is released, the output frequency increases according to the set start function by parameter ID505.

518 Acceleration/deceleration ramp speed scaling ratio between prohibit frequency limits 234567 (P1.5.3, P1.5.7)

Defines the acceleration/deceleration time when the output frequency is between the selected prohibit frequency range limits (ID509 and ID510). The ramping speed (selected acceleration/deceleration time 1 or 2) is multiplied with this factor. E.g. value 0.1 makes the acceleration time 10 times shorter than outside the prohibit frequency range limits.

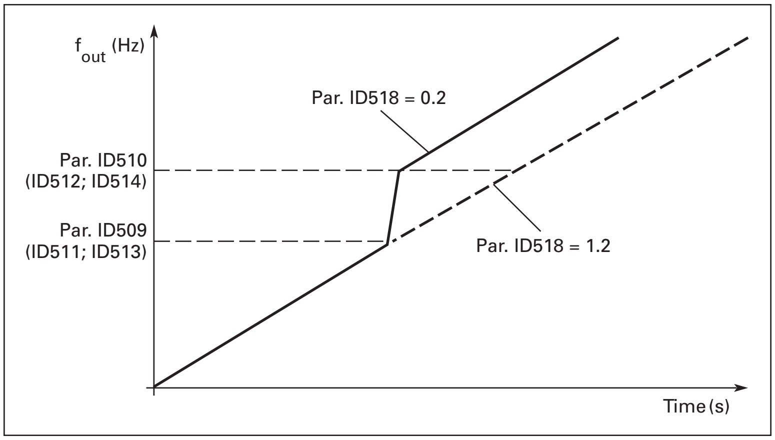


Figure 8-46: Ramp Speed Scaling between Prohibit Frequencies

519 Flux braking current 234567 (P1.4.13)

Defines the flux braking current value. This value can be set between $0.4*I_H$ and the Current limit.

520 Flux brake 234567 (P1.4.12)

Instead of DC braking, flux braking is a useful form of braking for motors ≤ 20 hp. When braking is needed, the frequency is reduced and the flux in the motor is increased, which in turn increases the motor’s capability to brake. Unlike DC braking, the motor speed remains controlled during braking.

The flux braking can be set ON or OFF.

0 Flux braking OFF

1 Flux braking ON

Note: Flux braking converts the energy into heat in the motor, and should be used intermittently to avoid motor damage.

521 Motor control mode 2 6 (P1.6.12)

With this parameter you can set another motor control mode. The mode which is used is determined by ID164.

For the available selections, see parameter ID600.

600 Motor control mode 234567 (P1.6.1)

0 Frequency control: The I/O terminal and keypad references are frequency references and the SVX9000 controls the output frequency (output frequency resolution = 0.01 Hz)

1 Speed control: The I/O terminal and keypad references are speed references and the SVX9000 controls the motor speed compensating for motor slip (accuracy ± 0.5%).

601 Switching frequency 234567 (P1.6.9)

Motor noise can be minimized using a high switching frequency. Increasing the switching frequency reduces the rating of the SVX9000. The range of switching frequencies is dependent upon the horsepower size of the SVX9000:

Table 8-12: Size-Dependent Switching Frequencies

Type	Min. [kHz]	Max. [kHz]	Default [kHz]
230V: 1 – 20 hp 480V: 1-1/2 – 40 hp	1.0	16.0	10.0
230V: 25 – 30 hp 480V: 50 – 250 hp	1.0	10.0	3.6

602 Field weakening point 234567 (P1.6.4)

The field weakening point is the output frequency at which the output voltage reaches the set (ID603) maximum value.

603 Voltage at field weakening point 234567 (P1.6.5)

Above the frequency at the field weakening point, the output voltage remains at the set maximum value. Below the frequency at the field weakening point, the output voltage depends on the setting of the V/Hz curve parameters. See ID109, ID108, ID604 and ID605.

When ID110 and ID111 (nominal voltage and nominal frequency of the motor) are set, ID602 and ID603 are automatically set to the corresponding values. If you need different values for the field weakening point and the maximum output voltage, change these parameters **after** setting ID110 and ID111.

604 V/Hz curve, middle point frequency 234567 (P1.6.6)

If the programmable V/Hz curve has been selected with ID108 this parameter defines the middle point frequency of the curve. See **Figure 8-2**.

605 V/Hz curve, middle point voltage **234567** (P1.6.7)

If the programmable V/Hz curve has been selected with the ID108 this parameter defines the middle point voltage of the curve. See **Figure 8-2**.

606 Output voltage at zero frequency **234567** (P1.6.8)

If the programmable V/Hz curve has been selected with the ID108 this parameter defines the zero frequency voltage of the curve. See **Figure 8-2**.

607 Overvoltage controller **234567** (P1.6.10)

This parameter (and ID608) allows the overvoltage (undervoltage) controller to be switched out of operation. This may be useful, for example, if the utility supply voltage varies more than -15% to +10% and the application will not tolerate the overvoltage (undervoltage). When on, this controller adjusts the output frequency based on the supply voltage fluctuations.

Note: An overvoltage trip may occur if the controller is switched off.

0 Controller switched off
1 Controller switched on (no ramping) = Minor adjustments of OP frequency are made
2 Controller switched on (with ramping) = Controller adjusts OP freq. up to max. freq.

608 Undervoltage controller **234567** (P1.6.11)

See ID607.

Note: An undervoltage trip may occur if the controller is switched off.

0 Controller switched off
1 Controller switched on

609 Torque limit **234567** (P1.10.1)

With this parameter you can set the torque limit control between 0.0 – 400.0%.

610 Torque limit control P-gain **6** (P1.10.2)

This parameter defines the gain of the torque limit controller.

611 Torque limit control I-gain **6** (P1.10.3)

This parameter determines the I-gain of the torque limit controller.

620 CL: Load drooping **234567** (P1.6.12, P1.6.15)

The drooping function enables speed drop as a function of load. This parameter sets that amount corresponding to the nominal torque of the motor.

631 Identification **234567** (P1.6.13, P1.6.16)

636 Minimum frequency for Open Loop torque control 6 (P1.10.8)

Defines the frequency limit below which the frequency converter operates in the frequency control mode.

Because of the nominal slip of the motor, the internal torque calculation is inaccurate at low speeds where is it recommended to use the frequency control mode.

637 Speed controller P gain, Open Loop 6 (P1.6.13)

Defines the P gain for the speed controlled in Open Loop control mode.

638 Speed controller I gain, Open Loop 6 (P1.6.14)

Defines the I gain for the speed controlled in Open Loop control mode.

639 Torque controller P gain 6 (P1.10.9)

Defines the P gain of the torque controller.

640 Torque controller I gain 6 (P1.10.10)

Defines the I gain of the torque controller.

641 Torque reference selection 6 (P1.10.4)

Defines the source for torque reference.

0	Not used
1	Analog input 1
2	Analog input 2
3	Analog input 3
4	Analog input 4
5	Analog input 1 (joystick)
6	Analog input 2 (joystick)
7	From keypad, parameter R2.4
8	Fieldbus

642 Torque reference scaling, maximum value 6 (P1.10.5)

643 Torque reference scaling, minimum value 6 (P1.10.6)

Scale the custom minimum and maximum levels for analog inputs within -300.0 – 300.0%.

644 Torque speed limit 6 (P1.10.7)

With this parameter the maximum frequency for the torque control can be selected.

0 Maximum frequency, ID102
1 Selected frequency reference
2 Preset speed 7, ID130

700 Response to the 4 mA reference fault 234567 (P1.7.1)

0 No response
1 Warning
2 Warning, the frequency from 10 seconds back is set as reference
3 Warning, the Preset Frequency (ID728) is set as reference
4 Fault, stop mode after fault according to ID506
5 Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated if the 4 – 20 mA reference signal is used and the signal falls below 3.5 mA for 5 seconds or below 0.5 mA for 0.5 seconds. The information can also be programmed into digital output DO1 or relay outputs RO1 and RO2.

701 Response to external fault 234567 (P1.7.3)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated from the external fault signal applied to programmable digital input DIN3. The information can also be programmed into digital output DO1 or relay outputs RO1 and RO2.

702 Output phase supervision 234567 (P1.7.6)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

Output phase supervision of the motor ensures that the motor phases have approximately equal currents.

703 Earth fault protection 234567 (P1.7.7)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

Earth (ground) fault protection ensures that the sum of the motor phase currents is zero. Regardless of the setting of this parameter, the overcurrent protection always functions and protects the SVX9000 from earth (ground) faults with high currents.

704 Motor thermal protection 234567 (P1.7.8)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

If a trip is selected the SVX9000 will stop and activate the fault stage. Deactivating this protection, i.e. setting parameter to **0**, will reset the thermal stage of the motor to 0%. See **Page A-3**.

