EATON | Cutler-Hammer

SLX9000 Adjustable Frequency Drives

User Manual

April 2006
New Information

April 2006

Important Notice – Please Read

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

Cover Photo: Cutler-Hammer® SLX9000 Adjustable Frequency Drive.

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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 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® SLX9000 Adjustable Frequency Drive from Eaton's electrical business.

Warnings

⚠ WARNING

Only a competent electrician may carry out the electrical installation.

⚠ WARNING

The components of the power unit of the drive are live when the SLX9000 drive is connected to power supply. Coming into contact with this voltage is extremely dangerous and may cause death or severe injury. The control unit is isolated from mains potential.

⚠ WARNING

The motor terminals U, V, W (T1, T2, T3) and the DC-link/brake resistor terminals -/+ (in SLX9000 ≥1.1 kW) are **live** when drive is connected to mains, **even if the motor is not running**.

⚠ WARNING

The control I/O-terminals are isolated from the mains potential. However, the relay outputs and other I/O-terminals may have dangerous control voltage present even when the drive is disconnected from the power supply.

⚠ WARNING

The drive has a large capacitive leakage current.

⚠ WARNING

If the drive is used as a part of a machine, the machine manufacturer is responsible for providing the machine with a main switch (EN 60204-1).

⚠ WARNING

Only spare parts delivered by Eaton can be used.

⚠ WARNING

If the motor thermistor is connected to DIN3, the instructions on **Page 4-6 must be** followed, otherwise a serious safety hazard may result from the connection.

Cautions

CAUTION

The SLX9000 drive is meant for fixed installations only.

CAUTION

Do not perform any measurements when the drive is connected to the power supply.

CAUTION

After having disconnected the drive from the power supply, wait until the fan stops and the indicators on the keypad go out (if no keypad is attached see the indicator through the keypad base). Wait 5 more minutes before doing any work on drive connections.

CAUTION

Do not perform any voltage withstand tests on any part of drive. There is a certain procedure according to which the tests shall be performed. Ignoring this procedure may result in damaged product.

CAUTION

Prior to measurements on the motor or the motor cable, disconnect the motor cable from the drive.

CAUTION

Do not touch the IC-circuits on the circuit boards. Static voltage discharge may damage the components.

CAUTION

Check the correct positions of the jumpers. Running the motor with signal settings different from the jumper positions will not harm the drive but may damage the motor.

Grounding and ground fault protection

The SLX9000 drive must always be grounded with a ground conductor connected to the ground terminal.

The ground fault protection inside the drive only protects the drive itself against ground faults in the motor or the motor cable.

Due to the high capacity currents present in the drive, fault current protective switches may not function properly. If fault current protective switches are used, they need to be tested with ground fault currents present during possible fault situations.

Motor and Equipment Safety

⚠ CAUTION

Before starting the motor, check that the motor is mounted properly and ensure that the machine connected to the motor allows the motor to be started.

⚠ CAUTION

Set the maximum motor speed (frequency) according to the motor and the machine connected to it.

⚠ CAUTION

Before reversing the motor, make sure that this can be done safely.

⚠ CAUTION

Make sure that no power correction capacitors are connected to the motor cable.

⚠ CAUTION

Make sure that the motor terminals are not connected to mains potential.

April 2006

Chapter 1 — Overview

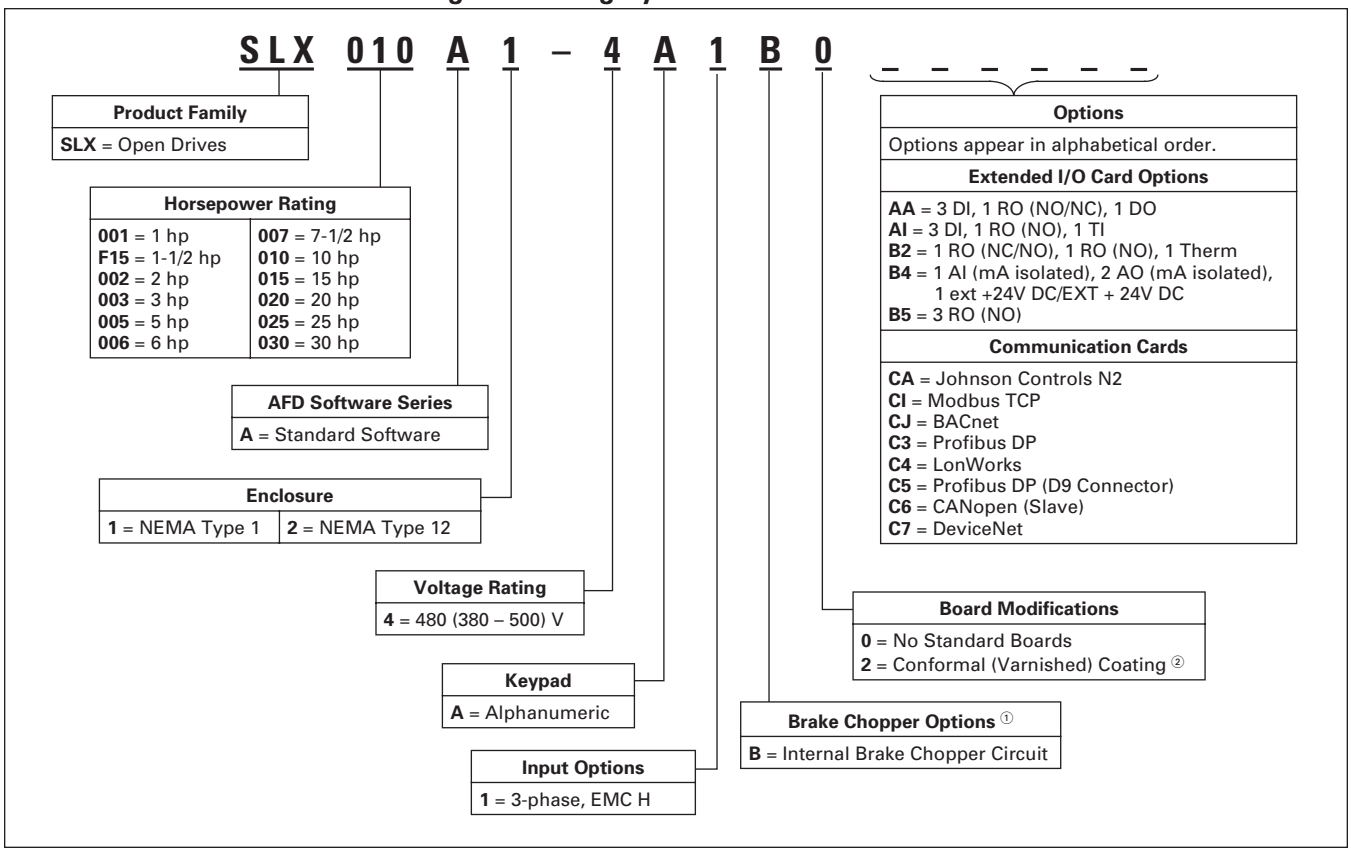
Receiving and Inspection

Cutler-Hammer® SLX9000 Adjustable Frequency Drives from Eaton's electrical business have undergone scrupulous tests and quality checks at the factory before they are delivered to the customer. However, after unpacking the product, check that no signs of transport damages are to be found on the product and that the delivery is complete (compare the catalog number of the product to the code below, see **Table 1-1**).

If the drive has been damaged during shipping, please contact the cargo insurance company or the carrier.

If the delivery does not correspond to your order, contact the supplier immediately.

Table 1-1: SLX9000 AF Drive Catalog Numbering System



① 480V Drives up to 30 hp (I_H) are only available with Brake Chopper Option **B**.
② Factory promise delivery. Consult Sales Office for availability.

Storage

If the drive is to be kept in storage before use, make sure that the ambient conditions are acceptable:

Storing temperature: -40 to 158°F (-40 to 70°C)
Relative humidity: <95%, no condensation

Maintenance

In normal conditions, Cutler-Hammer drives are maintenance-free. However, we recommend to clean the heatsink (using e.g. a small brush) whenever necessary. Most drives are equipped with a cooling fan, which can easily be changed if necessary.

Technical Data

SLX9000 is a compact drive with ratings ranging from 1 to 30 hp. It is well adapted for HVAC and OEM applications where its uses are almost unlimited.

The Motor and Application Control Block is based on microprocessor software. The microprocessor controls the motor basing on the information it receives through measurements, parameter settings, control I/O and control keypad. The IGBT Inverter Bridge produces a symmetrical, three-phase PWM-modulated AC-voltage to the motor.

The control keypad constitutes a link between the user and the drive. The control keypad is used for parameter setting, reading status data and giving control commands. Instead of the control keypad, a PC can also be used to control the drive if connected through a cable and a serial interface adapter (optional equipment).

The drive can be supplied with control I/O boards OPTAA, OPTAI, OPTB_ or OPTC_.

All sizes have an internal brake chopper. For more information, contact Eaton. The input EMC filters are internal and included as standard.

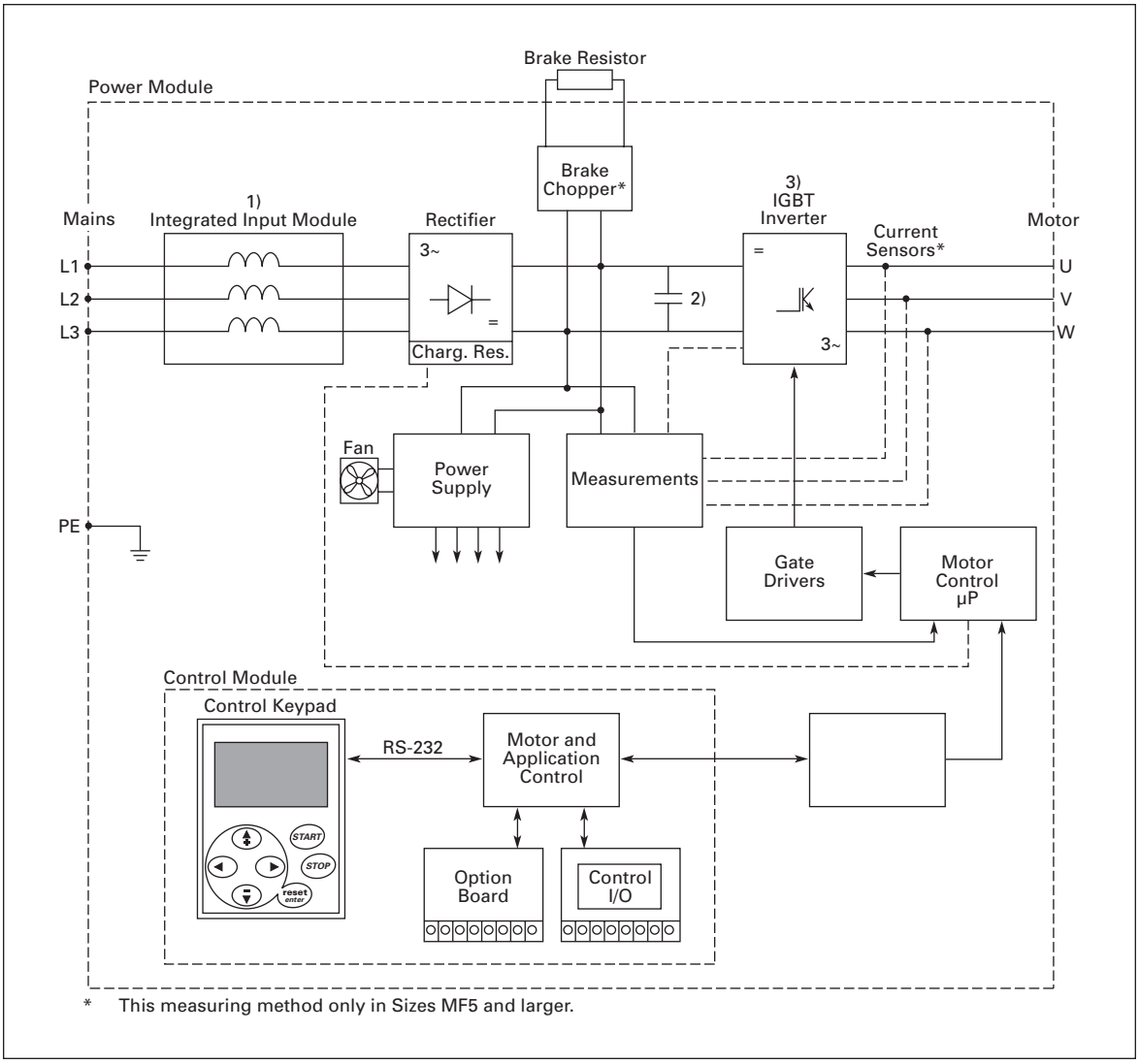


Figure 1-1: SLX9000 Block Diagram

Power Ratings

Table 1-2: NEMA Type 1 Power Ratings

Catalog Number	Frame Size	High Overload 150% (I_H)		Low Overload 110% (I_L)	
		hp	Current Rating	hp	Current Rating
SLX001A1-4A1B0	FR4	1	2.2	1-1/2	3.3
SLXF15A1-4A1B0		1-1/2	3.3	2	4.3
SLX002A1-4A1B0		2	4.3	3	5.6
SLX003A1-4A1B0		3	5.6	4	7.6
SLX005A1-4A1B0		4	7.6	5	9
SLX006A1-4A1B0		5	9	7-1/2	12
SLX007A1-4A1B0	FR5	7-1/2	12	10	16
SLX010A1-4A1B0		10	16	15	23
SLX015A1-4A1B0		15	23	20	31
SLX020A1-4A1B0	FR6	20	31	25	38
SLX025A1-4A1B0		25	38	30	46
SLX030A1-4A1B0		30	46	40	61

Table 1-3: NEMA Type 12 Power Ratings

Catalog Number	Frame Size	High Overload 150% (I_H)		Low Overload 110% (I_L)	
		hp	Current Rating	hp	Current Rating
SLX001A2-4A1B0	FR4	1	2.2	1-1/2	3.3
SLXF15A2-4A1B0		1-1/2	3.3	2	4.3
SLX002A2-4A1B0		2	4.3	3	5.6
SLX003A2-4A1B0		3	5.6	4	7.6
SLX005A2-4A1B0		4	7.6	5	9
SLX006A2-4A1B0		5	9	7-1/2	12
SLX007A2-4A1B0	FR5	7-1/2	12	10	16
SLX010A2-4A1B0		10	16	15	23
SLX015A2-4A1B0		15	23	20	31
SLX020A2-4A1B0	FR6	20	31	25	38
SLX025A2-4A1B0		25	38	30	46
SLX030A2-4A1B0		30	46	40	61

Table 1-4: Technical Information

Description	Specification
Mains Connection	
Input Voltage V_{in}	380 – 500V; -15% to +10% three-phase
Input Frequency	45 – 66 Hz
Connection to Mains	Once per minute or less (normal case)
Motor Connection	
Output Voltage	0 – V_{in}
Continuous Output Current	I_H: Ambient temperature max. +50°C, overload 1.5 x I_H (1 min./10 min.) I_L: Ambient temperature max. +40°C, overload 1.1 x I_L (1 min./10 min.)
Starting Torque	150% (Low overload); 200% (High overload)
Starting Current	2 x IH 2 secs every 20 secs, if output frequency <30 Hz and temperature of heatsink <+60°C
Output Frequency	0 – 320 Hz
Frequency Resolution	.01 Hz
Control Characteristics	
Control Method	Frequency control V/f Open Loop Sensorless Vector Control
Switching Frequency (See Parameter 2.6.8)	1 – 16 kHz; Factory default 6 kHz
Frequency Reference – Analog Input – Keypad Reference	 Resolution .1% (10-bit), accuracy ±1% Resolution .01 Hz
Field Weakening Point	30 – 320 Hz
Acceleration Time	.1 – 3000 sec.
Deceleration Time	.1 – 3000 sec.
Braking Torque	DC brake: 30%*T_N (without brake option)
Ambient Conditions	
Ambient Operating Temperature	14°F (-10°C) (no frost) to 122°F (50°C): I_H 14°F (-10°C) (no frost) to 104°F (40°C): I_L
Storage Temperature	-40 to 158°F (-40 to 70°C)
Relative Humidity	0 – 95% RH, non-condensing, non-corrosive, no dripping water
Air Quality: – Chemical Vapors – Mechanical Particles	 IEC 721-3-3, unit in operation, class 3C2 IEC 721-3-3, unit in operation, class 3S2
Altitude	100% load capacity (no derating) up to 1000m 1-% derating for each 100m above 1000.; max. 3000m

Table 1-4: Technical Information (Continued)

Description	Specification
Ambient Conditions (Continued)	
Vibration EN 50178/EN 60068-2-6	5 – 150 Hz Displacement amplitude 1 mm (peak) at 5 – 15.8 Hz Max acceleration amplitude 1G at 15.8 – 150 Hz
Shock EN 50178, IEC 68-2-27	UPS Drop Test (for applicable UPS weights) Storage and shipping: max 15G, 11 ms (in package)
Enclosure Class	NEMA Type 1/IP21 or NEMA Type 12/IP54
EMC	
Immunity	Complies with EN 50082-1, -2, EN 61800-3
Emissions	**MF4 – MF6:** EMC-level H: EN 61800-3 (1996)+A11 (2000) 1. environment, restricted use; 2. environment
Safety	
	EN 50178, EN 60204-1, CE, UL, cUL, FI, GOST R, IEC 61800-5 (see unit nameplate for more detailed approvals)
Control Connections	
Analog Input Voltage	0 – 10V, R_i = 200 kΩ, Resolution 10 bit, accuracy ±1%
Analog Input Current	0(4) – 20 mA, R_i = 250Ω differential
Digital Inputs	3 positive logic; 18 – 24V DC
Auxiliary Voltage	+24V, ±15%, max. 100 mA
Output Reference Voltage	+10V, +3%, max. load 10 mA
Analog Output	0(4) – 20 mA; R_L max. 500Ω; Resolution 16 bit; Accuracy ±1%
Relay Outputs	1 programmable change-over relay output Switching capacity: 24V DC/8A, 250V AC/8A, 125V DC/.4A
Protections	
Overvoltage Protection	380 – 500V DC: 911V DC
Undervoltage Protection	380 – 500V DC: 333V DC
Ground Fault Protection	In case of ground fault in motor or motor cable, only the drive is protected
Unit Overtemperature Protection	Yes
Motor Overload Protection	Yes
Motor Stall Protection	Yes
Motor Underload Protection	Yes
Short Circuit Protection of +24V and +10V Reference Voltages	Yes
Overcurrent Protection	Trip limit 4.0*I_H instantaneously

Chapter 2 — Installation

Mounting

MF4, MF5 and MF6

The drive is mounted with four screws (or bolts, depending on the unit size). Enough space needs to be maintained around the drive to ensure sufficient cooling, see **Table 2-4** and **Figure 2-3**.