705 Motor thermal protection: Motor ambient temp. factor 234567 (P1.7.9)

The factor can be set between -100.0% – 100.0%. See **Page A-3**.

706 Motor thermal protection: Motor cooling factor at zero speed 234567 (P1.7.10)

The current can be set between 0 – 150.0% x I_{nMotor}. This parameter sets the value for thermal current at zero frequency. See **Figure 8-47**.

The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or even higher).

Note: The value is set as a percentage of the motor nameplate data, ID113 (nominal current of the motor), not the SVX9000's nominal output current. The motor's nominal current is the current that the motor can withstand in direct on-line use without being overheated.

If you change the parameter Nominal current of motor, this parameter is automatically restored to the default value.

Setting this parameter does not affect the maximum output current of the drive which is determined by parameter ID107 alone. See **Page A-3**.

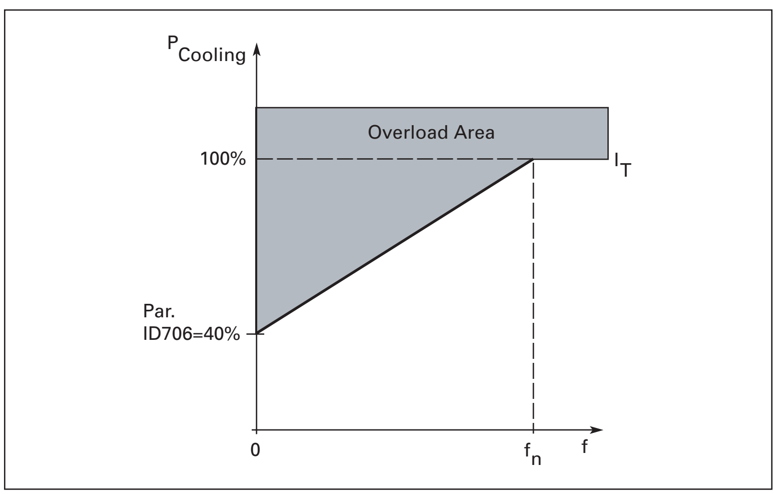


Figure 8-47: Motor Thermal Current I_T Curve

707 Motor thermal protection: Time constant **234567** (P1.7.11)

This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor, the larger the motor, the longer the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

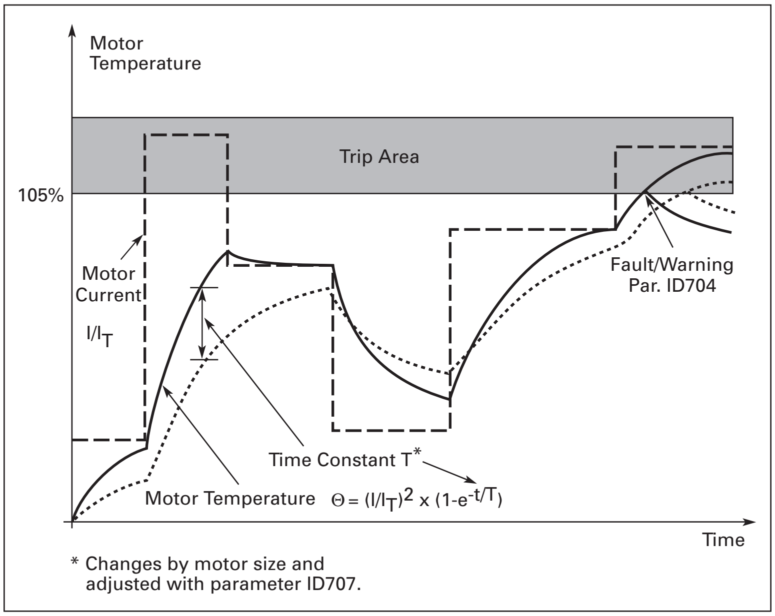


Figure 8-48: Motor Thermal Protection

The motor thermal time is specific to the motor design and it varies between different motor manufacturers.

If the motor's t6 – time (t6 is the time in seconds the motor can safely operate at six times the rated current) is known (from the motor manufacturer) the time constant parameter can be set based on it. As a rule of thumb, the motor thermal time constant in minutes is equal to 2xt6. If the SVX9000 is in stop stage the time constant is internally increased to three times the set parameter value. The cooling in the stop stage is based on convection only so the time constant is increased. See **Figure 8-48.**

708 Motor thermal protection: Motor duty cycle **234567** (P1.7.12)

Defines how much of the nominal motor load is applied.
The value can be set to 0% – 100%. See **Page A-3.**

709 Stall protection **234567** (P1.7.13)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

Setting the parameter to **0** will deactivate the protection and reset the stall time counter. See **Page A-3.**

710 Stall current limit 234567 (P1.7.14)

The current can be set to 0.1 – I_{nMotor}*2. For a stall stage to occur, the current must have exceeded this limit. See **Figure 8-49**. If ID113, nominal motor current is changed, this parameter is automatically restored to the default value (I_L). See **Page A-3.**

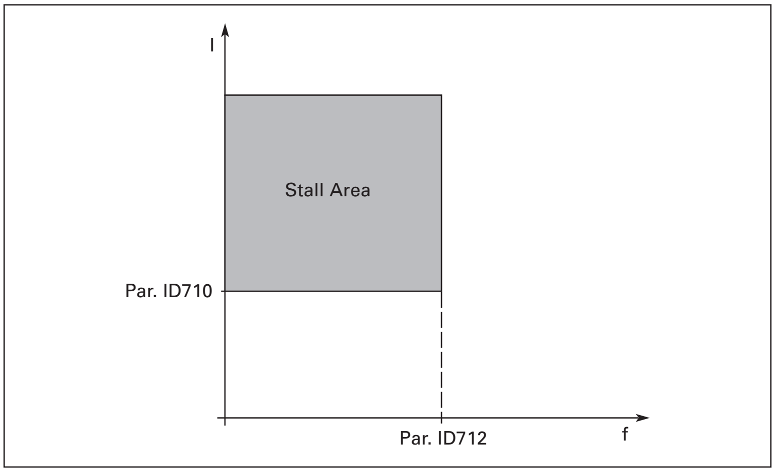


Figure 8-49: Stall Characteristics Settings

711 Stall time 234567 (P1.7.15)

This time can be set between 1.0 and 120.0s.

This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter. If the stall time counter value goes above this limit the protection will cause a trip (see ID709). See **Page A-3.**

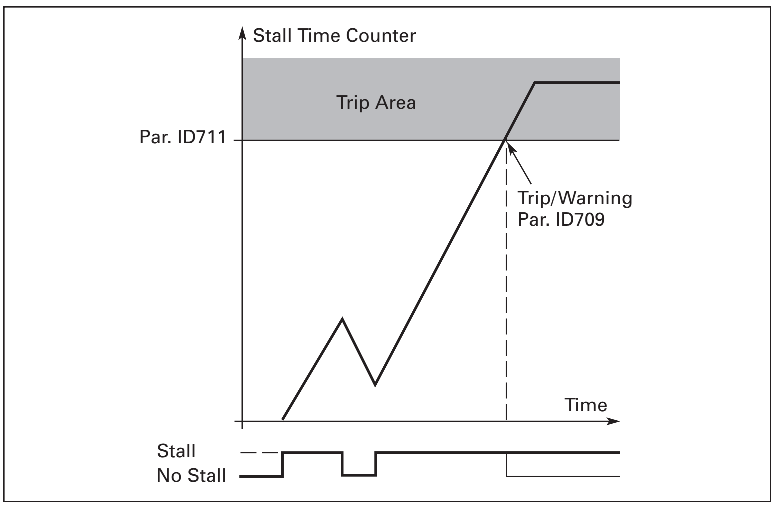


Figure 8-50: Stall Time Count

712 Stall frequency limit 234567 (P1.7.16)

The frequency can be set between 1 – f_{mAx} (ID102).

For a stall state to occur, the output frequency must have remained below this limit. See **Page A-3.**

713 Underload protection **234567** (P1.7.17)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

If tripping is set active the drive will stop and activate the fault stage. Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero. See **Page A-4**.

714 Underload protection, field weakening area load **234567** (P1.7.18)

The torque limit can be set between 10.0 – 150.0 % x T_{nMotor}.

This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point. See **Figure 8-51**.

If you change ID113, nominal motor current, this parameter is automatically restored to the default value. See **Page A-4**.

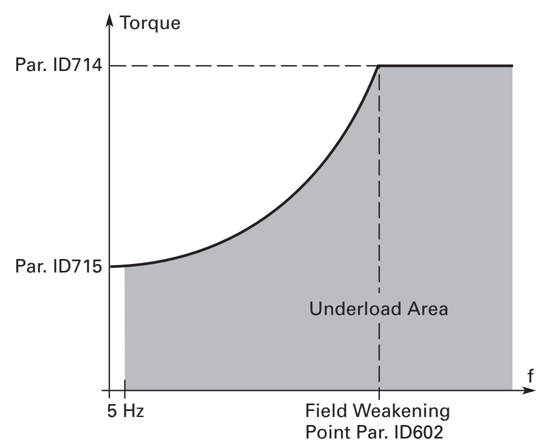


Figure 8-51: Setting of Minimum Load

715 Underload protection, zero frequency load **234567** (P1.7.19)

The torque limit can be set between 5.0 – 150.0 % x T_{nMotor}.

This parameter gives value for the minimum torque allowed with zero frequency. See **Figure 8-51**.

If you change the value of ID113, nominal motor current, this parameter is automatically restored to the default value. See **Page A-4**.

716 Underload time 234567 (P1.7.20)

This time can be set between 2.0 and 600.0s.

This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to ID713. If the SVX9000 is stopped the underload counter is reset to zero. See **Figure 8-52** and **Page A-4**.

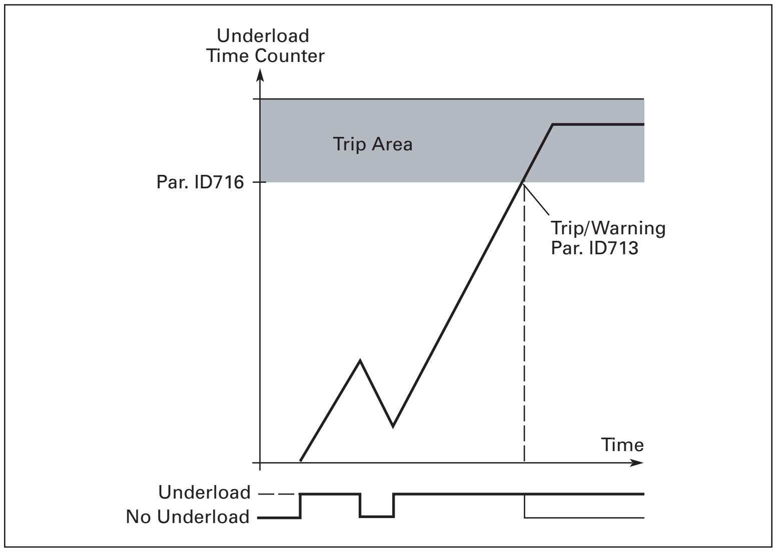


Figure 8-52: Underload Time Counter Function

717 Automatic restart: Wait time 234567 (P1.8.1)

ID717 defines the elapsed time before the SVX9000 tries to automatically restart, after the fault has cleared.

718 Automatic restart: Trial time 234567 (P1.8.2)

The Automatic restart function restarts the SVX9000 when the faults selected with ID720 to ID725 have cleared and the waiting time has elapsed.

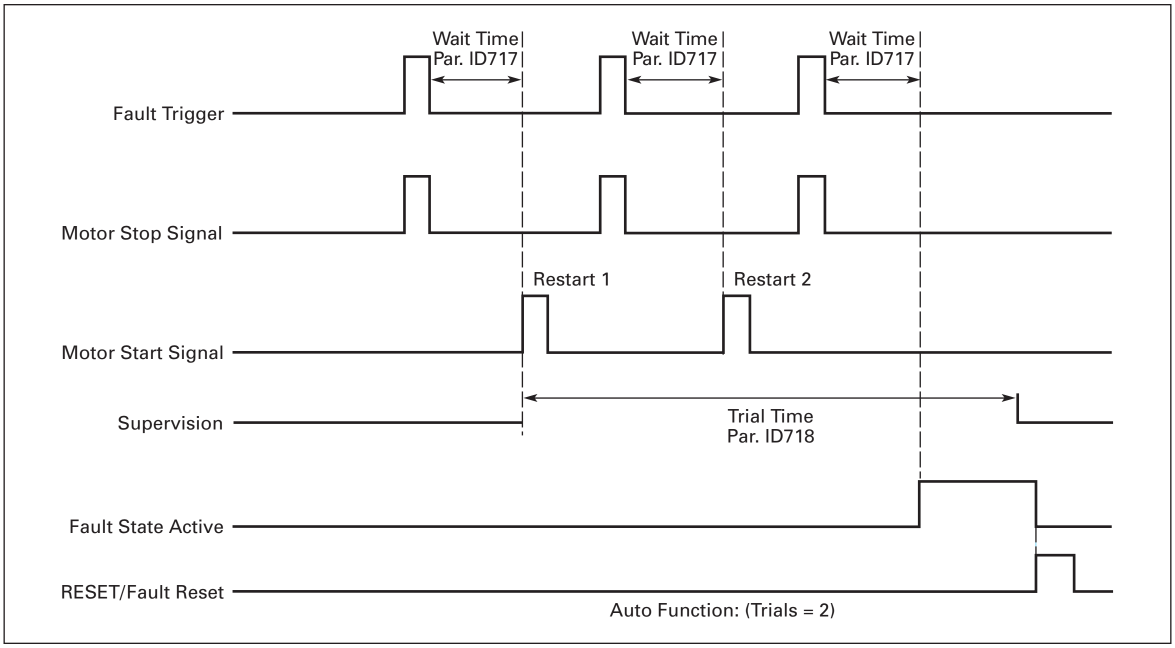


Figure 8-53: Example of Automatic Restarts with Two Restarts

Parameters ID720 to ID725 determine the maximum number of automatic restarts during the trial time set by parameter ID718. The time count starts from the first autorestart. If the number of faults occurring during the trial time exceeds the values of parameters ID720 to ID725 the fault state becomes active. Otherwise the fault is cleared after the trial time has elapsed and the next fault starts the trial time count again.

If a single fault remains during the trial time, a fault state is true.

719 Automatic restart: Start function 234567 (P1.8.3)

The Start function for Automatic restart is selected with this parameter. The parameter defines the start mode:

0 Start with ramp
1 Flying start
2 Start according to ID505

720 Automatic restart: Number of tries after undervoltage fault trip **234567** (P1.8.4)

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718 after an undervoltage trip.

0 No automatic restart

>0 Number of automatic restarts after undervoltage fault. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.

721 Automatic restart: Number of tries after overvoltage trip **234567** (P1.8.5)

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718 after an overvoltage trip.

0 No automatic restart after overvoltage fault trip

>0 Number of automatic restarts after overvoltage fault trip. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.

722 Automatic restart: Number of tries after overcurrent trip **234567** (P1.8.6)

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

Note: An IGBT temperature fault also included as part of this fault.

0 No automatic restart after overcurrent fault trip

>0 Number of automatic restarts after an overcurrent trip, saturation trip or IGBT temperature fault.

723 Automatic restart: Number of tries after reference trip **234567** (P1.8.7)

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

0 No automatic restart after reference fault trip

>0 Number of automatic restarts after the analog current signal (4 – 20 mA) has returned to the normal level (≥ 4 mA)

725 Automatic restart: Number of tries after external fault trip **234567** (P1.8.9)

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

0 No automatic restart after External fault trip

>0 Number of automatic restarts after External fault trip

726 Automatic restart: Number of tries after motor temperature fault trip **234567** (P1.8.8)

This parameter determines how many automatics restarts can be made during the trial time set by ID718.

0 No automatic restart after Motor temperature fault trip
>0 Number of automatic restarts after the motor temperature has returned to its normal level

727 Response to undervoltage fault **234567** (P1.7.5)

0 Fault stored to Fault History
1 Fault not stored to Fault History

728 4 mA reference fault: preset frequency reference **234567** (P1.7.2)

If the value of parameter ID700 is set to 3 and the 4 mA fault occurs then the frequency reference to the motor is the value of this parameter.

730 Input phase supervision **234567** (P1.7.4)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

The input phase supervision ensures that the input phases of the SVX9000 have approximately equal currents.

731 Automatic restart **1** (P1.22)

The Automatic restart is used when this parameter is enabled.

0 Disabled
1 Enabled

The function resets the following faults (max. three times) (see the *SVX9000 User Manual*, Appendix B):

- Overcurrent (F1)
- Overvoltage (F2)
- Undervoltage (F9)
- SVX9000 overtemperature (F14)
- Motor overtemperature (F16)
- Reference fault (F50)

732 Response to thermistor fault 234567 (P1.7.21)

0	No response
1	Warning
2	Fault, stop mode after fault according to ID506
3	Fault, stop mode after fault always by coasting

Setting the parameter to **0** will deactivate the protection.

733 Response to fieldbus fault 234567 (P1.7.22)

This sets the response mode for the fieldbus fault when a fieldbus board is used. For more information, see the respective Fieldbus Board Manual.

See ID732.

734 Response to slot fault 234567 (P1.7.23)

This sets the response mode for a board slot fault caused by a missing or failed board.

See ID732.