Also make sure that the mounting plane is relative even.

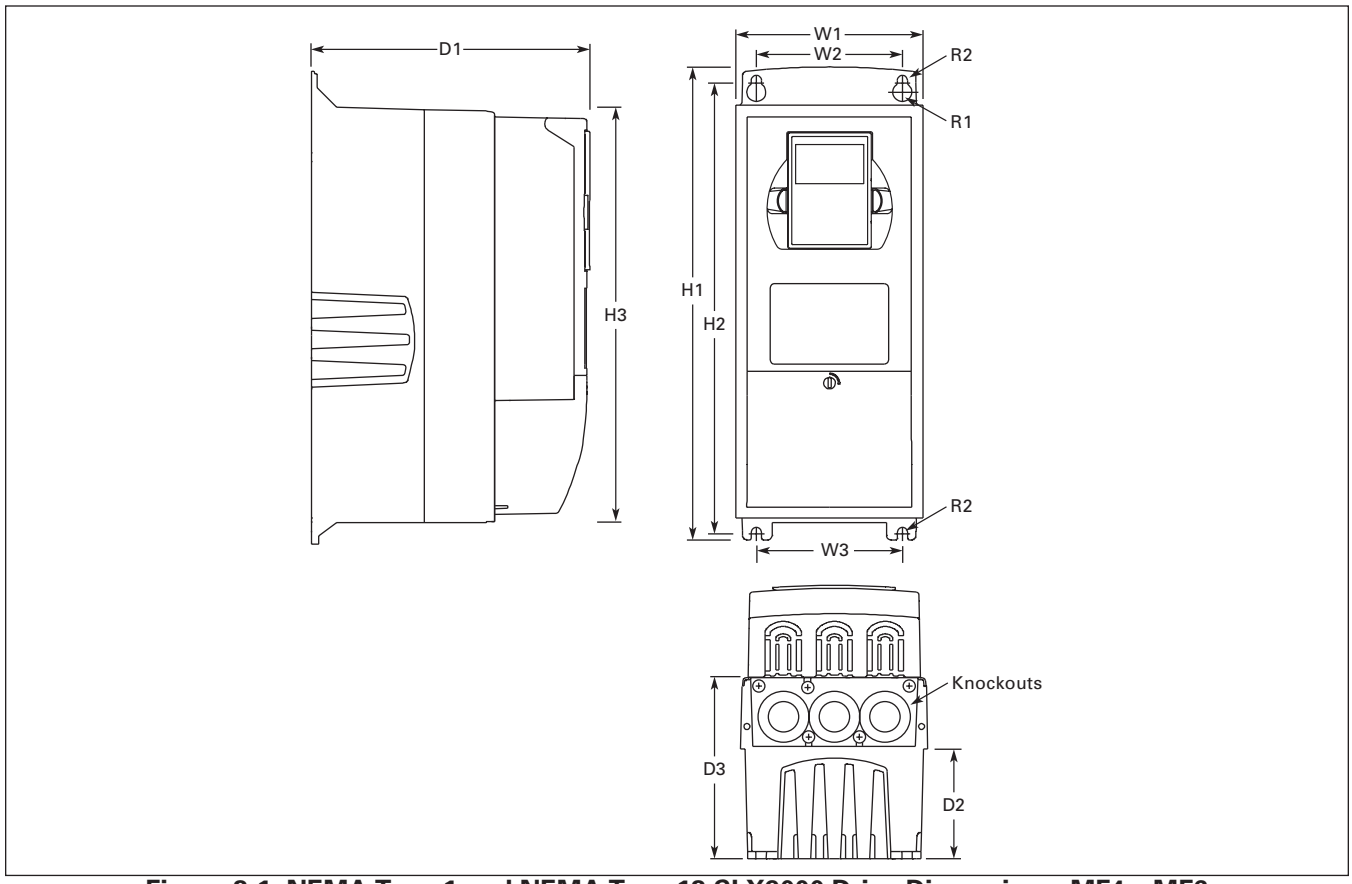


Figure 2-1: NEMA Type 1 and NEMA Type 12 SLX9000 Drive Dimensions, MF4 – MF6

Table 2-1: SLX9000 Drive Dimensions

Frame Size	hp (IH)	Approximate Dimensions in Inches (mm)											Weight Lbs. (kg)	Knockouts @ Inches (mm)
		H1	H2	H3	D1	D2	D3	W1	W2	W3	R1 dia.	R2 dia.		N1 (O.D.)
MF4	1 – 5	12.9 (327)	12.3 (313)	11.5 (292)	7.5 (190)	3.0 (77)	5.0 (126)	5.0 (128)	3.9 (100)	—	.5 (13)	.3 (7)	11.0 (5)	3 @ 1.1 (28)
MF5	7-1/2 – 15	16.5 (419)	16.0 (406)	15.3 (389)	8.4 (214)	3.9 (100)	5.8 (148)	5.6 (143)	3.9 (100)	—	.5 (13)	.3 (7)	17.9 (8)	2 @ 1.5 (37) 1 @ 1.1 (28)
MF6	20 – 30	22.0 (558)	21.3 (541)	20.4 (519)	9.3 (237)	4.2 (105)	6.5 (165)	7.6 (195)	5.8 (148)	—	.6 (15.5)	.4 (9)	40.8 (19)	3 @ 1.5 (37)

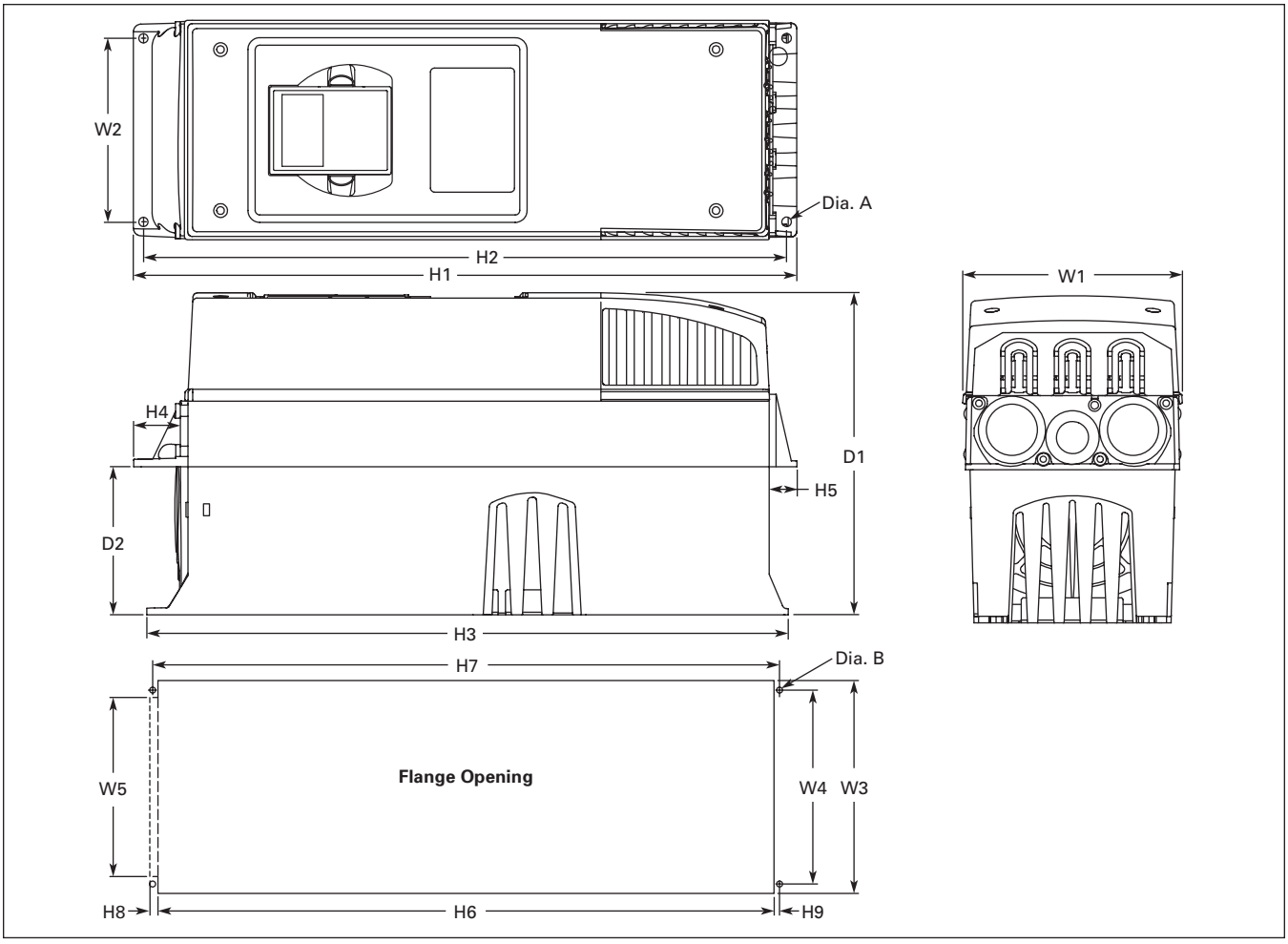


Figure 2-2: SLX9000 Dimensions, NEMA Type 1 and NEMA Type 12 with Flange Kit, MF4 – MF6

Table 2-2: Dimensions for SLX9000, MF4 – MF6 with Flange Kit

Frame Size	Approximate Dimensions in Inches (mm)									
	W1	W2	H1	H2	H3	H4	H5	D1	D2	Dia. A
MF4	5.0 (128)	4.5 (113)	13.3 (337)	12.8 (325)	12.9 (327)	1.2 (30)	.9 (22)	7.5 (190)	3.0 (77)	.3 (7)
MF5	5.6 (143)	4.7 (120)	17.0 (434)	16.5 (420)	16.5 (419)	1.4 (36)	.7 (18)	8.4 (214)	3.9 (100)	.3 (7)
MF6	7.7 (195)	6.7 (170)	22.0 (560)	21.6 (549)	22.0 (558)	1.2 (30)	.8 (20)	9.3 (237)	4.2 (106)	.3 (7)

Table 2-3: Dimensions for the Flange Opening, MF4 – MF6

Frame Size	Approximate Dimensions in Inches (mm)							
	W3	W4	W5	H6	H7	H8	H9	Dia. B
MF4	4.8 (123)	4.5 (113)	—	12.4 (315)	12.8 (325)	—	.2 (5)	.3 (7)
MF5	5.3 (135)	4.7 (120)	—	16.2 (410)	16.5 (420)	—	.2 (5)	.3 (7)
MF6	7.3 (185)	6.7 (170)	6.2 (157)	21.2 (539)	21.6 (549)	.3 (7)	.2 (5)	.3 (7)

Cooling

Forced air flow cooling is used for frames MF4, MF5 and MF6.

Enough free space needs to be left above and below the drive to ensure sufficient air circulation and cooling. You will find the required dimensions for free space in **Table 2-4**.

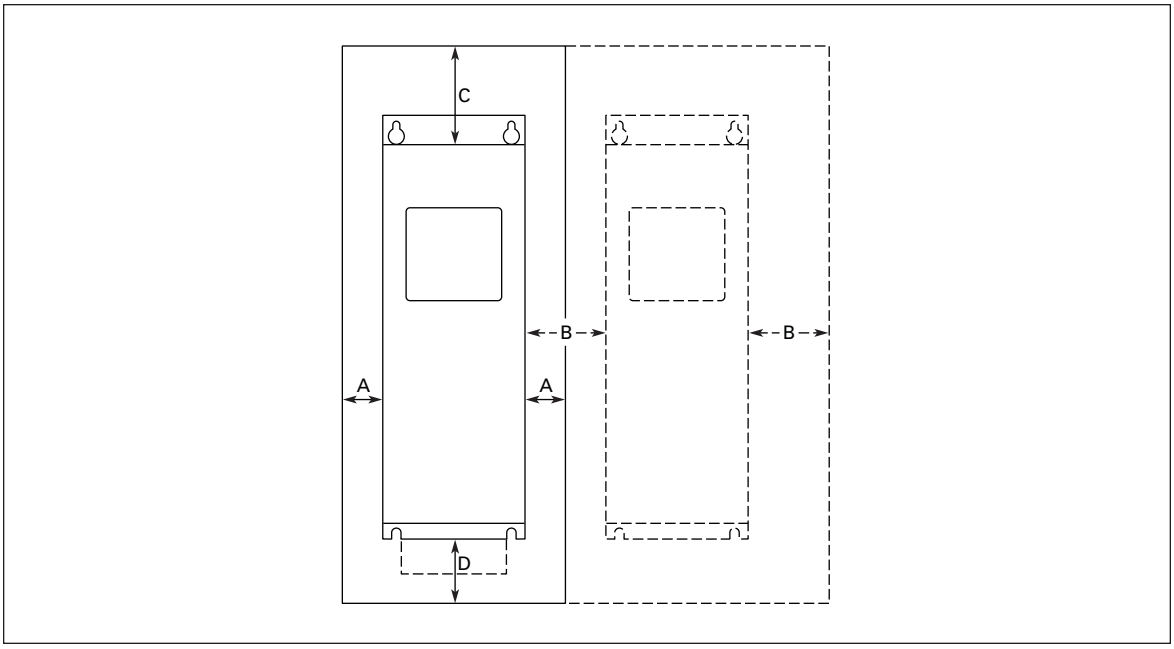


Figure 2-3: Installation Space

Table 2-4: Mounting Space Dimensions

Frame	Approximate Dimensions in Inches (mm)			
	A	**B**	**C**	**D**
MF4	.79 (20)	.79 (20)	3.94 (100)	1.97 (50)
MF5	.79 (20)	.79 (20)	4.72 (120)	2.36 (60)
MF6	1.18 (30)	.79 (20)	6.30 (160)	3.15 (80)

A = clearance around the drive (see also **B**)
B = clearance from one drive to another or distance to cabinet wall
C = free space above the drive
D = free space underneath the drive

Table 2-5: Required Cooling Air

Frame	Cooling Air Required (cfm)
MF4	41
MF5	112
MF6	250

Changing EMC Protection Class from H to T

The EMC protection class of SLX9000 drive frames MF4 – MF6 can be changed from **class H** to **class T** with a simple procedure presented in **Figure 2-4** – **2-5**.