738 Automatic restart: Number of tries after underload fault trip 234567 (P1.8.10)

This parameter determines how many automatic restarts can be made during the trial time set by parameter ID718.

0	No automatic restart after an Underload fault trip
>0	Number of automatic restarts after an Underload fault trip

739 Number of PT100 inputs in use 567 (P1.7.24)

If a PT100 input board is installed in the SVX9000, this sets the number of PT100 inputs in use. See the *9000X Option Board User Manual*.

Note: If the selected value is greater than the actual number of PT100 inputs being used, the display will read 200°C. If the input is short-circuited the displayed value is -30°C.

740 Response to PT100 fault 567 (P1.7.25)

0	No response
1	Warning
2	Fault, stop mode after fault according to ID506
3	Fault, stop mode after fault always by coasting

741 PT100 warning limit 567 (P1.7.26)

Set here the limit at which the PT100 warning will be activated.

742 PT100 fault limit 567 (P1.7.27)

Set here the limit at which the PT100 fault (F56) will be activated.

850 **Fieldbus reference minimum scaling** **6** (2.9.1)

851 **Fieldbus reference maximum scaling** **6** (2.9.2)

Use these two parameters to scale the fieldbus reference signal. Setting value limits: 0 ≤ par. ID850 ≤ ID851 ≤ ID102. If ID851 = 0, custom scaling is not used and the minimum and maximum frequencies are used for scaling. The scaling functions as illustrated in **Figure 8-10**. See **Page A-4**.

Note: Using this custom scaling function also affects the scaling of the actual value.

852 to 859 **Fieldbus data out selections 1 to 8** **6** (P1.9.3 to P1.9.10)

Using these, you can observe any monitored item or parameter from the fieldbus. Enter the ID number of the item you wish to observe for its value. See **Page A-4**.

Some typical values:

Table 8-13: Typical Monitored Items

Item	Description	Item	Description
1	Output frequency	15	Digital inputs 1,2,3 status
2	Motor speed	16	Digital inputs 4,5,6 status
3	Motor current	17	Digital and relay output status
4	Motor torque	25	Frequency reference
5	Motor power	26	Analog output current
6	Motor voltage	27	AI3
7	DC link voltage	28	AI4
8	Unit temperature	31	AO1 (expander board)
9	Motor temperature	32	AO2 (expander board)
13	AI1	37	Active fault 1
14	AI2	—	—

1001 Number of auxiliary drives 7 (P1.9.1)

With this parameter the number of auxiliary drives in use will be defined. The functions controlling the auxiliary drives (parameters ID458 to ID462) can be programmed to relay outputs or digital output. By default, one auxiliary drive is in use and it is programmed to relay output RO1 at B.1.

1002 Start frequency, auxiliary drive 1 7 (P1.9.2)

The frequency of the drive controlled by the frequency converter must exceed the limit defined with these parameters with 1 Hz before the auxiliary drive is started. The 1 Hz overdraft makes a hysteresis to avoid unnecessary starts and stops. See **Figure 8-54**. See also parameters ID101 and ID102.

1003 Stop frequency, auxiliary drive 1 7 (P1.9.3)

The frequency of the drive controlled by the frequency converter must fall with 1 Hz below the limit defined with these parameters before the auxiliary drive is stopped. The stop frequency limit also defines the frequency to which the frequency of the drive controlled by the frequency converter is dropped after starting the auxiliary drive. See **Figure 8-54**.

1004 Start frequency, auxiliary drive 2 7 (P1.9.4)

1005 Stop frequency, auxiliary drive 2 7 (P1.9.5)

1006 Start frequency, auxiliary drive 3 7 (P1.9.6)

1007 Stop frequency, auxiliary drive 3 7 (P1.9.7)

1008 Start frequency, auxiliary drive 4 7 (P1.9.8)

1009 Stop frequency, auxiliary drive 4 7 (P1.9.9)

See ID1002 and ID1003.

1010 Start delay of auxiliary drives 7 (P1.9.10)

The frequency of the SVX9000 must remain above the start frequency of the auxiliary drive for the time defined with this parameter before the auxiliary drive is started. The delay defined applies to all auxiliary drives. This prevents unnecessary starts caused by the start limit being momentarily exceeded. See **Figure 8-54.**

1011 Stop delay of auxiliary drives 7 (P1.9.11)

The frequency of the SVX9000 must remain below the stop limit of the auxiliary drive for the time defined with this parameter before the auxiliary drive is stopped. The delay defined applies to all auxiliary drives. This prevents unnecessary stops caused by the stop limit frequency momentarily dropping below the limit. See **Figure 8-54**.

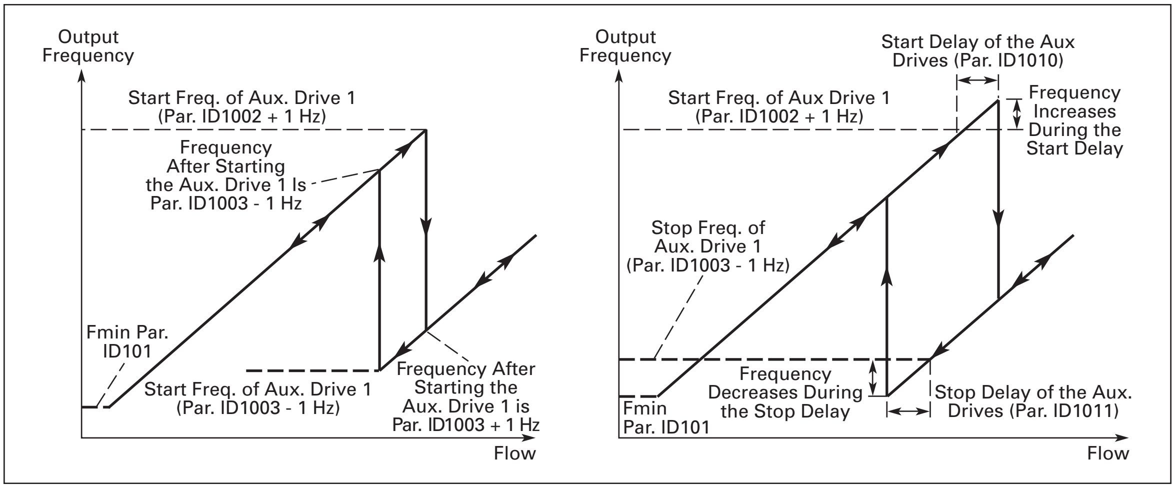


Figure 8-54: Example of Parameter Setting

SVX9000 and One Auxiliary Drive

1012	**Reference step after start of auxiliary drive 1**	**7**	(P1.9.12)
1013	**Reference step after start of auxiliary drive 2**	**7**	(P1.9.13)
1014	**Reference step after start of auxiliary drive 3**	**7**	(P1.9.14)
1015	**Reference step after start of auxiliary drive 4**	**7**	(P1.9.15)

The reference step will always be automatically added to the reference value when the corresponding auxiliary drive is started. These reference steps provide compensation for the pressure loss in the piping caused by the increased flow. See **Figure 8-55.**

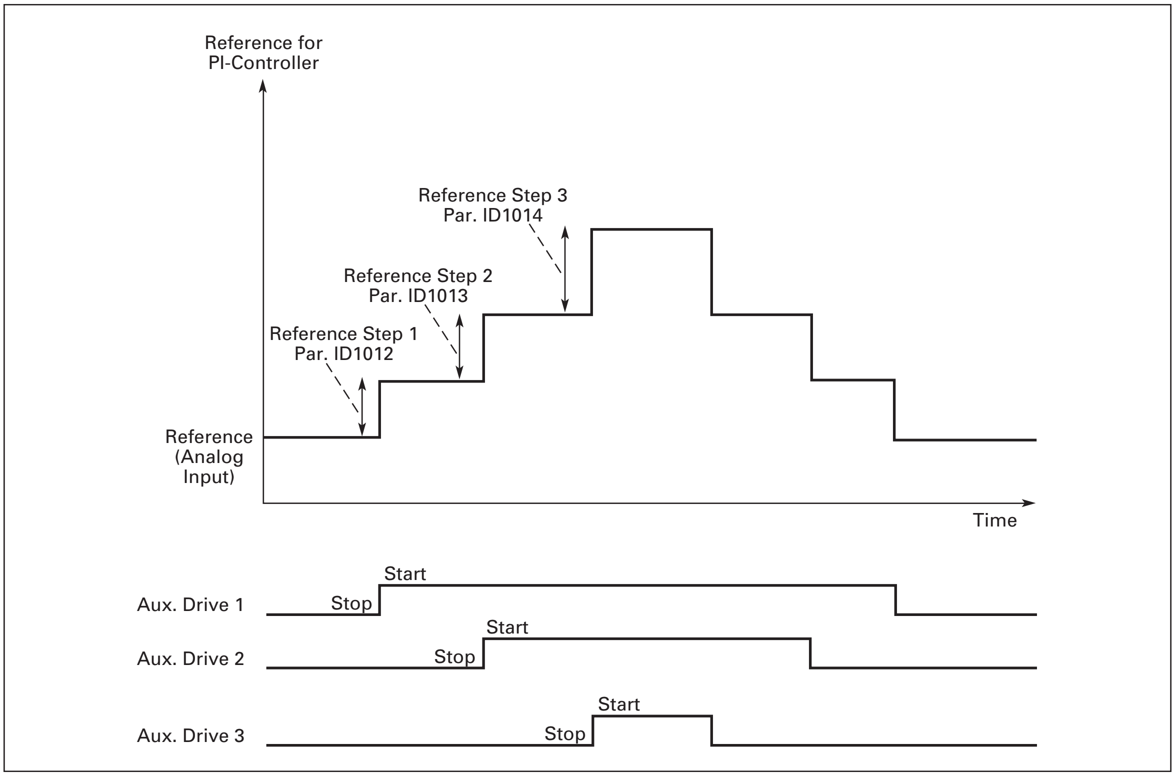


Figure 8-55: Reference Steps after Starting Auxiliary Drives

1016 Sleep frequency **57** (P1.1.19)

The SVX9000 is automatically stopped if its frequency below the Sleep level defined with this parameter for a time greater than that determined by ID1017. During the Stop state, the PID controller is operating switching the SVX9000 back to the Run state when the actual value signal either falls below or exceeds (ID1019) the Wake-up level determined by ID1018. See **Figure 8-56.**

1017 Sleep delay **57** (P1.1.20)

The minimum amount of time the frequency has to remain below the Sleep level before the SVX9000 is stopped. See **Figure 8-56.**

1018 Wake-up level **57** (P1.1.21)

The wake-up level defines the level below which the actual value must fall or which has to be exceeded before the Run state of the SVX9000 is restored. See **Figure 8-56.**

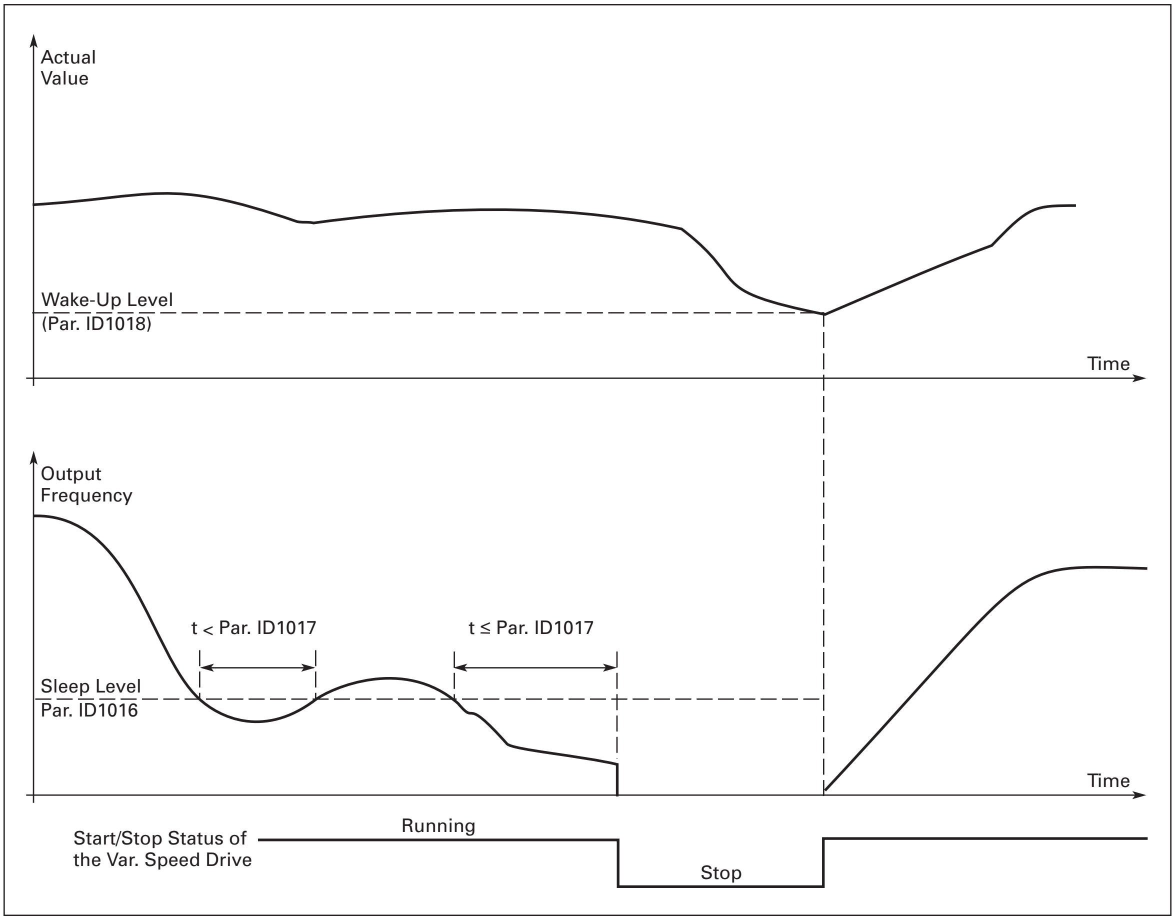


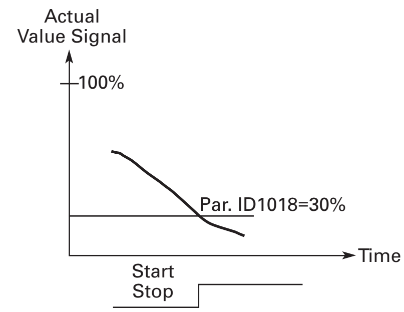
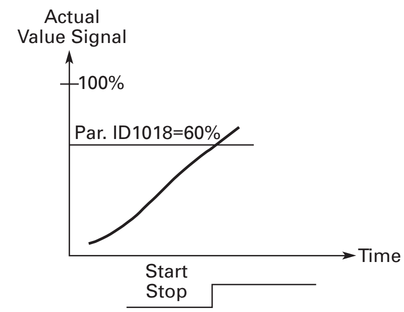
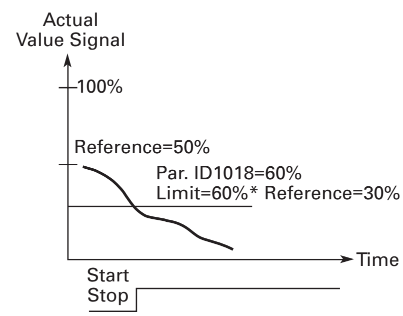
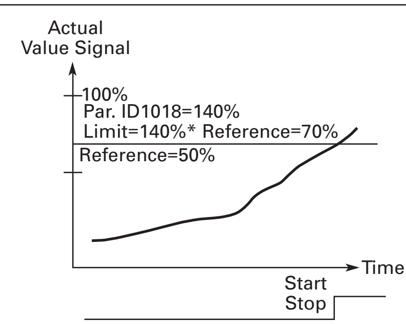
Figure 8-56: Frequency Converter Sleep Function

1019 Wake-up function 57 (P1.1.22)

This parameter defines whether the restoration of the Run state occurs when the actual value signal falls below or exceeds the Wake-up level (ID1018). See **Figures 8-56** and **8-57**.

Application 5 has selections **0** – **1** and Application 7 selections **0** – **3** available.

Table 8-14: Selectable Wake-Up Functions

Parameter Value	Function	Limit	Description
0	Wake-up happens when actual value goes below the limit	The limit defined with parameter ID1018 is in percent of the maximum actual value	
1	Wake-up happens when actual value exceeds the limit	The limit defined with parameter ID1018 is in percent of the maximum actual value	
2	Wake-up happens when actual value goes below the limit	The limit defined with parameter ID1018 is in percent of the current value of the reference signal	
3	Wake-up happens when actual value exceeds the limit	The limit defined with parameter ID1018 is in percent of the current value of the reference signal	

1020 PID controller bypass **7** (P1.9.16)

With this parameter, the PID controller can be programmed to be bypassed. Then the frequency of the controlled drive and the starting points of the auxiliary drives are defined according to the actual value signal. See **Figure 8-57.**