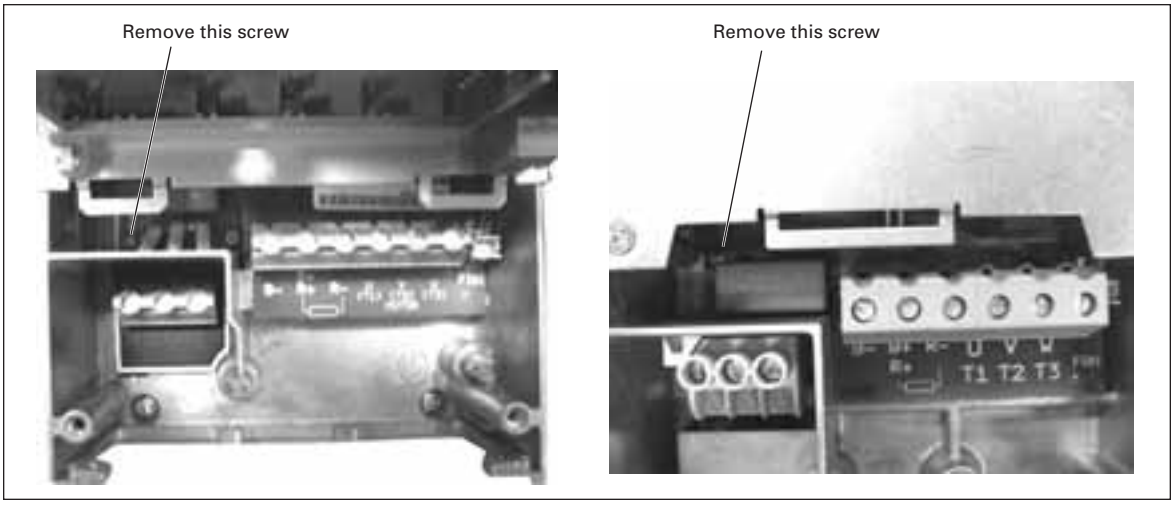


Figure 2-4: Changing of EMC Protection Class, MF4 (left) and MF5 (right)

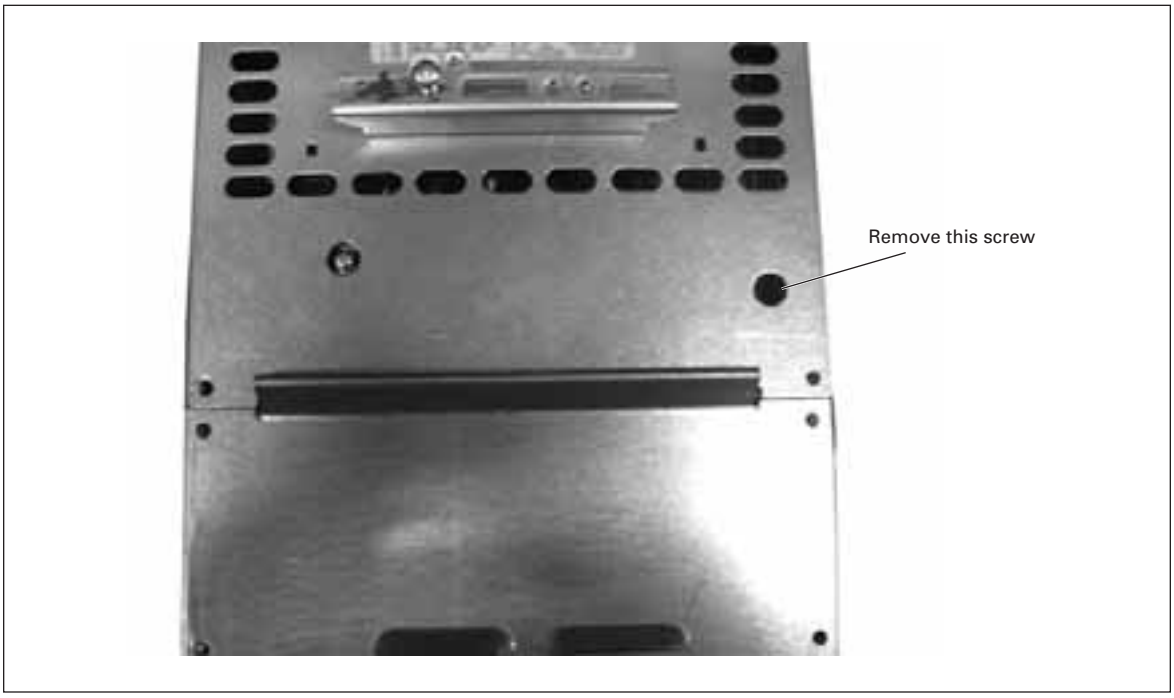


Figure 2-5: Changing of EMC Protection Class, MF6

Note: Do not attempt to change the EMC-level back to class H. Even if the procedure above is reversed, the drive will no longer fulfill the EMC requirements of class H!

Chapter 3 — Power Wiring

Power Connections

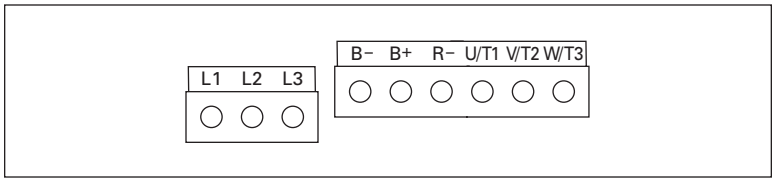


Figure 3-1: Power Connections, MF4 – MF6

Use cables with heat resistance of at least +70°C. The cables and the fuses must be dimensioned according to **Tables 3-1** and **3-2**. Installation of cables according to UL regulations is found on **Page 3-11**.

The fuses also function as cable overload protection.

These instructions apply only to cases with one motor and one cable connection from the drive to the motor. In any other case, ask the factory for more information.

Table 3-1: Cable Types Required to Meet Standards

Cable Type	1st Environment (Restricted Distribution) Level H/C	2nd Environment Level L	Level T	Level N
Mains Cable	1	1	1	1
Motor Cable	3①	2	1	1
Control Cable	4	4	4	4

Level C = EN 61800-3+A11, 1st environment, unrestricted distribution EN 61000-6-3
Level H = EN 61800-3+A11, 1st environment, restricted distribution EN 61000-6-4
Level L = EN 61800-3, 2nd environment
Level T: Consult Eaton.
Level N: Consult Eaton.
1 Power cable intended for fixed installation and the specific mains voltage. Shielded cable not required.
2 Power cable equipped with concentric protection wire and intended for the specific mains voltage.
3 Power cable equipped with compact low-impedance shield and intended for the specific mains voltage.
4 Screened cable equipped with compact low-impedance shield.

① 360° grounding of both motor and FC connection required to meet the standard.

Frames MF4 – MF6: A cable entry flange should be used when installing the motor cable at both ends in order to reach the EMC levels.

Note: The EMC requirements are fulfilled at factory defaults of switching frequencies (all frames).

Cable and Fuse Sizes

Table 3-2: Cable and Fuse Sizes for SLX9000, 380 – 500V

Frame	Horsepower	I_L (A)	Fuse (A)	Mains Cable Cu (mm^2)	Terminal Cable Size (Min./Max.)			
					Main Terminal (mm^2)	Ground Terminal (mm^2)	Control Terminal (mm^2)	Relay Terminal (mm^2)
MF4	1 – 5	7 – 9	10	3x1.5+1.5	1 – 4	1 – 2.5	.5 – 1.5	.5 – 2.5
MF4	6	12	16	3x2.5+2.5	1 – 4	1 – 2.5	.5 – 1.5	.5 – 2.5
MF5	7-1/2	16	20	3x4+4	1 – 10	1 – 10	.5 – 1.5	.5 – 2.5
MF5	10	22	25	3x6+6	1 – 10	1 – 10	.5 – 1.5	.5 – 2.5
MF5	15	31	35	3x10+10	1 – 10	1 – 10	.5 – 1.5	.5 – 2.5
MF6	20 – 25	38 – 45	50	3x10+10	2.5 – 50 Cu 6 – 50 Al	6 – 35	.5 – 1.5	.5 – 2.5
MF6	30	61	63	3x16+16	2.5 – 50 Cu 6 – 50 Al	6 – 35	.5 – 1.5	.5 – 2.5

Note: Cable recommendation is based on standard EN 60204-1 and PVC isolated cable where there is either one cable on a shelf temperature of 40°C or four cables on a shelf temperature of 30°C.

Mounting of Cable Accessories

Enclosed with your drive you have received a plastic bag containing components that are needed for the installation of the mains and motor cables in the drive.

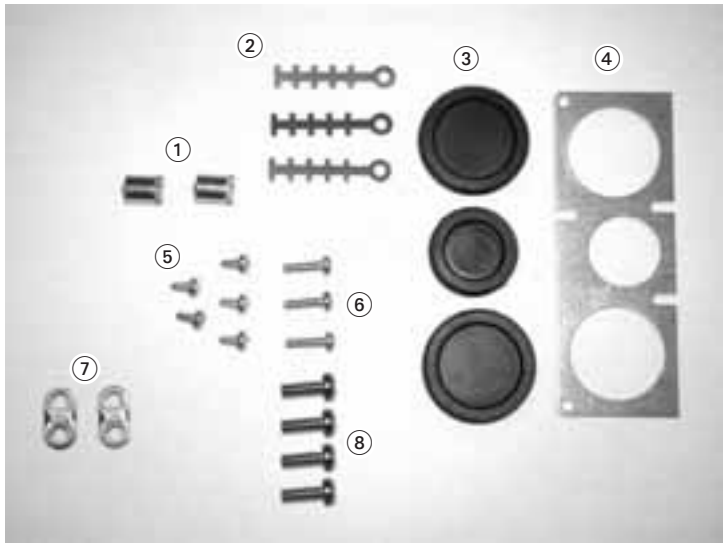


Figure 3-2: Cable Accessories

Components:

1	Grounding terminals (MF4, MF5) (2)	5	Screws, M4x10 (5)
2	Cable clamps (3)	6	Screws, M4x16 (3)
3	Rubber grommets (sizes vary from class to class) (3)	7	Grounding cable clamps (MF6) (2)
		8	Grounding screws M5x16 (MF6) (4)
4	Cable entry gland (1)		

Note: The cable accessories installation kit for drives of protection class NEMA Type 12 includes all components except 4 and 5.

Table 3-3: Mounting Procedure

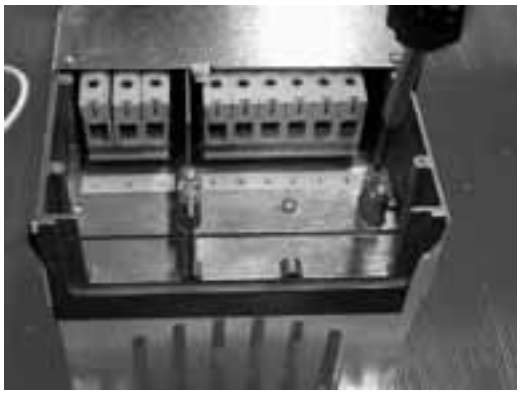
1	Make sure that the plastic bag you have received contains all necessary components.	
2	Open the cover of the drive.	
3	Remove the cable cover. Observe the places for: a) the grounding terminals (MF4/MF5)	
	b) the grounding cable clamps (MF6)	

Table 3-3: Mounting Procedure (Continued)

4	Re-install the cable cover. Mount the cable clamps with the three M4x16 screws as shown. Note that the location of the grounding bar in FR6/ MF6 is different from what is shown in the picture.	
5	Place the rubber grommets in the openings as shown.	
6	Fix the cable entry gland to the frame of the drive with the five M4x10 screws. Close the cover of the drive.	

Installation Instructions

1. Before starting the installation, check that none of the components of the drive is live.
2. Place the motor cables sufficiently far from other cables:
   - **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 3-4**.
   - The given distances also apply between the motor cables and signal cables of other systems.
   - **The maximum length of the motor cables is 164 feet (50m) for MF4 and 984 feet (300m) for MF5 – MF6.**
   - If the **motor cables cross** other cables, it should be at an angle of 90 degrees.

Table 3-4: Cable Distances

Distance Between Cables in Inches (m)	Shielded Cable in Feet (m)
11.8 (.3) 39.4 (1.0)	≤66 (20) ≤164 (50)

3. If cable insulation checks are needed, see **Page 3-11**.
4. Connect the cables:
   - Strip the motor and mains cables as advised in **Table 3-5** and **Figure 3-3**.
   - Connect the mains, motor and control cables into their respective terminals.
   - For Information on cable installation according to UL regulations see **Page 3-11**.
   - Make sure that the control cable wires do not come in contact with the electronic components of the unit.
   - If an external brake resistor (option) is used, connect its cable to the appropriate terminal.
   - Check the connection of the ground cable to the motor and the drive terminals marked with ⏚.
   - Connect the separate shield of the motor cable to the ground plate of the drive, motor and the supply center.
   - Ensure that the control cables or the cables of the unit are **not trapped** between the frame and the protection plate.

Stripping Lengths of Motor and Mains Cables

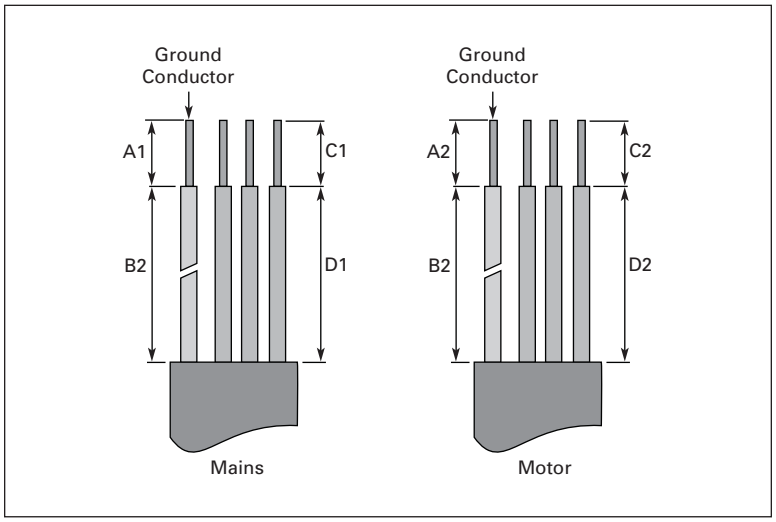


Figure 3-3: Stripping of Cables

Table 3-5: Cable Stripping Lengths

Frame	Approximate Dimensions in Inches (mm)							
	A1	**B1**	**C1**	**D1**	**A2**	**B2**	**C2**	**D2**
MF4	.59 (15)	1.38 (35)	.39 (10)	.79 (20)	.28 (7)	1.97 (50)	.28 (7)	1.38 (35)
MF5	.79 (20)	1.57 (40)	.39 (10)	1.18 (30)	.79 (20)	2.36 (60)	.39 (10)	1.57 (40)
MF6	.79 (20)	3.54 (90)	.59 (15)	2.36 (60)	.79 (20)	3.54 (90)	.59 (15)	2.36 (60)

Installation of Cables to SLX9000, MF4 – MF6

Figure 3-4: SLX9000, MF4

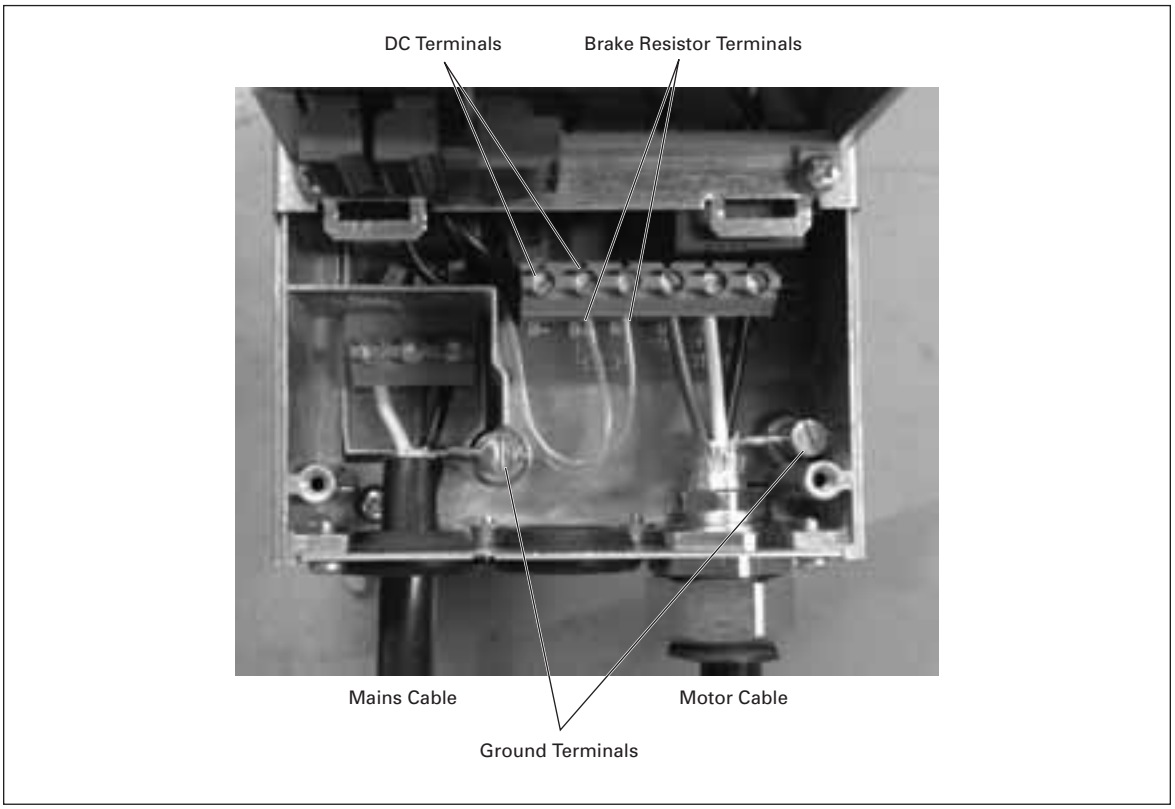


Figure 3-5: Cable Installation in SLX9000, MF4

Figure 3-6: SLX9000, MF5

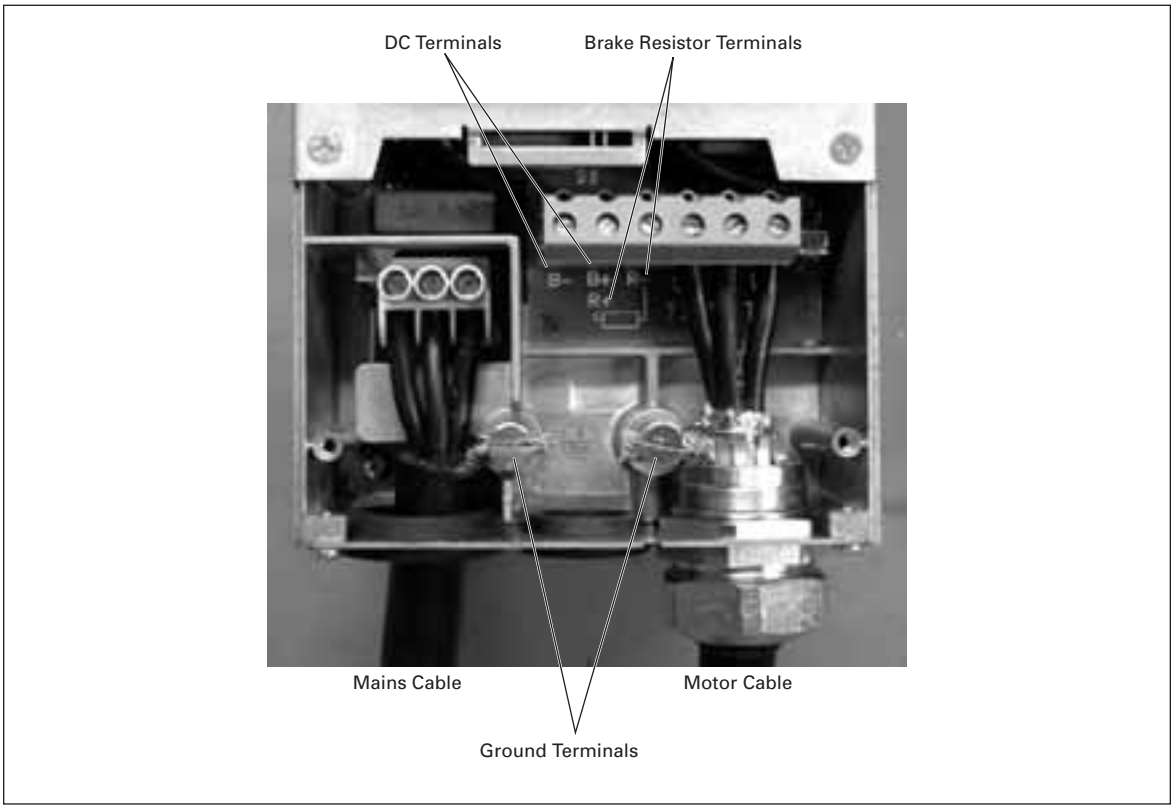


Figure 3-7: Cable Installation in SLX9000, MF5

Figure 3-8: SLX9000, MF6

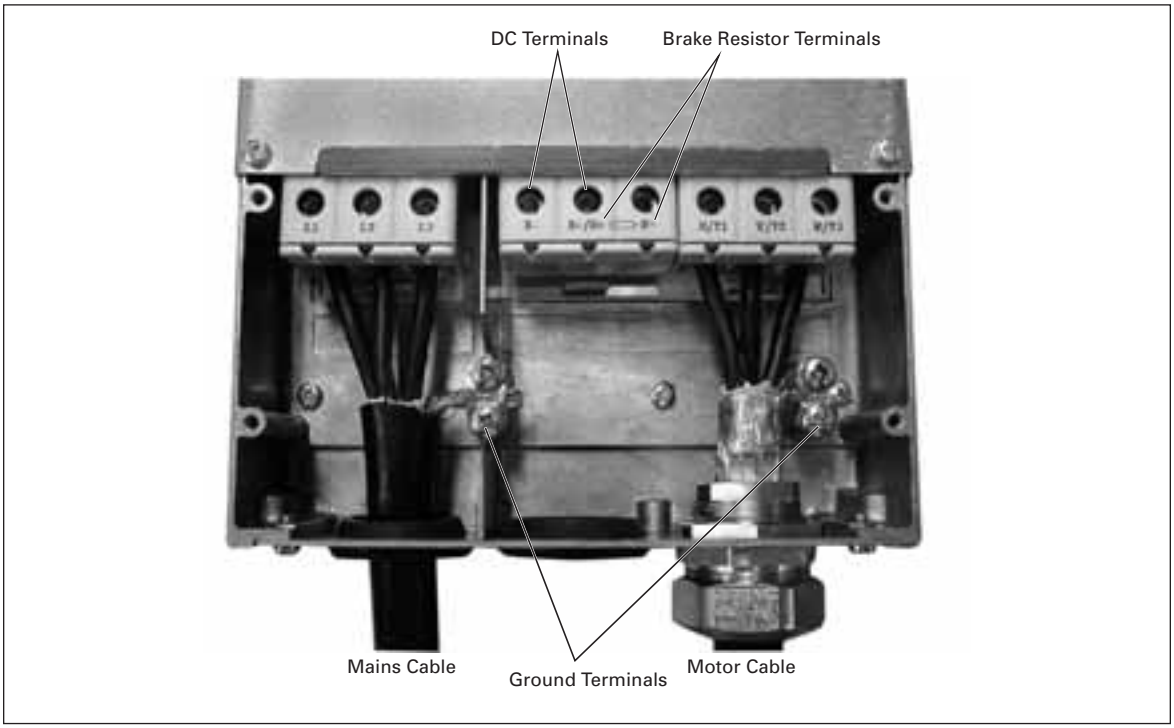


Figure 3-9: Cable Installation in SLX9000, MF6

Cable Installation and the UL Standards

To meet the UL (Underwriters Laboratories) regulations, a UL-approved copper cable with a minimum heat-resistance of +60/75°C must be used.

The tightening torques of the terminals are given in **Table 3-6**.

Table 3-6: Tightening Torques of Terminals

Frame	Tightening Torque (Nm)	Tightening Torque in-lbs.
MF4	.5 – .6	4 – 5
MF5	1.2 – 1.5	10 – 13
MF6	4	35

Cable and Motor Insulation Checks

1. Motor cable insulation checks

   Disconnect the motor cable from terminals U, V and W of the drive 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 >1MΩ.

2. Mains cable insulation checks

   Disconnect the mains cable from terminals L1, L2 and L3 of the drive and from the mains. Measure the insulation resistance of the mains cable between each phase conductor as well as between each phase conductor and the protective ground conductor.

   The insulation resistance must be >1MΩ.

3. Motor insulation checks

   Disconnect the motor cable from the motor and open the 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 >1MΩ.

Chapter 4 — Control Wiring

Control Unit

In frames MF4 – MF6 there are two option board connectors SLOT D and SLOT E (see **Figure 4-1**) . Newest software supports hardware with two board slots. Also older software versions can be used, but they will not support hardware with two board slots.

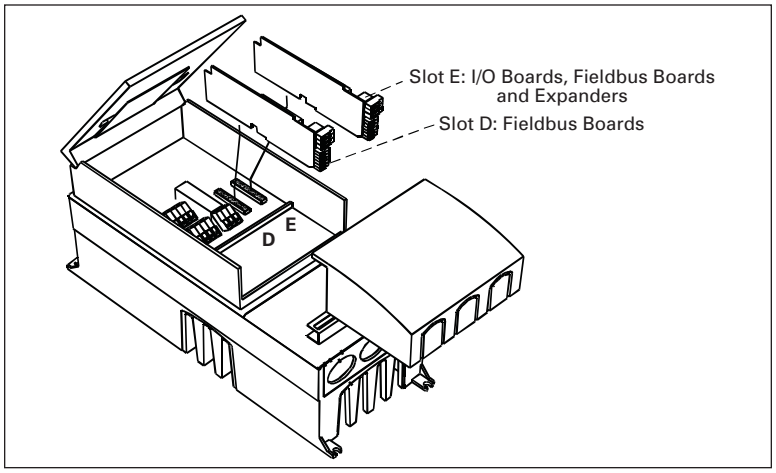


Figure 4-1: Option Board Slots D and E in Frames MF4 – MF6

Allowed Option Boards in MF4 – MF6

See below for the allowed option boards in the two slots on MF4 – MF6 drives.

SLOT D	C3	C4	C6	C7	CI	CJ									
SLOT E	AA	AI	B1	B2	B4	B5	B9	C2	C3	C4	C6	C7	C8	CI	CJ

When two option boards are used, the one in slot E has to be OPTAI or OPTAA. Do not use two OPTB_ or OPTC_ boards. Also, combinations of OPTB_ and OPTC_ boards are prohibited.

See descriptions for OPTAA and OPTAI option boards in **Appendixes B** and **C**.

Control Connections

The basic control connections are shown on **Page 4-2**.

The signal descriptions of the Multicontrol Application are presented below and in the application manual.

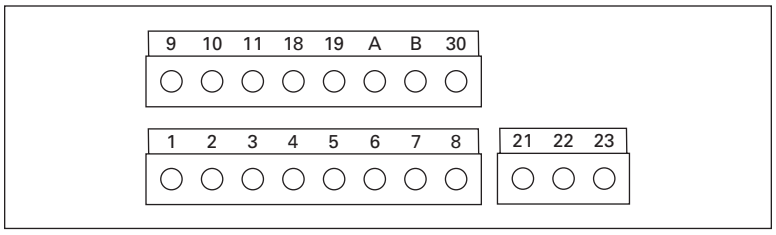
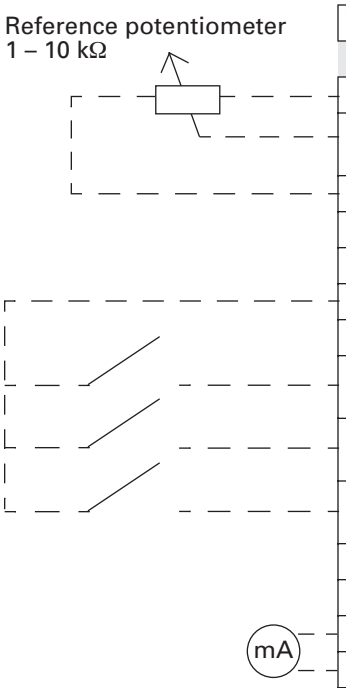


Figure 4-2: Control Connections, MF4 – MF6

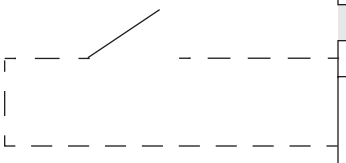
Control Input/Output

Table 4-1: Multicontrol Application Default Input/Output Configuration



Terminal		Signal	Description
1	+10 V_{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-/GND		
6	+24V	Control voltage output	Voltage for switches, etc. max .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	Multi-step speed selection 1 (programmable)	Contact closed = multi-step speed
11	GND	I/O ground	Ground for reference and controls
18	AO1+	Output frequency Analog output	Programmable Range 0 – 20 mA, R_L max. 500Ω
19	AO1-		
A	RS-485	Serial bus	Differential receiver/transmitter
B	RS-485	Serial bus	Differential receiver/transmitter
30	+24V	24V auxiliary input voltage	Control power supply backup
21	RO1	Relay output 1 FAULT	Programmable
22	RO1		
23	RO1		

Table 4-2: AI1 Configuration, When Programmed as DIN4



Terminal		Signal	Description
1	+10 V_{ref}	Reference output	Voltage for potentiometer, etc.
2	AI1+ **or DIN4**	Analog input, voltage range 0 – 10V DC	Voltage input frequency reference (MF2 – MF3) Voltage/current input frequency reference (MF4 – MF6) **Can be programmed as DIN4**
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analog input, current range 0 – 10V DC or current range 0 – 20 mA	Voltage or current input frequency reference
5	AI2-/GND		
6	+24V	Control voltage output	
7	GND	I/O ground	Ground for reference and controls

Control Terminal Signals

Table 4-3: Control Input/Output Terminal Signals

Terminal		Signal	Description
1	+10 V_{ref}	Reference voltage	Maximum current 10 mA
2	AI1+	Analog input, voltage (MF4 and larger: voltage or current)	**MF4 – MF6:** Selection V or mA with jumper block X8 (see **Page 4-2**): Default: 0 – 10V (Ri = 200 kΩ) 0 – 20 mA (Ri = 250W)
3	AI1-	Analog input common	Differential input if not connected to ground; Allows ±20V differential mode voltage to GND
4	AI2+	Analog input, voltage or current	Selection V or mA with jumper block X13 (MF4 – MF6) Default: 0 – 20mA (Ri = 250 Ω) 0 – 10V (Ri = 200 kΩ)
5	AI2-	Analog input common	Differential input; Allows ±20V differential mode voltage to GND
6	24 V_{out}	24V auxiliary output voltage	±10%, maximum current 100 mA
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Digital input 1	R_i = min. 5 kΩ
9	DIN2	Digital input 2	
10	DIN3	Digital input 3	
11	GND	I/O ground	Ground for reference and controls
18	AO1+	Analog signal (+output)	Output signal range: Current 0(4) – 20 mA, R_L max 500Ω or
19	AO1-/GND	Analog output common	
A	RS-485	Serial bus	Differential receiver/transmitter, bus impedance 120Ω
B	RS-485	Serial bus	Differential receiver/transmitter, bus impedance 120Ω
30	+24V	24V auxiliary input voltage	Control power supply backup
21	RO1/1	 Relay output 1	Switching capacity: 24V DC/8A 250V AC/8A 125V DC/.4A Relay output terminals are galvanically isolated from the I/O ground
22	RO1/2		
23	RO1/3		

Jumper Selections on SLX9000 Basic Board

The user is able to customize the functions of the drive to better suit an application by selecting certain positions for the jumpers on the SLX9000 board. The positions of the jumpers determine the signal type of analog input (terminal #2) and whether the termination resistor RS-485 is used or not.

The following figures present the jumper selections of SLX9000 drives:

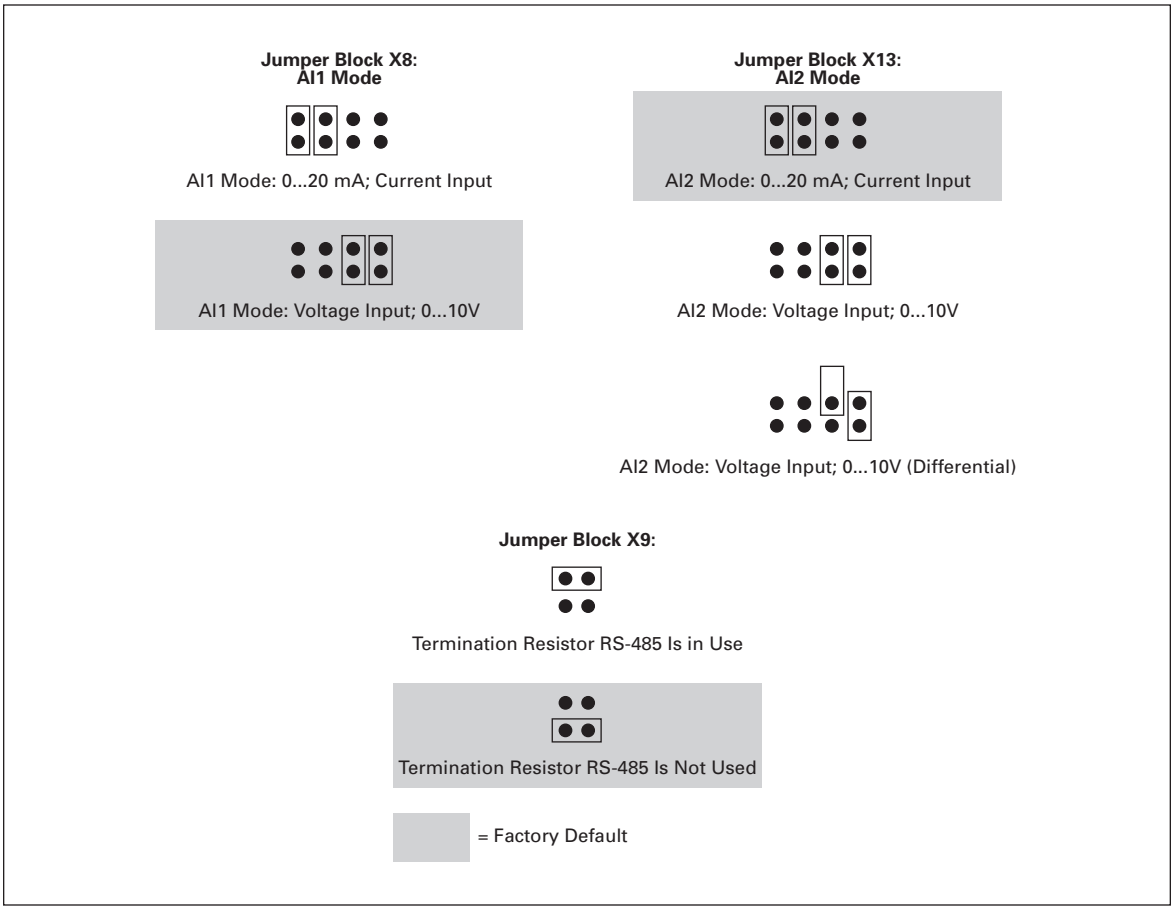


Figure 4-3: Jumper Selection for SLX9000, MF4 – MF6

⚠ CAUTION

Check the correct positions of the jumpers. Running the motor with signal settings different from the jumper positions will not harm the drive but may damage the motor.