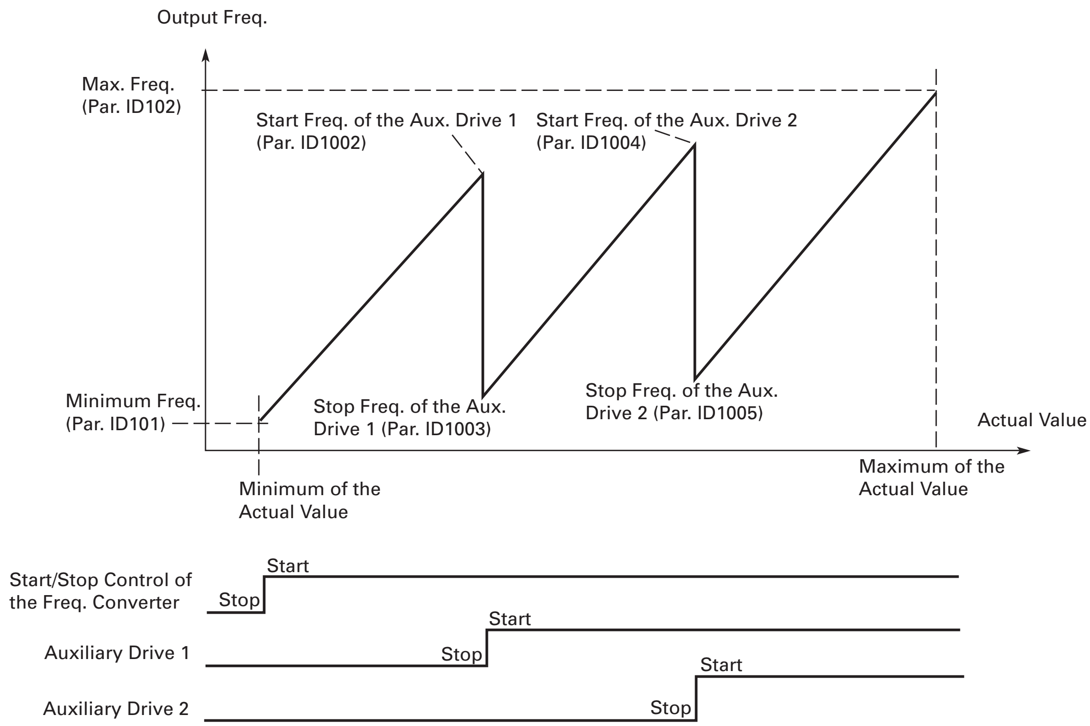


Figure 8-57: Example of SVX9000 and Two Auxiliary Drives with Bypassed PID Controller

1021 Analog input selection for input pressure measurement **7** (P1.9.17)
1022 Input pressure high limit **7** (P1.9.18)
1023 Input pressure low limit **7** (P1.9.19)
1024 Output pressure drop value **7** (P1.9.20)

In pressure increase stations there may be need for decreasing the output pressure if the input pressure decreases below a certain limit. The input pressure measurement which is needed is connected to the analog input selected with ID1021. See **Figure 8-58.**

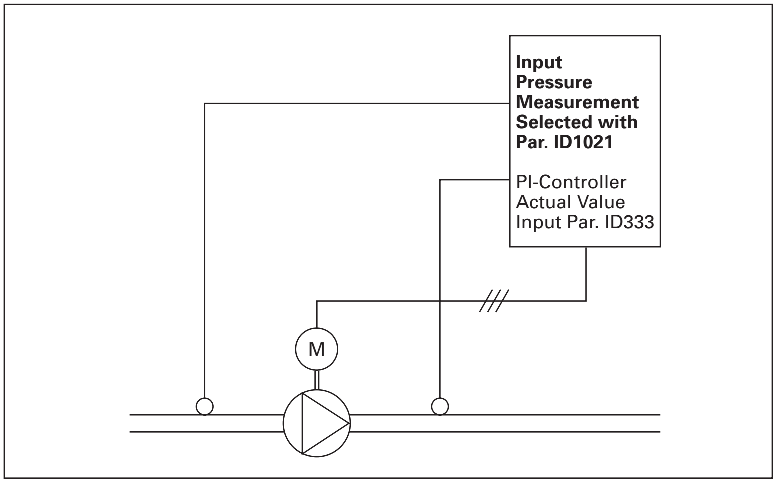


Figure 8-58: Input and Output Pressure Measuring

ID1022 and ID1023 are used to select the limits for the area of the input pressure, where the output pressure is decreased. The values are in percent of the input pressure measurement maximum value. With ID1024 the value for the output pressure decrease within this area can be set. The value is in percent of the reference value maximum. See **Figure 8-59.**

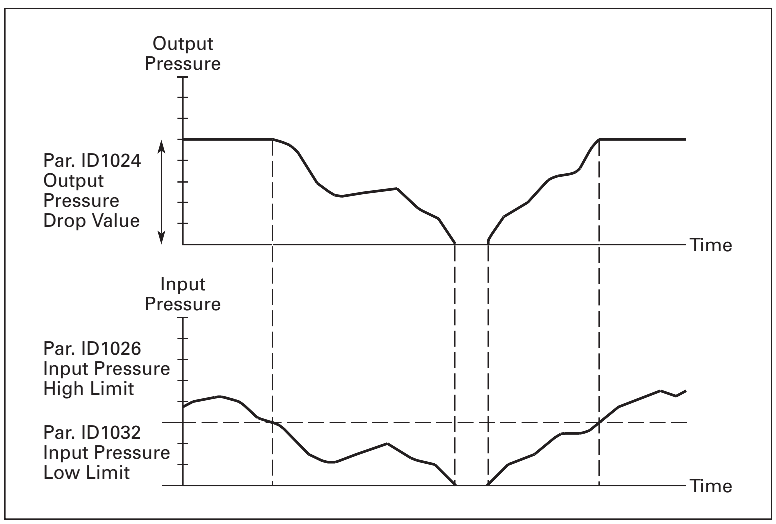


Figure 8-59: Output Pressure Behavior Depending on Input Pressure and Parameter Settings

1025 Frequency drop delay after starting auxiliary drive **7** (P1.9.21)

1026 Frequency increase delay after stopping auxiliary drive **7** (P1.9.22)

If the speed of auxiliary drive increases slowly (e.g. in soft starter control) then a delay between the start of auxiliary drive and the frequency drop of the SVX9000 will make the control smoother. This delay can be adjusted with ID1025.

In the same way, if the speed of the auxiliary drives decreases slowly a delay between the auxiliary drive stop and the frequency increase of the SVX9000 can be programmed with ID1026. See **Figure 8-60**.

If either of the values of ID1025 or ID1026 is set to maximum (300.0 s) no frequency drop nor increase takes place.

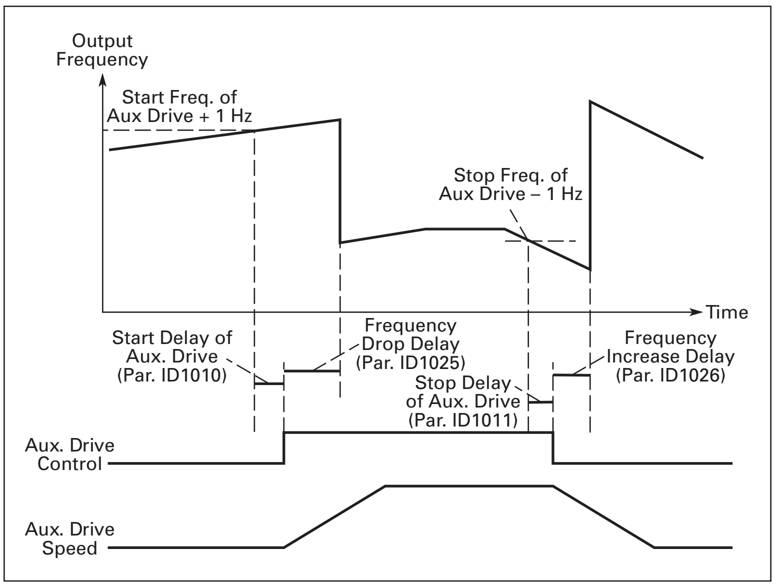


Figure 8-60: Frequency Drop and Increase Delays

1027 Autochange **7** (P1.9.24)

0 Autochange not used

1 Autochange used

1028 Autochange/interlocks automatics selection **7** (P1.9.25)

0 Automatics (autochange/interlockings) applied to auxiliary drives only

The motor controlled by SVX9000 remains the same. Only a utility line contactor is needed for each auxiliary drive. See **Figure 8-61**.