Note: If you change the AI signal content also remember to change the corresponding parameters (S6.9.1, 6.9.2) in System Menu.

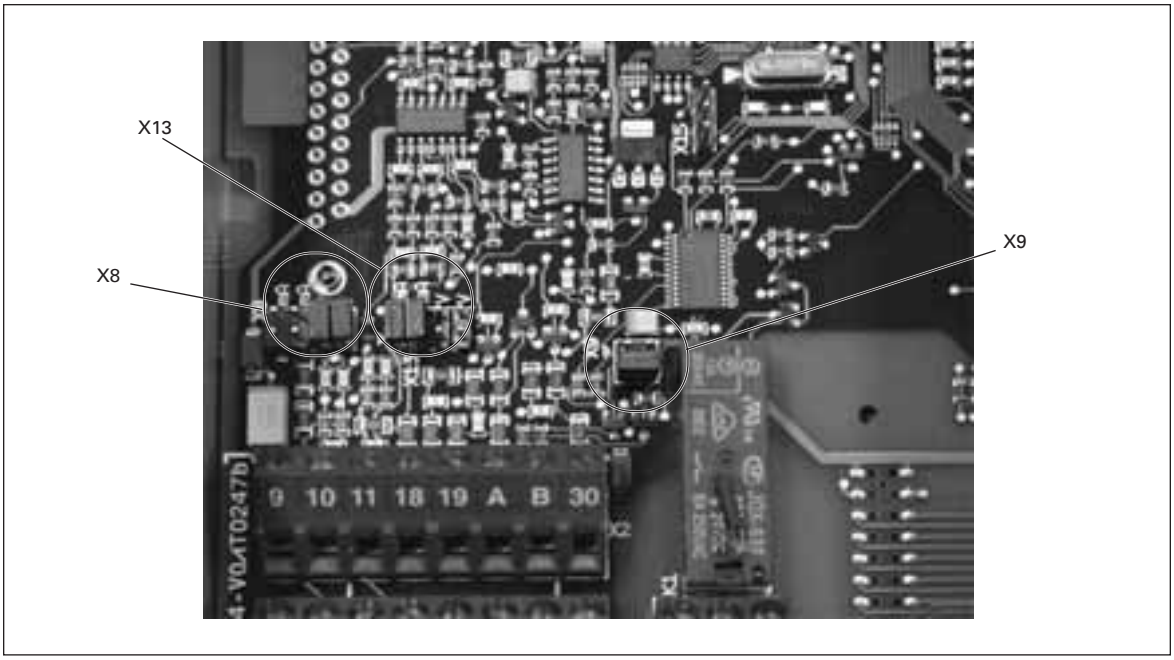


Figure 4-4: Location of Jumper Blocks in the Control Board of MF4 – MF6

Motor Thermistor (PTC) Connection

There are three ways to connect a PTC resistor to SLX9000.

1. With optional board OPTAI (recommended method).

   SLX9000 drive equipped with OPTAI fulfills IEC 664 if the motor thermistor is insulated (= effective double insulation).

2. With optional board OPTB2.

   SLX9000 drive equipped with OPTB2 fulfills IEC 664 if the motor thermistor is insulated (= effective double insulation).

3. With the digital input (DIN3) of SLX9000 drive.

   The DIN3 is galvanically connected to other I/Os of SLX9000. This is why reinforced or double insulation of the thermistor (IEC 664) is absolutely required outside the drive (in the motor or between the motor and the drive).

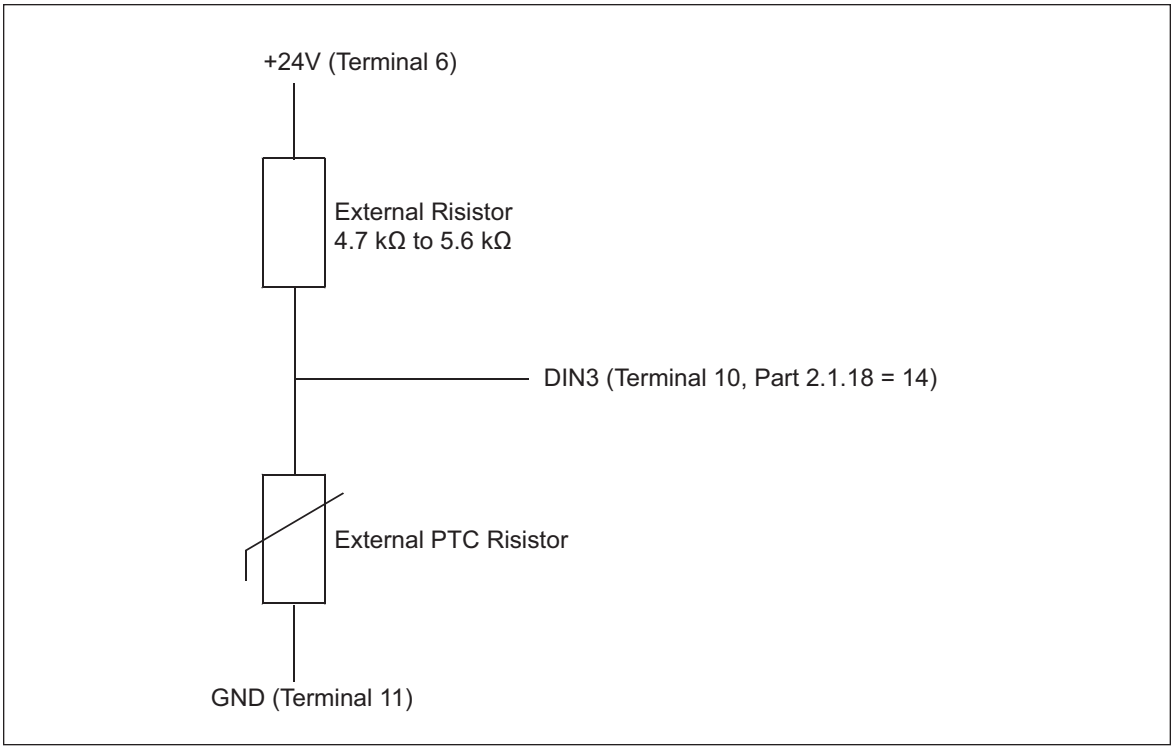


Figure 4-5: Motor Thermistor (PTC) Connection

Note: The drive trips when PTC impedance exceeds 4.7 kΩ.

We strongly recommend the use of OPTAI or OPTB2 board for motor thermistor connection.

⚠ WARNING

If the motor thermistor is connected to DIN3, the instructions above **must be** followed, otherwise a serious safety hazard may result from the connection.

Chapter 5 — Menu Information

Keypad Operation

The control keypad is the link between the SLX9000 drive and the user. The control keypad features an alphanumeric display with seven indicators for the Run status (RUN, counterclockwise, clockwise, READY, STOP, ALARM, FAULT) and three indicators for the control place (I/O term/Keypad/BusComm).

The control information, i.e. the menu number, the displayed value and the numeric information are represented with numeric symbols.

The drive is operable through the seven pushbuttons of the control keypad. Furthermore, the buttons can be used in setting parameters and monitoring values.

The keypad is detachable and isolated from the input line potential.

Indicators on the Keypad Display

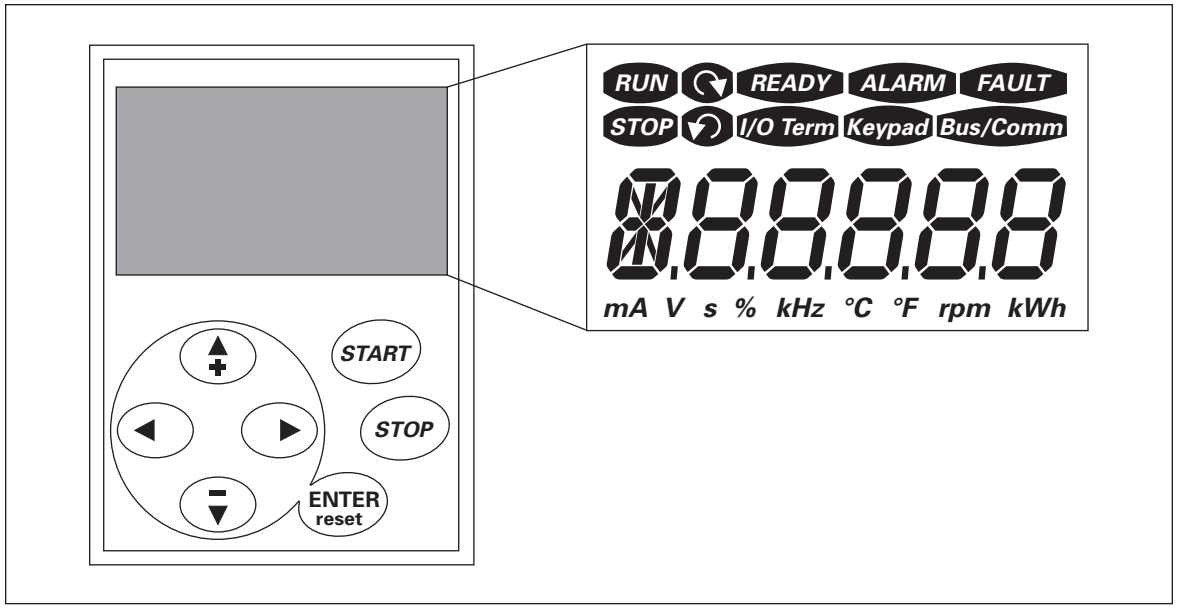


Figure 5-1: Control Keypad and Drive Status Indications

Drive Status Indicators

The drive status symbols tell the user the status of the motor and the drive.

Table 5-1: Drive Status Indicators

Indicator	Description
RUN	**RUN** Motor is running; Blinks when the stop command has been given but the frequency is still ramping down.
	Indicates the direction of motor rotation.
STOP	**STOP** Indicates that the drive is not running.
READY	**READY** Lights up when AC power is on. In case of a fault, the symbol will not light up.
ALARM	**ALARM** Indicates that the drive is running outside a certain limit and a warning is given.
FAULT	**FAULT** Indicates that unsafe operating conditions were encountered due to which the drive was stopped.

Control Place Indicators

The symbols I/O term, Keypad and Bus/Comm (see **Table 5-2**) indicate the choice of control place made in the Keypad control menu (M3) (see **Table 5-6**).

Table 5-2: Control Place Indicators

Indicator	Description
I/O Term	**I/O Terminal** I/O terminals are selected as the control place i.e. START/STOP commands or reference values etc. are given through the I/O terminals.
Keypad	**Keypad** Control keypad is selected as the control place i.e. the motor can be started or stopped, or its reference values etc. altered from the keypad.
Bus/comm	**Bus/Comm** The drive is controlled through a fieldbus.

Numeric Indicators

The numeric indications provide the user with information on present location in the keypad menu structure as well as with information related to the operation of the drive.

Keypad Pushbuttons

The SLX9000 seven-segment control keypad features seven pushbuttons that are used for the control of the DRIVE (and motor) and parameter setting.

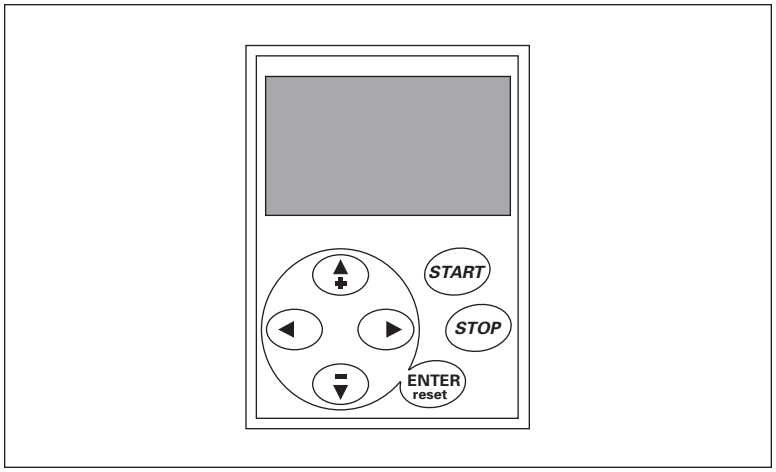


Figure 5-2: Keypad Pushbuttons

Table 5-3: Button Descriptions

Indicator	Description
ENTER reset	There are two operations integrated in this button. The button operates mainly as RESET button except in the parameter edit mode. The button operation is shortly described below. The ENTER button serves for: 1. confirmation of selections 2. fault history reset (2 – 3 seconds) RESET is used to reset active faults. **Note:** The motor may start immediately after resetting the faults.
▲	**Browser Button Up** Browse the main menu and the pages of different submenus. Edit values.
▼	**Browser Button Down** Browse the main menu and the pages of different submenus. Edit values.
◄	**Menu Button Left** Move backward in menu. Move cursor left (in parameter menu). Exit edit mode. Press for 2 to 3 seconds to return to main menu.
►	**Menu Button Right** Move forward in menu. Move cursor right (in parameter menu). Enter edit mode.
START	**START Button** Pressing this button starts the motor if the keypad is the active control place. See **Page 5-10**.
STOP	**STOP Button** Pressing this button stops the motor (unless disabled by parameter P3.4). See **Page 5-10**. STOP button also serves for activating the Start-Up Wizard (see **Page 6-4**).

Menu Navigation

The data on the control keypad are arranged in menus and submenus. The menus are used for the display and editing of measurement and control signals, parameter settings (see **Page 5-8**) and reference value (see **Page 5-11**) and fault displays (see **Page 5-11**).

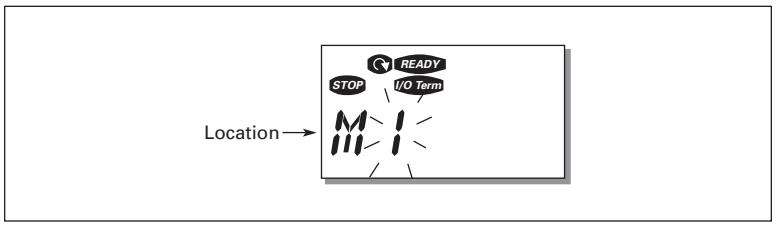


Figure 5-3: Keypad Display Data

The first menu level consists of menus M1 to E7 and is called the Main Menu. The user can navigate in the main menu with the Browser buttons up and down. The desired submenu can be entered from the main menu with the Menu buttons. When there still are pages to enter under the currently displayed menu or page, the last digit of the figure blinks and you can reach the next menu level by pressing Menu Button Right.

The control keypad navigation chart is shown in **Figure 5-4**. Please note that menu **M1** is located in the lower left corner. From there you will be able to navigate your way up to the desired menu using the menu and browser buttons.

You will find more detailed descriptions of the menus later in this chapter.

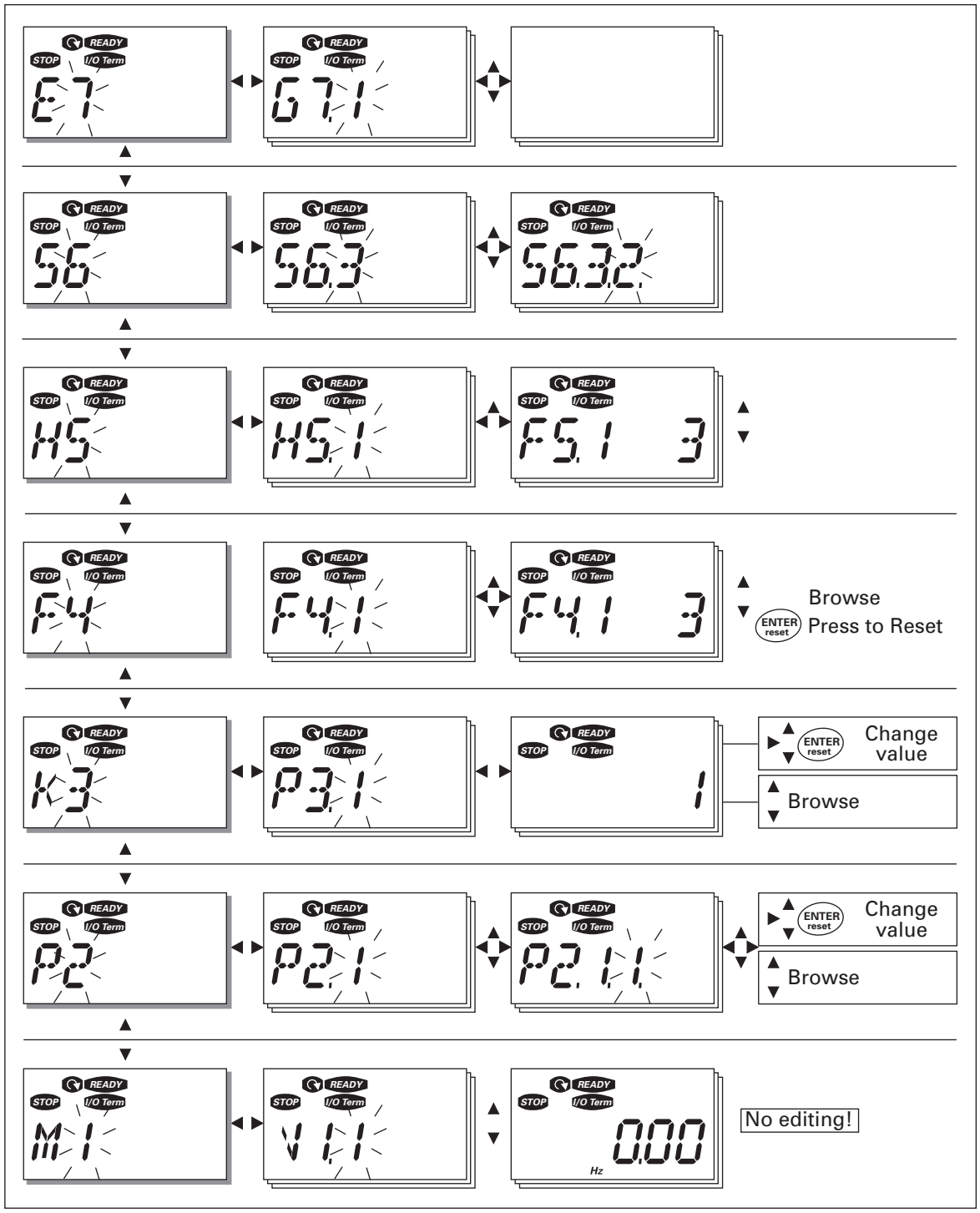


Figure 5-4: Keypad Navigation Chart

Table 5-4: Main Menu Functions

Code	Menu	Min.	Max.	Selections
M1	Monitoring menu	V1.1	V1.24	**See Page 5-7 for the monitoring values**
P2	Parameter menu	P2.1	P2.10	P2.1 = Basic parameters P2.2 = Input signals P2.3 = Output signals P2.4 = Drive control P2.5 = Prohibit frequencies P2.6 = Motor control P2.7 = Protections P2.8 = Autorestart P2.9 = PID control P2.10=Pump and fan control **See the Multi-control application manual for detailed parameter lists**
K3	Keypad control menu	P3.1	P3.6	P3.1 = Selection of control place R3.2 = Keypad reference P3.3 = Keypad direction P3.4 = Stop button activation P3.5 = PID reference 1 P3.6 = PID reference 2
F4	Active faults menu			Shows the active faults and their types
H5	Fault history menu			Shows the fault history list
S6	System menu	S6.3	S6.10	S6.3 = Copy parameters S6.5 = Security S6.6 = Keypad settings S6.7 = Hardware settings S6.8 = System info S6.9 = AI mode S6.10 = Fieldbus parameters **Parameters are described on Page 5-13**
E7	Expander board menu			

Monitoring Menu (M1)

You can enter the Monitoring menu from the Main menu by pressing Menu Button Right when the location indication **M1** is visible on the display. **Figure 5-5** shows how to browse through the monitored values.

The monitored signals carry the indication **V#.#** and listed in **Table 5-5**. The values are updated once every .3 seconds.

This menu is for signal checking. The values cannot be changed. To change values of the parameters, see **Page 5-8**.

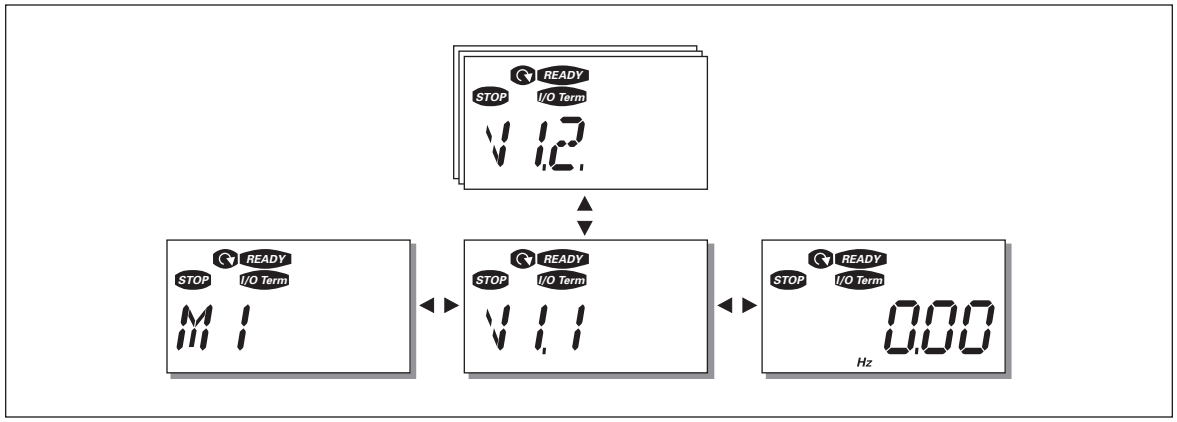


Figure 5-5: Monitoring Menu

Table 5-5: Monitored Signals

Code	Signal Name	Unit	ID	Description
V1.1	Output frequency	Hz	1	Frequency to the motor
V1.2	Frequency reference	Hz	25	
V1.3	Motor speed	rpm	2	Calculated motor speed
V1.4	Motor current	A	3	Measured motor current
V1.5	Motor torque	%	4	Calculated actual torque/nominal torque of the motor
V1.6	Motor power	%	5	Calculated actual power/nominal power of the motor
V1.7	Motor voltage	V	6	Calculated motor voltage
V1.8	DC-link voltage	V	7	Measured DC-link voltage
V1.9	Unit temperature	°C	8	Heatsink temperature
V1.10	Analog input 1		13	AI1
V1.11	Analog input 2		14	AI2
V1.12	Analog output current	mA	26	AO1
V1.13	Analog output current 1, expander board	mA	31	
V1.14	Analog output current 2, expander board	mA	32	
V1.15	DIN1, DIN2, DIN3		15	Digital input statuses
V1.16	DIE1, DIE2, DIE3		33	I/O expander board: Digital input statuses
V1.17	RO1		34	Relay output 1 status
V1.18	ROE1, ROE2, ROE3		35	I/O exp. board: Relay output statuses
V1.19	DOE1		36	I/O exp. board: Digital output 1 status
V1.20	PID Reference	%	20	In percent of the maximum process reference
V1.21	PID Actual value	%	21	In percent of the maximum actual value
V1.22	PID Error value	%	22	In percent of the maximum error value
V1.23	PID Output	%	23	In percent of the maximum output value
V1.24	Autochange outputs 1, 2, 3		30	Used only in pump and fan control

Parameter Menu (P2)

Parameter values can be edited by entering the Parameter Menu from the Main Menu when the location indication **P2** is visible on the display. The value editing procedure is presented in **Figure 5-6**.

Pressing Menu Button Right once takes you to the Parameter Group Menu (G#). Locate the desired parameter group by using the Browser buttons and press Menu Button Right again to see the group and its parameters. Use the Browser buttons to find the parameter (P#) you want to edit. Pressing Menu Button Right takes you to the edit mode. As a sign of this, the parameter value starts to blink. You can now change the value in two different ways:

- Set the desired value with the Browser buttons and confirm the change with the ENTER button. Consequently, the blinking stops and the new value is visible in the value field.
- Press Menu Button Right once more. Now you will be able to edit the value digit by digit. This may come in handy, when a relatively greater or smaller value than that on the display is desired. Confirm the change with the ENTER button.

The value will not change unless the ENTER button is pressed. Pressing Menu Button Left takes you back to the previous menu.

Several parameters are locked, i.e. cannot be edited, when the drive is in RUN status. The drive must be stopped to edit these parameters.

The parameter values can also be locked using the function in menu **S6** (see **Page 5-16**).

You can return to the Main Menu any time by pressing Menu Button Left for 1 to 2 seconds.

The basic parameters are listed in **Chapter 6**. You will find the complete parameter lists and descriptions in the *Multi-Control Application* manual.

Once in the last parameter of a parameter group, you can move directly to the first parameter of that group by pushing the Browser button up.

Once in the last parameter of a parameter group, you can move directly to the first parameter of that group by pressing Browser Button Up.

See the diagram for parameter value change procedure in **Figure 5-6**.

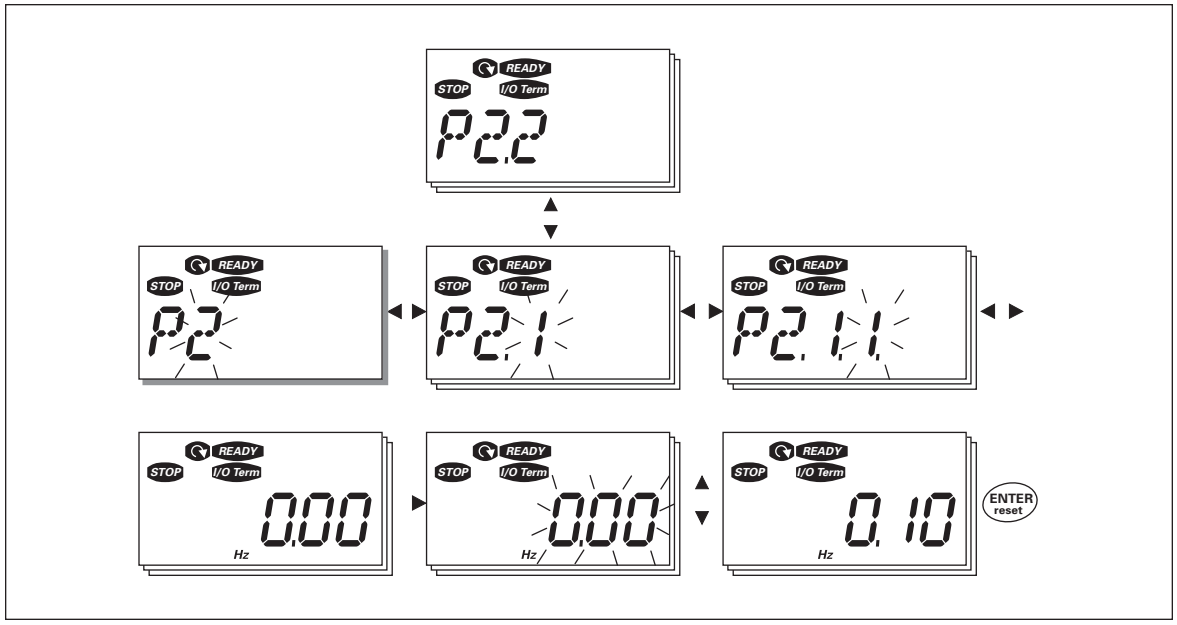


Figure 5-6: Parameter Value Change Procedure

Keypad Control Menu (K3)

In the Keypad Control Menu, you can choose the control place, edit the frequency reference and change the direction of the motor. You can enter the submenu level by pressing Menu Button Right.

Table 5-6: Keypad Control Menu Selections

Parameters in Menu K3	Selections
P3.1 = Selection of control place	**1** = I/O terminals **2** = Keypad **3** = Fieldbus
R3.2 = Keypad reference	
P3.3 = Keypad direction	**0** = Forward **1** = Reverse
P3.4 = Stop button activation	**0** = Limited function of Stop button **1** = Stop button always enabled
P3.5 = PID reference 1	
P3.6 = PID reference 2	

Selection of Control Place

There are three different places (sources) where the drive can be controlled. For each control place, a different symbol will appear on the alphanumeric display:

- I/O terminals
- Keypad (panel)
- Fieldbus

You can change the control place by entering the edit mode with Menu Button Right. The options can then be browsed with the Browser buttons. Select the desired control place with the ENTER button. See **Figure 5-7**.

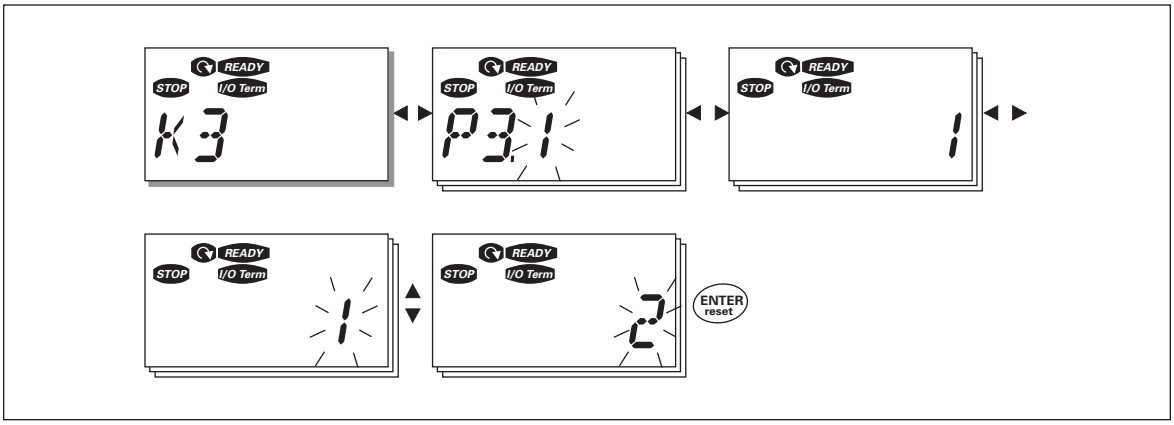


Figure 5-7: Selection of Control Place

Keypad Reference

The keypad reference submenu (**R3.2**) displays and allows the operator to edit the frequency reference. The changes will take place immediately. **This reference value will not, however, influence the rotation speed of the motor unless the keypad has been selected as the active control place.**

Note: The maximum difference between the output frequency and the keypad reference is 6 Hz. The program automatically monitors the keypad reference value.

You may edit the reference value (pressing the ENTER button is not necessary). See **Figure 5-6**.

Keypad Direction

The keypad direction submenu displays and allows the operator to change the rotating direction of the motor. **This setting will not, however, influence the rotation direction of the motor unless the keypad has been selected as the active control place.**

Note: See **Table 5-6** for how to change the rotation direction.

STOP Button Activated

By default, pushing the STOP button will **always** stop the motor regardless of the selected control place. You can disable this function by giving parameter 3.4 the value **0**. If the value of this parameter is **0**, the STOP button will stop the motor only **when the keypad has been selected as the active control place**.

Note: See **Table 5-6** for how to change the value of this parameter.

Active Faults Menu (F4)

You can enter the Active Faults menu from the Main Menu by pressing Menu Button Right when the location indication **F4** is visible on the keypad display.

The memory of active faults can store a maximum of five faults in the order of appearance. The display can be cleared with the RESET button and the read-out will return to the same state it was in before the fault trip. The fault remains active until it is cleared with the RESET button or with a reset signal from the I/O terminal.

Note: Remove external Start signal before resetting the fault to prevent unintentional restart of the drive.

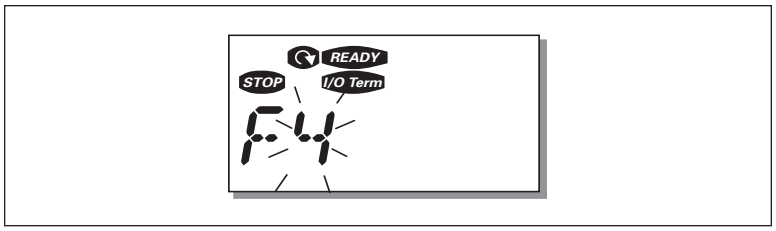


Figure 5-8: Normal State, No Faults

Fault Types

The drive has two types of faults. These types differ from each other on the basis of the subsequent behavior of the drive. See **Table 5-7**.