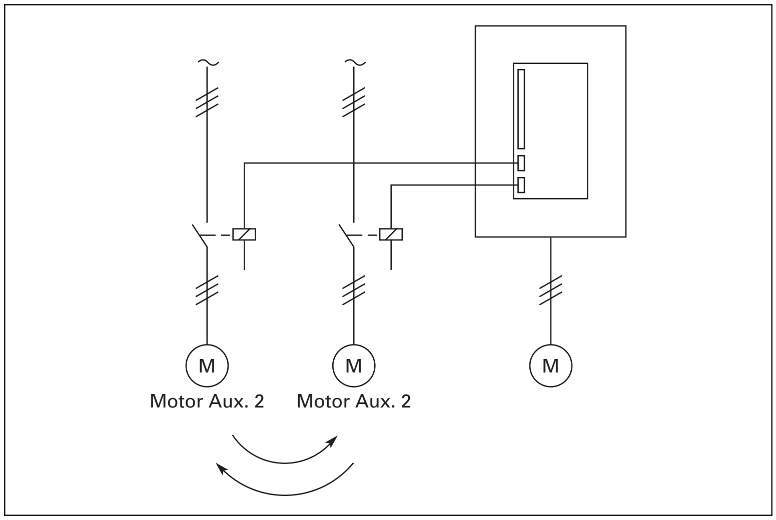


Figure 8-61: Autochange Applied to Auxiliary Drives Only

1 All drives included in the autochange/interlockings sequence

The motor controlled by the SVX9000 is included in the automatics and two contactors are needed for each auxiliary drive to connect it to the utility or the SVX9000. See **Figure 8-62**.

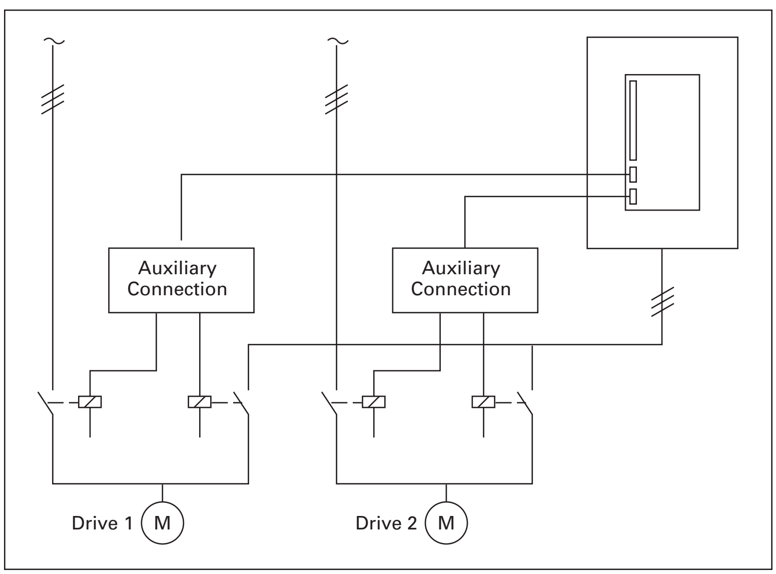


Figure 8-62: Autochange with All Drives

1029 Autochange interval 7 (P1.9.26)

After the expiration of the time defined with this parameter, the autochange function takes place if the capacity used lies below the level defined with ID1031 (*Autochange frequency limit*) and ID1030 (*Maximum number of auxiliary drives*). Should the capacity exceed the value of ID1031, the autochange will not take place before the capacity goes below this limit.

• The time count is activated only if the Start/Stop request is active.

• The time count is reset after the autochange has taken place.

See **Figure 8-63**.

1030 Maximum number of auxiliary drives 7 (P1.9.27)

1031 Autochange frequency limit 7 (P1.9.28)

These parameters define the level below which the capacity used must remain for autochange to take place.

This level is defined as follows:

- If the number of running auxiliary drives is smaller than the value of ID1030 the autochange function can take place.
- If the number of running auxiliary drives is equal to the value of ID1030 and the frequency of the controlled drive is below the value of ID1031 the autochange can take place.
- If the value of parameter ID1031 is 0.0 Hz, the autochange can take place only at rest position (Stop and Sleep) regardless of the value of ID1030.

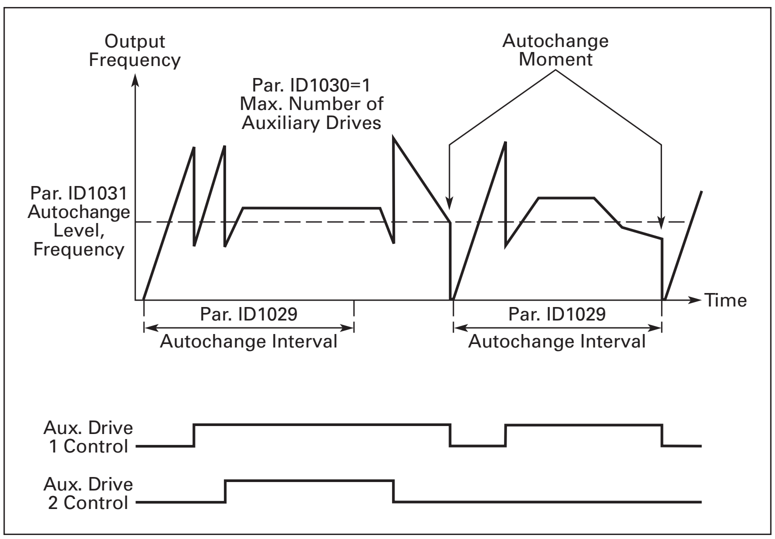


Figure 8-63: Autochange Interval and Limits

1032 Interlock selection **7** (P1.9.23)

With this parameter you can activate or deactivate the feedback signal from the drives. The interlock feedback signals come from the switches that connect the motors to the automatic control (SVX9000), directly to the utility line or place them in the off-state. The interlock feedback functions are connected to the digital inputs of the SVX9000. Program ID426 to ID430 to connect the feedback functions to the digital inputs. Each auxiliary drive must be connected to its own interlock input. The Pump and fan control only controls those motors whose interlock input is active.

0 Interlock feedback not used

The SVX9000 receives no interlock feedback from the auxiliary drives

1 Update of autochange order in Stop

The SVX9000 receives interlock feedback from the auxiliary drives. In case one of the auxiliary drives is, for some reason, disconnected from the system and eventually re-connected, it will be placed last in the autochange line without stopping the system. However, if the autochange order now becomes, for example, [P1 → P3 → P4 → P2], it will be updated in the next Stop (autochange, sleep, stop, etc.)

Example:

[P1 → P3 → P4] → [P2 LOCKED] → [P1 → P3 → P4 → P2] → [SLEEP] → [P1 → P2 → P3 → P4]

2 Update of order immediately

The SVX9000 receives interlock feedback from the auxiliary drives. At re-connection of an auxiliary drive to the autochange line, the automatics will stop all motors immediately and re-start with a new setup.

Example:

[P1 → P2 → P4] → [P3 LOCKED] → [STOP] → [P1 → P2 → P3 → P4]

1033 Actual value special display minimum **7** (P1.9.29)

1034 Actual value special display maximum **7** (P1.9.30)

1035 Actual value special display decimals **7** (P1.9.31)

These parameters set the minimum and maximum values and the number of decimals of the actual value special display. Observe the actual value display in menu ***M1,*** *Monitoring values*.

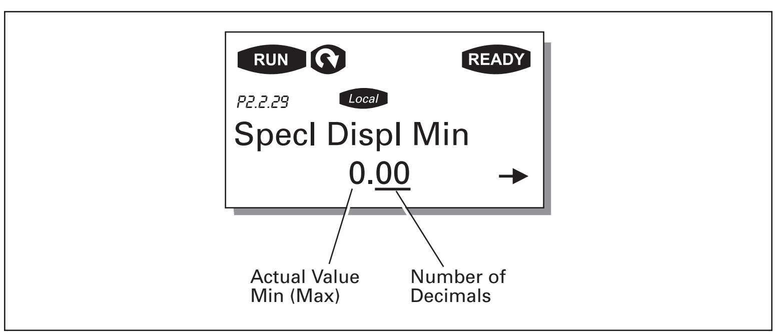


Figure 8-64: Actual Value Special Display

Keypad control parameters

Unlike the parameters listed above, these parameters are located in the **M2** menu of the control keypad. The reference parameters do not have an ID number.

114 STOP button activated (P2.3, P2.5)

To make the STOP button a "hotspot" which always stops the SVX9000 regardless of the selected control place, set the value of this parameter to **1**.

123 Keypad direction (P2.2)

0 Forward: The rotation of the motor is forward, when the keypad is the active control place.

1 Reverse: The rotation of the motor is reverse, when the keypad is the active control place.

For more information, see the *SVX9000 User Manual*, Chapter 5, Keypad Control Menu (M2).

R2.1 Keypad reference (R2.1)

The frequency reference can be adjusted from the keypad with this parameter.

The output frequency can be copied as the keypad reference by pushing the STOP button for 3 seconds when you are on any of the pages of menu **M2**. For more information, see the *SVX9000 User Manual*, Chapter 5, Keypad Control Menu (M2).

R2.3 PID reference 1 **57** (R2.3)

The PID controller keypad reference can be set between 0% and 100%. This reference value is the active PID reference if ID332 = 2.