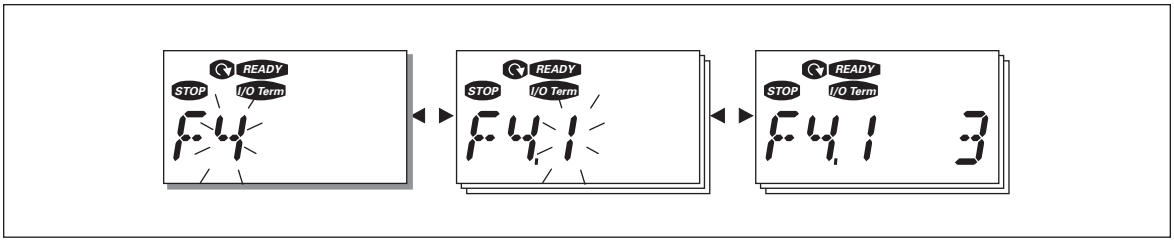


Figure 5-9: Fault Display

Table 5-7: Fault Types

Fault Type Symbol	Meaning
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" makes the drive stop. Actions need to be taken to restart the drive.

Note: Fault Codes are listed in **Appendix A**.

Fault History Menu (H5)

You can enter the Fault History menu from the Main Menu by pressing Menu Button Right when the location indication **H5** is visible on the keypad display.

All faults are stored in the Fault History menu where you can browse them with the Browser buttons. You can return to the previous menu any time by pressing Menu Button Left.

The memory of the drive can store a maximum of 5 faults in order of appearance. The latest fault is indicated by H5.1, the one before that by H5.2 and so on. If there are 5 uncleared faults in the memory, the next fault will erase the oldest fault from the memory.

Pressing the ENTER button for about 2 to 3 seconds resets the whole fault history.

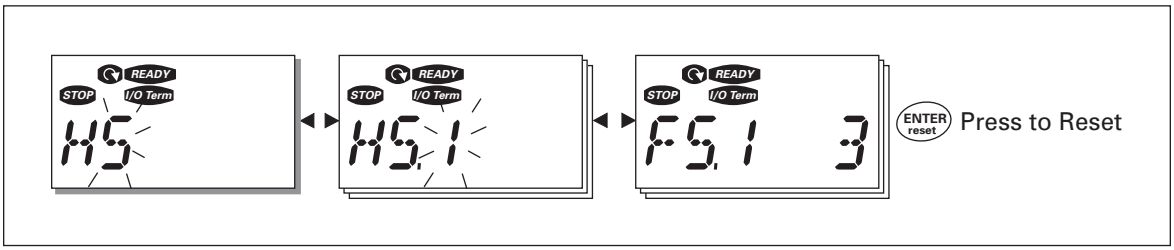


Figure 5-10: Fault History Menu

System Menu (S6)

You can enter the System Menu from the Main menu by pressing Menu Button Right when the location indication **S6** is visible on the first line of the keypad display.

The controls associated with the general use of the drive, such as keypad settings, customized parameter sets or information about the hardware and software are located under the System Menu.

Table 5-8 has a list of the functions available in the System Menu.

Table 5-8: System Menu Functions

Code	Function	Min.	Max.	Unit	Default	Cust.	Selections
S6.3	**Copy parameters**						
P6.3.1	Parameter sets						**0** = Select **1** = Store set 1 **2** = Load set 1 **3** = Store set 2 **4** = Load set 2 **5** = Load factory defaults **6** = Fault **7** = Wait **8** = OK
S6.5	**Security**						
P6.5.2	Parameter lock	0	1		0		**0** = Change Enabled **1** = Change Disabled
S6.6	**Keypad settings**						
P6.6.1	Default page	0			1.1		
P6.6.3	Timeout time	5	65535	s	1200		
S6.7	**Hardware settings**						
P6.7.2	Fan control	0			0		**0** = Continuous **1** = Temperature (only sizes MF4 and larger)
P6.7.3	HMI acknowledg. timeout	200	5000	mS	200		
P6.7.4	HMI number of retries	1	10		5		
S6.8	**System info**						
S6.8.1	Counters menu						
C6.8.1.1	Mwh counter			KWh			
C6.8.1.2	Operating days counter			hh:mm:ss			
C6.8.1.3	Operating hours counter			hh:mm:ss			
S6.8.2	Trip counters						
T6.8.2.1	MWh trip counter			kWh			
P6.8.2.2	Clear MWh trip counter						**0** = No action **1** = Clear MWh trip counter
T6.8.2.3	Operating days trip counter						

Table 5-8: System Menu Functions (Continued)

Code	Function	Min.	Max.	Unit	Default	Cust.	Selections
T6.8.2.4	Operating hours trip counter			hh:mm:ss			
P6.8.2.5	Clear operating time counter						**0** = No action **1** = Clear T6.8.2.3, T6.8.2.4
S6.8.3	Software info						
I6.8.3.1	Software package						Scroll information with menu button right
I6.8.3.2	System SW version						
I6.8.3.3	Firmware interface						
I6.8.3.4	System load			%			
S6.8.4	Application info						
S6.8.4.1	Application						
A6.8.4.1.1	Application ID						
A6.8.4.1.2	Application version						
A6.8.4.1.3	Firmware interface						
S6.8.5	Hardware info						
I6.8.5.2	Unit voltage			V			
I6.8.5.3	Brake chopper						**0** = Not present, **1** = Present
S6.8.6	Options						
S6.8.6.1	Slot E OPT-						**Note:** the submenus do not show if no option board is installed
I6.8.6.1.1	Slot E status	1	5				**1** = Connection lost **2** = Initializing **3** = Run **5** = Fault
I6.8.6.1.2	Slot E program version						
S6.8.6.2	Slot D OPT-						**Note:** the submenus do not show if no option board is installed
I6.8.6.2.1	Slot D status	1	5				**1** = Connection lost **2** = Initializing **3** = Run **5** = Fault
I6.8.6.2.2	Slot D program version						
S6.9	AI mode						
P6.9.1	AIA1 mode	0	1		0		**0** = Voltage input **1** = Current input (Types MF4 – MF6)
P6.9.2	AIA2 mode	0	1		1		**0** = Voltage input **1** = Current input
S6.10	Fieldbus parameters						
I6.10.1	Communication status						

Table 5-8: System Menu Functions (Continued)

Code	Function	Min.	Max.	Unit	Default	Cust.	Selections
P6.10.2	Fieldbus protocol	1	1		1		**0** = Not used **1** = Modbus protocol
P6.10.3	Slave address	1	255		1		Addresses 1 – 255
P6.10.4	Baud rate	0	8		5		**0** = 300 baud **1** = 600 baud **2** = 1200 baud **3** = 2400 baud **4** = 4800 baud **5** = 9600 baud **6** = 19200 baud **7** = 38400 baud **8** = 57600 baud
P6.10.5	Stop bits	0	1		0		**0** = 1 **1** = 2
P6.10.6	Parity type	0	2		0		**0** = None **1** = Odd **2** = Even
P6.10.7	Communication timeout	0	300	s	0		**0** = Not used **1** = 1 second **2** = 2 seconds, etc.

Copy Parameters

The Copy parameters submenu (**S6.3**) is located under the System menu.

The SLX9000 drive allows the user to store and load two customized parameter sets (all parameters included in the application, not the system menu parameters) and to load back the factory default parameter values.

Parameter Sets (S6.3.1)

On Parameter sets page (**S6.3.1**), push the Menu Button Right to enter the Edit menu. You can store or load two customized parameter sets or load back the factory defaults. Confirm with the ENTER button. Wait until **8 (=OK)** appears on the display.

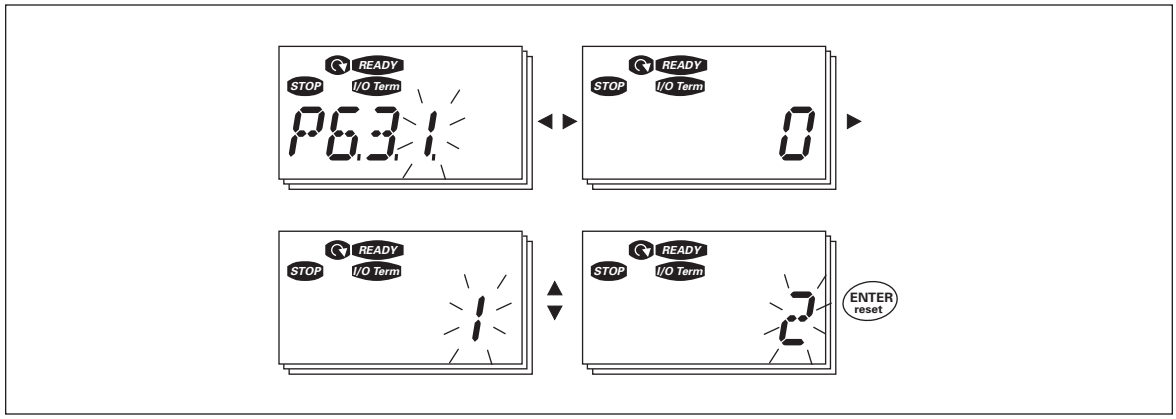


Figure 5-11: Storing and Loading of Parameter Sets

Security

The Security submenu (**S6.5**) under the system menu has a function that allows the user to prohibit changes to the parameters.

Parameter Lock (P6.5.2)

If the parameter lock is activated the parameter values cannot be edited.

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

Enter the edit mode by pushing the Menu Button Right. Use the Browser buttons to change the parameter lock status (**0** = changes enabled, **1** = changes disabled). Accept the change with the ENTER button or return to the previous level with the Menu Button Left.

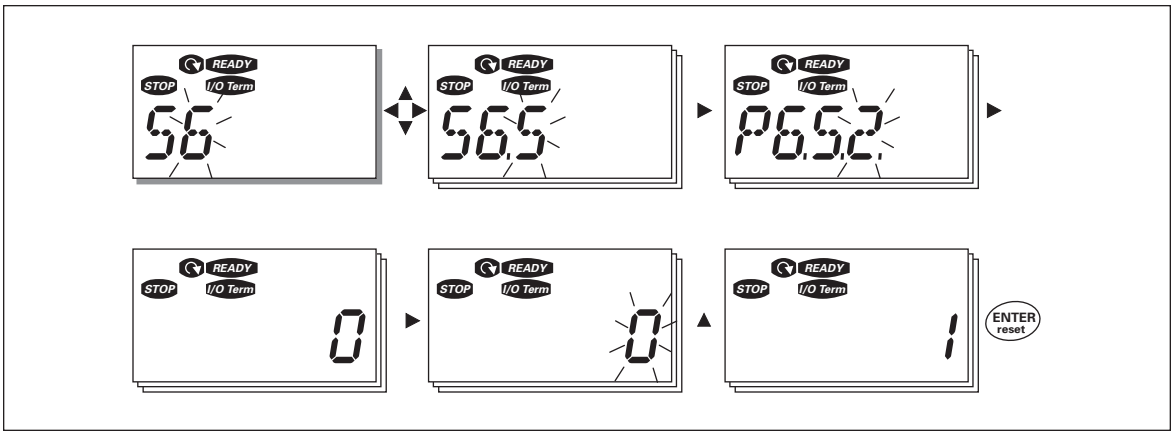


Figure 5-12: Parameter Locking

Keypad Settings

In the Keypad Settings submenu under the System menu, you can further customize your drive operator interface.

Locate the Keypad Setting submenu (**S6.6**). Under the submenu, there are two pages (**P#**) associated with the keypad operation:

Default Page (P6.6.1)

Here you can set the location (page) to which the display automatically moves as the Timeout Time (see below) has expired or as the power is switched on to the keypad.

Press the Menu Button Right once to enter the edit mode. Pressing the Menu Button Right once again makes you able to edit the number of the submenu/page digit by digit. Confirm the new default page value with the ENTER button. You can return to the previous step anytime by pushing the Menu Button Left.

Note: If you set a page that does not exist in the menu, the display will automatically move to the last available page in the menu.

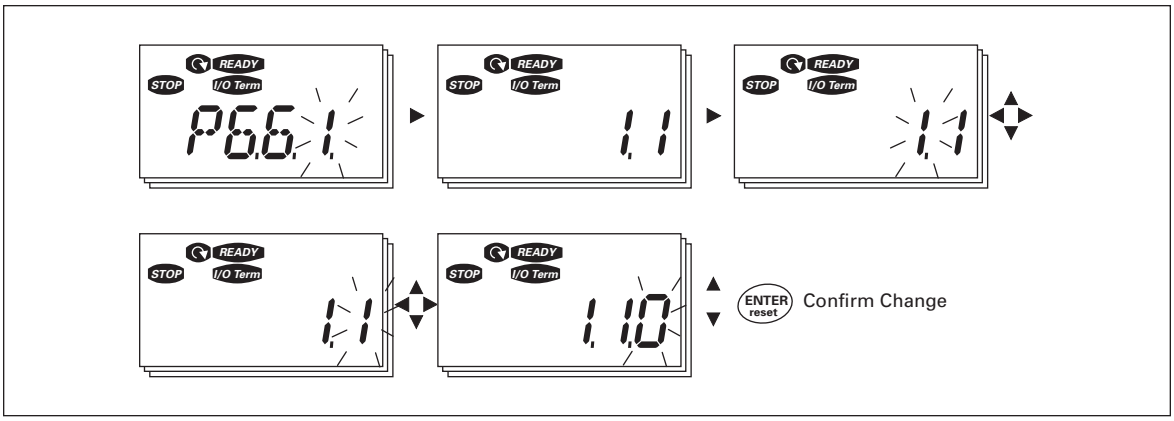


Figure 5-13: Default Page Function

Timeout Time (P6.6.3)

The Timeout Time setting defines the time after which the keypad display returns to the Default page (P6.6.1).

Enter the edit mode by pressing Menu Button Right. Set the desired timeout time and confirm it with the ENTER button. You can return to the previous menu at any time by pressing Menu Button Left.

Note: This function cannot be disabled.

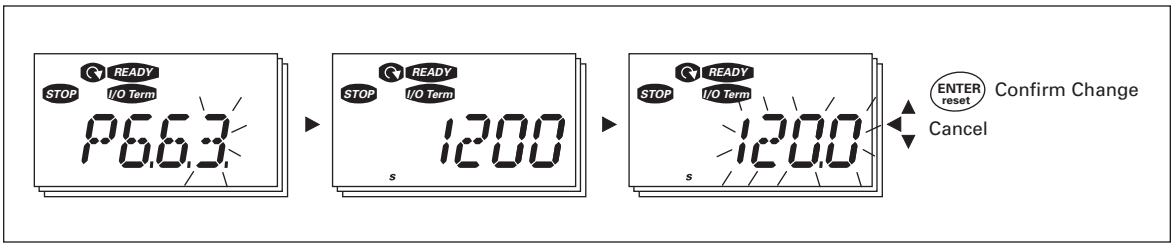


Figure 5-14: Timeout Time Setting

Hardware Settings

In the Hardware settings submenu (S6.7) you can further customize the settings of the drive with three parameters: Fan control, HMI acknowledgement timeout and HMI retry.

Fan Control (P6.7.2)

Note: Only the higher power modules of MF3 have been equipped with a cooling fan, in lower power modules of MF3 the cooling fan is available as optional equipment.

If the cooling fan has been installed in MF3 it runs continuously when the power is switched on.

Sizes MF4 and larger:

This function allows you to control the drive's cooling fan. You can set the fan to run continuously when the power is switched on or depending 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. However the fan runs for about a minute after receiving the stop command, as well as after changing the value from **0** *(Continuous)* to **1** *(Temperature)*.

Enter the edit mode by pushing the Menu Button Right. The present mode shown starts to blink. Use the Browser buttons to change the fan mode. Accept the change with the ENTER button or return to the previous level with the Menu Button Left.

HMI Acknowledge Timeout (P6.7.3)

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

Note: If the drive has been connected to the PC with a **normal cable**, the default values of parameters 6.7.3 and 6.7.4 (200 and 5) **must not be changed**.

If the drive has been connected to the PC via a modem and there is delay in transferring messages, the value of par. 6.7.3 must be set according to the delay as follows:

Example:

- Transfer delay between the drive and the PC = 600 ms
- The value of par. 6.7.3 is set to 1200 mS (2 x 600, sending delay + receiving delay)
- The corresponding setting shall be entered in the (Misc)-part of the file NCDrive.ini:
  - Retries = 5
  - AckTimeOut = 1200
  - TimeOut = 6000

It must also be considered that intervals that are shorter than the AckTimeOut-time cannot be used in NC-Drive monitoring.

Enter the edit mode by pushing the Menu Button Right. Use the Browser buttons to change the acknowledgement time. Accept the change with the ENTER button or return to the previous level with the Menu Button Left. See **Figure 5-15** for how to change the HMI acknowledgement timeout.