R2.3 PID reference 2 **57** (R2.4)

Appendix A — Additional Information

In this section you will find additional information on special parameter groups. Such groups are:

- Parameters of External Brake Control with Additional Limits (see below)
- Parameters of Motor Thermal Protection (see **Page A-3**)
- Parameters of Stall Protection (see **Page A-3**)
- Parameters of Underload Protection (see **Page A-4**)
- Fieldbus Control Parameters (see **Page A-4**)

External Brake Control with Additional Limits

IDs 315, 316, 346 to 349, 352, 353

The external brake used for additional braking can be controlled through parameters ID315, ID316, ID346 to ID349 and ID352/ID353 for the Multi-Purpose Control Application. Selecting On/Off Control for the brake, defining the frequency or torque limit(s) the brake should react to and defining the Brake-On/-Off delays will allow an effective brake control. See **Figure A-1**.

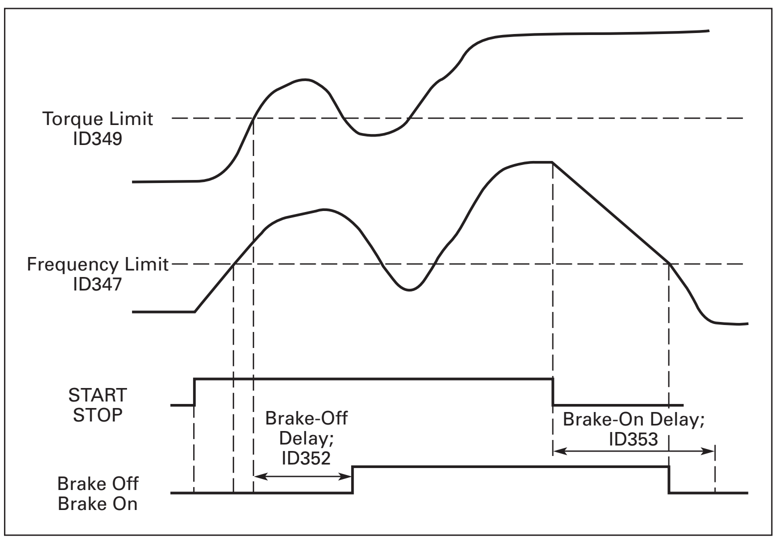


Figure A-1: Brake Control with Additional Limits

In **Figure A-1** the brake control is set to react to both the torque supervision limit (ID349) and frequency supervision limit (ID347). Additionally, the same frequency limit is used for both brake-off and brake-on control by giving ID346 the value **4.** Use of two different frequency limits is also possible for which ID315 and ID346 must be given the value **3.**

Brake-off: In order for the brake to release, three conditions must be fulfilled: 1) the SVX9000 must be in Run state, 2) the torque must be over the set limit (if used) and 3) the output frequency must be over the set limit (if used).

Brake-on: The Stop command activates the brake delay count and the brake is closed when the output frequency falls below the set limit (ID315 or ID346). As a precaution, at the latest, the brake closes when the brake-on delay expires.

Note: A fault or Stop state will close the brake immediately without a delay.

See **Figure A-2**.

Note: It is strongly advisable that the brake-on delay be set longer than the ramp time in order to avoid damaging of the brake.

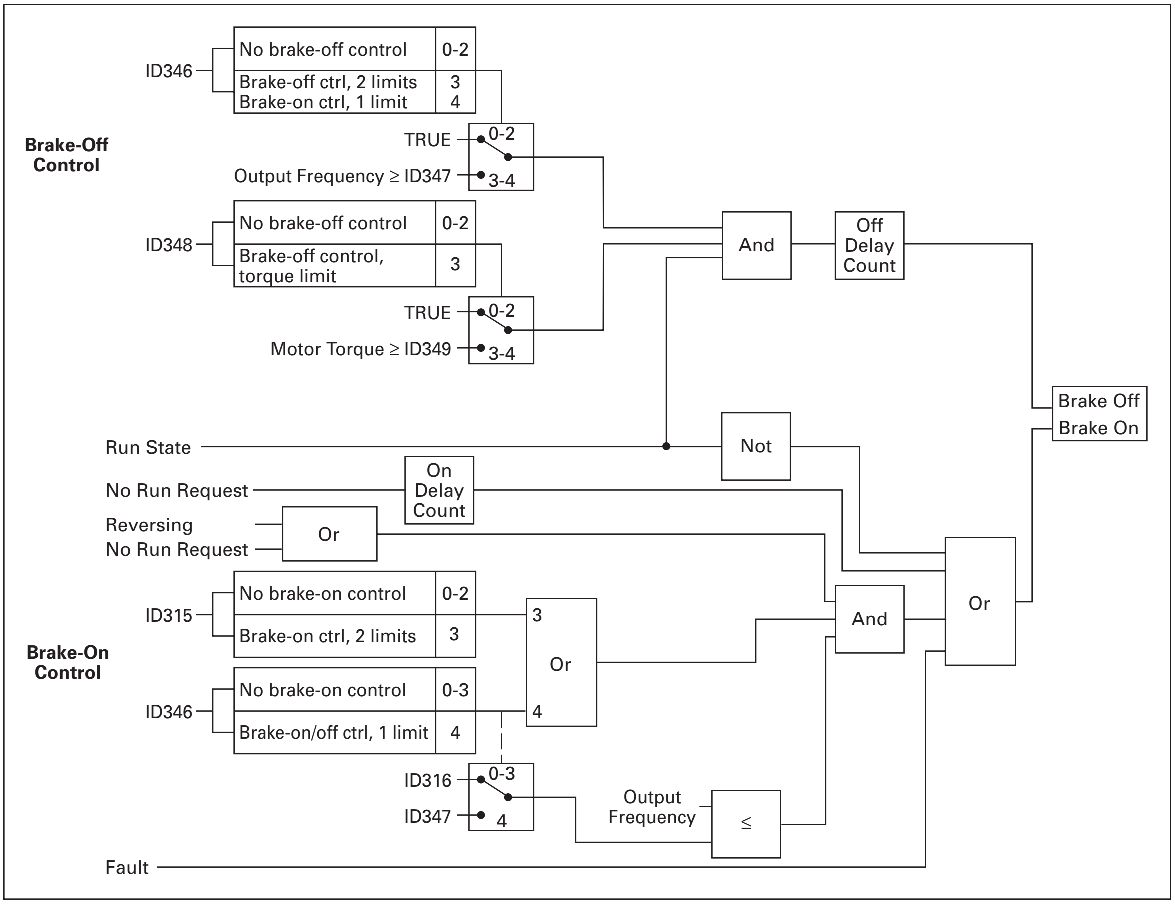


Figure A-2: Brake Control Logic

Parameters of Motor Thermal Protection

ID704 to ID708

General

The motor thermal protection is to protect the motor from overheating. The SVX9000 is capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that the motor will be thermally overloaded. This is the case especially at low frequencies. At low frequencies the cooling effect of the integral motor fan is reduced as well as its capacity. If the motor is equipped with an external fan the load reduction at low speeds is small.

The motor thermal protection is based on a calculated model and it uses the output current of the SVX9000 to determine the load on the motor.

The motor thermal protection can be adjusted with ID704 to ID708. The thermal current I_T specifies the load current above which the motor is overloaded. This current limit is a function of the output frequency.

The thermal stage of the motor can be monitored on the control keypad display. See the *SVX9000 User Manual*, Chapter 5, Monitoring Menu (M7).

⚠ CAUTION

The calculated model does not protect the motor if the airflow to the motor is reduced by a cooling fan failure or a blocked air intake grill.

Parameters of Stall Protection

ID709 to ID712

General

The motor stall protection protects the motor from short time overload situations such as one caused by a stalled shaft. The reaction time of the stall protection can be set shorter than that of motor thermal protection. The stall state is defined with two parameters, ID710 (Stall current) and ID712 (Stall frequency limit). If the current is higher than the set limit and output frequency is lower than the set limit, the stall state is true. Actual shaft rotation is not determined. Stall protection is a type of overcurrent protection.

Parameters of Underload Protection

ID713 to ID716

General

The purpose of the motor underload protection is to ensure that there is load on the motor when the SVX9000 is running. If the motor loses its load, there might be a problem in the process, e.g. a broken belt or a dry pump.

Motor underload protection can be adjusted by setting the underload curve with parameters ID714 (Field weakening area load) and ID715 (Zero frequency load). The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5 Hz (the underload time counter is stopped).

The torque values for setting the underload curve are set as a percentage of the nominal torque of the motor. The motor's nameplate data, the motor nominal current and the SVX9000's nominal current I_H are used to find the scaling ratio for the internal torque value. If other than a standard motor is used, the accuracy of the torque calculation decreases.

Fieldbus Control Parameters

ID850 to ID859

The Fieldbus control parameters are used when the frequency or the speed reference comes from the fieldbus (Modbus, Profibus, DeviceNet, etc.). With the Fieldbus Data Out Selection 1 – 8 you can monitor values from the fieldbus.

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