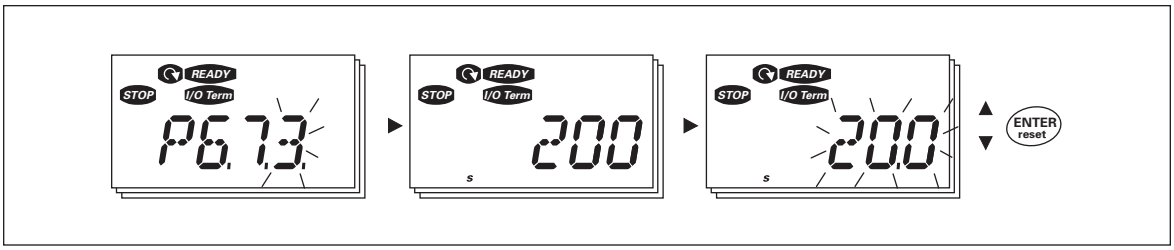


Figure 5-15: HMI Acknowledge Timeout

Number of Retries to Receive HMI Acknowledgement (P6.7.4)

With this parameter you can set the number of times the drive will try receive acknowledgement if this does not succeed within the acknowledgement time (P6.7.3)

Enter the edit mode by pushing the Menu Button Right. The present value shown starts to blink. Use the Browser buttons to change the amount of retries. Accept the change with the ENTER button or return to the previous level with the Menu Button Left.

System Information

In the submenu S6.8 under the System menu you can find drive-related hardware and software information as well as operation-related information.

Enter the Info menu by pressing the Menu Button Right. Now you can browse through the information pages with the Browser buttons.

Counters Submenu (S6.8.1)

In the Counters submenu (**S6.8.1**) you can find information related to the drive operation times, i.e. the total numbers of MWh, operation days and operation hours passed so far. Unlike the counters in the trip counters menu, these counters cannot be reset.

Note: The operation time counter (days and hours) always runs when the power is on.

Table 5-9: Counter Pages

Page	Counter
C6.8.1.1	MWh counter
C6.8.1.2	Operation day counter
C6.8.1.3	Operation hour counter

Trip Counters Submenu (S6.8.2)

Trip counters (menu **S6.8.2**) are counters with values of which can be reset i.e. restored to zero. You have the following resettable counters at your disposal:

Table 5-10: Trip Counter Pages

Page	Counter
C6.8.2.1	MWh counter
P6.8.2.2	Clear mWh counter
T6.8.2.3	Operation day counter
T6.8.2.4	Operation hour counter
P6.8.2.5	Clear operation time counter

Note: The trip counters only run when the motor is running.

Example: When you want to reset the operation counters, you should do the following:

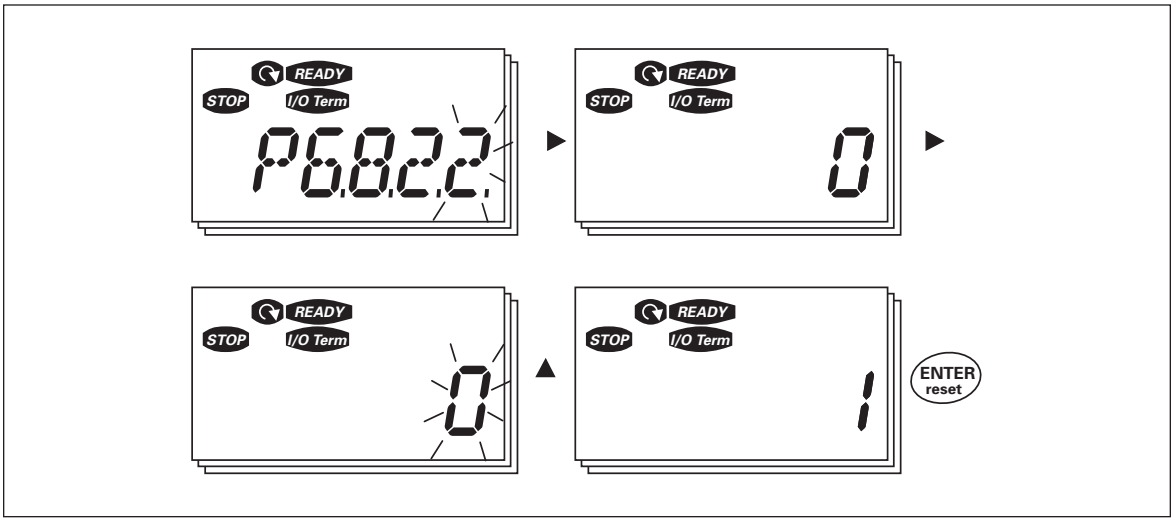


Figure 5-16: MWh Counter Reset

Software Into Submenu (S6.8.3)

The following information can be found under the Software Info submenu (S6.8.3):

Table 5-11: Software Information Pages

Page	Content
I6.8.3.1	Software package
I6.8.3.2	System software version
I6.8.3.3	Firmware interface
I6.8.3.4	System load

Application Information Submenu (S6.8.4)

You can find the following information from the Application Info submenu (S6.8.4):

Table 5-12: Application Information Pages

Page	Content
A6.8.4.1	Application
D6.8.4.1.1	Application ID
D6.8.4.1.2	Version
D6.8.4.1.3	Firmware interface

Hardware Information Submenu (S.8.5)

You can find the following information from the Hardware Info submenu (S6.8.5):

Table 5-13: Hardware Information Pages

Page	Content
I6.8.5.2	Unit voltage
I6.8.5.3	Brake chopper

Connected Options Submenu (S6.8.6)

The Connected options submenu (S6.8.6) shows the following information on the option board connected to the drive:

Table 5-14: Connected Options Submenu

Page	Content
S6.8.6.1	Slot E option board
I6.8.6.1.1	Slot E option board status
I6.8.6.1.2	Slot E program version
S6.8.6.2	Slot D option board
I6.8.6.2.1	Slot D option board status
I6.8.6.2.2	Slot D program version

In this submenu you find information about the option board connected to the control board (see **Chapter 4**).

You can check the status of the slot by entering the board submenu with the Menu Button Right and using the Browser buttons. Push the Menu Button Right again to display the status of the board. The selections are shown in **Table 5-8**. The keypad will also display the program version of the respective board when you push either one of the Browser buttons.

For more information on the expander board-related parameters, see **Page 5-26**.

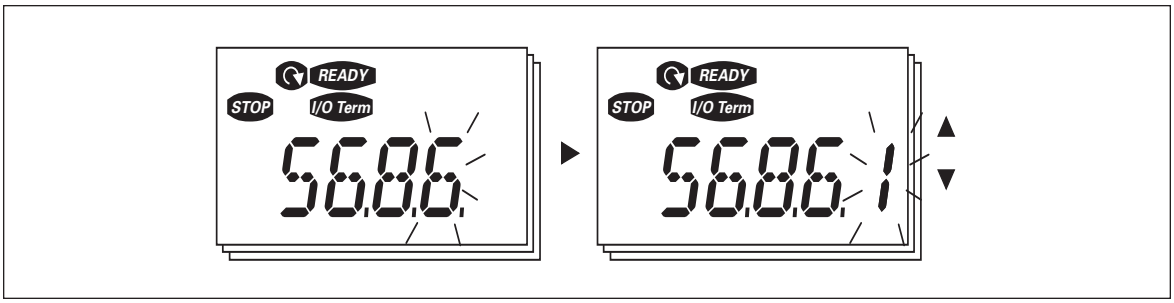


Figure 5-17: Expander Board Information Menu

AI mode

The parameters P6.9.1 and P6.9.2 select the analog input mode. **P6.9.1** appears only in classes MF4 – MF6.

0 = voltage input (par. 6.9.1 default)
1 = current input (par. 6.9.2 default)

Note: Make sure that the jumper selections correspond to the selections of this parameter. See **Figure 4-3**.

Modbus Interface

SLX9000 has a built-in Modbus RTU bus interface. The signal level of the interface is in accordance with the RS-485 standard.

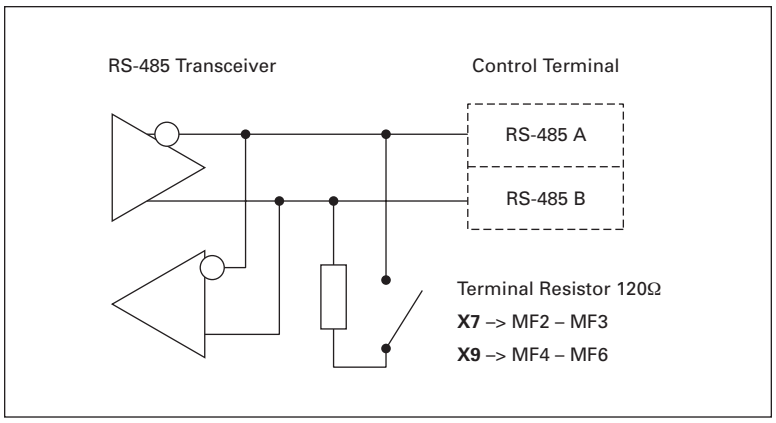


Figure 5-18: Modbus Interface

Protocol:	Modbus RTU
Baud rates:	300, 600, 1200, 2400, 4800, 9600, 19200, 38700, 57600 (bit/s)
Signal level:	RS-485 (TIA/EIA-485-A)
Input impedance:	2 kΩ

Modbus RTU Protocol

Modbus RTU protocol is a simple but effective fieldbus protocol. Modbus network has a bus topology, where every device has an individual address. With the help of the individual bus addresses the commands are directed to the single devices within the network. Modbus supports also broadcast-type messages, that are received by every device of the bus. Broadcast messages are sent to the address “0” which is reserved for these messages.

The protocol includes CRC error detection and parity check for preventing the handling of messages containing errors. In Modbus the data is transferred in hex mode asynchronically and a break of approximately 3.5 characters is used as an end character. The length of the break depends on the used baud rate.

Table 5-15: Modbus Commands Supported by SLX9000

Function Code	Function Name	Address	Broadcast Messages
03	Read Holding Register	All ID numbers	No
04	Read Input Register	All ID numbers	No
06	Preset Single Register	All ID numbers	Yes
16	Preset Multiple Register	All ID numbers	Yes

Termination Resistor

The RS-485 bus is terminated with 120Ω termination resistors in both ends. SLX9000 has a built-in termination resistor which is switched off as a default. See the jumper selections in **Chapter 4**.

Modbus Address Area

The Modbus bus of SLX9000 uses the ID numbers of the application as addresses. The ID numbers can be found in the parameter tables of the application manual.

When several parameters/monitoring values are read at a time they must be consecutive. 11 addresses can be read and the addresses can be parameters or monitoring values.

Modbus Process Data

Process data is an address area for fieldbus control. Fieldbus control is active when the value of parameter 3.1 (Control place) is **2** (= fieldbus). The contents of the process data has been determined in the application. The following tables present the process data contents in the Multi-Control Application.

Table 5-16: Output Process Data

Addr.	Modbus Register	Name	Scale	Type
2101	32101, 42101	FB Status Word	—	Binary coded
2102	32102, 42102	FB General Status Word	—	Binary coded
2103	32103, 42103	FB Actual Speed	0.01	%
2104	32104, 42104	Motor speed	0.01	+/- Hz
2105	32105, 42105	Motor speed	1	+/- Rpm
2106	32106, 42106	Motor current	0.1	A
2107	32107, 42107	Motor Torque	0.1	+/- % (of nominal)
2108	32108, 42108	Motor Power	0.1	+/- % (of nominal)
2109	32109, 42109	Motor Voltage	0.1	V
2110	32110, 42110	DC Voltage	1	V
2111	32111, 42111	Active Fault	—	Fault code

Table 5-17: Input Process Data

Addr.	Modbus Register	Name	Scale	Type
2001	32001, 42001	FB Control Word	—	Binary coded
2002	32002, 42002	FB General Control Word	—	Binary coded
2003	32003, 42003	FB Speed Reference	0.01	%
2004	32004, 42004	PID Control Reference	0.01	%
2005	32005, 42005	PID Actual Value	0.01	%
2006	32006, 42006	—	—	—
2007	32007, 42007	—	—	—
2008	32008, 42008	—	—	—
2009	32009, 42009	—	—	—
2010	32010, 42010	—	—	—
2011	32011, 42011	—	—	—

Table 5-18: Status Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
—	—	—	—	—	—	—	—	F	Z	AREF	W	FLT	DIR	RUN	RDY

Information about the status of the device and messages is indicated in the Status word. The Status word is composed of 16 bits the meanings of which are described in **Table 5-19**.

Table 5-19: Actual Speed

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LSB

This is actual speed of the drive. The scaling is -10000 – 10000. In the application, the value is scaled in percentage of the frequency area between set minimum and maximum frequency.

Table 5-20: Control Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
—	—	—	—	—	—	—	—	—	—	—	—	—	RST	DIR	RUN

In SLX9000 applications, the three first bits of the control word are used to control the drive. However, you can customize the content of the control word for your own applications because the control word is sent to the drive as such.

Table 5-21: Speed Reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	LSB

This is the Reference 1 to the drive. Used normally as Speed reference. The allowed scaling is -10000 – 10000. In the application, the value is scaled in percentage of the frequency area between the set minimum and maximum frequencies.

Table 5-22: Bit Definitions

Bit	Description	
	Value = 0	**Value = 1**
RUN	Stop	Run
DIR	Clockwise	Counterclockwise
RST	Rising edge of this bit will reset active fault	
RDY	Drive not ready	Drive ready
FLT	No fault	Fault active
W	No warning	Warning active
AREF	Ramping	Speed reference reached
Z	—	Drive is running at zero speed
F	—	Flux Ready

Fieldbus Parameters

RS-485 Communication Status (I6.10.1)

With this function you can check the status of the RS-485 bus. If the bus is not in use, this value is **0**.

xx.yyy

xx = 0 – 64 (Number of messages containing errors)
yyy = 0 – 999 (Number of messages received correctly)

Fieldbus Protocol (P6.10.2)

With this function you can select the fieldbus communications protocol.

0 = Not used
1 = Modbus protocol

Slave Address (P6.10.3)

Sets the slave address for the Modbus protocol. You can set any address between 1 and 255.

Baud Rate (P6.10.4)

Selects the baud rate used with the Modbus communication.

0 = 300 baud
1 = 600 baud
2 = 1200 baud
3 = 2400 baud
4 = 4800 baud
5 = 9600 baud
6 = 19200 baud
7 = 38400 baud
8 = 57600 baud

Stop Bits (P6.10.5)

Sets number of stop bits used in Modbus communication.

0 = 1 stop bit
1 = 2 stop bits

Parity Type (P6.10.6)

Here you can select the type of parity checking used with the Modbus communication.

0 = None
1 = Odd
2 = Even

Communication time-out (P6.10.7)

If communication between two messages is broken for a longer time than that defined by this parameter, a communication error is initiated. If the value of this parameter is **0**, the function is not used.

0 = Not used
1 = 1 second
2 = 2 seconds, etc.

Expander Board Menu (E7)

The *Expander board menu* makes it possible for the user 1) to see which expander board is connected to the control board and 2) to reach and edit the parameters associated with the expander board.

Enter the following menu level (**E#**) with the Menu Button Right. You can view and edit the parameter values in the same way as described on **Page 5-8**.

Further Keypad Functions

The SLX9000 control keypad embodies additional application-related functions. See Eaton's *Multicontrol Application Manual* for more information.

Chapter 6 — Start-Up

Safety Precautions

Before start-up, note the following directions and warnings:

⚠ WARNING

1. Internal components and circuit boards of the drive (except for the galvanically isolated I/O terminals) are **live** when the drive is connected to mains potential. **Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.**
2. The motor terminals U, V, W and the DC-link/brake resistor terminals +/- are **live** when the drive is connected to DC supply, **even if the motor is not running**.
3. The control I/O-terminals are isolated from the mains potential. However, the relay outputs and other I/O-terminals may have a dangerous control voltage present even when the drive is disconnected from power supply.
4. Do not make any connections when the drive is connected to the power supply.
5. After having disconnected the drive, wait until the fan stops and the indicators on the keypad go out (if no keypad is attached see the indicator through the keypad base). Wait 5 more minutes before doing any work on drive connections. Do not open the cover before the time has expired.
6. Before connecting the drive to power supply, make sure that the drive's front cover is closed.
7. The heatsink of types MF2 and MF3 may be hot when the drive is in use. **Coming in contact with the heatsink may cause burns.**

Sequence of Operation

1. Carefully read the safety instructions in the front of this manual and above and follow them.
2. After the installation, make sure that:
   - both the drive and the motor are grounded.
   - the power supply and motor cables comply with the requirements given in **Chapter 3**.
   - the control cables are located as far as possible from the power cables (see **Chapter 3**) and the shields of the shielded cables are connected to protective ground. The wires may not touch the electrical components of the drive.
   - **For option boards only:** make sure that the common ends of digital input groups are connected to +24V or ground of the I/O terminal or the external supply.
3. Check the quality and quantity of cooling air. (See **Chapter 2**, Mounting Space Dimensions.)
4. Check the inside of the drive for condensation.
5. Check that all Start/Stop switches connected to the I/O terminals are in Stop position.
6. Connect the drive to power supply.
7. Set the parameters of group 1 according to the requirements of your application (see application manual). At least the following parameters should be set:
   - motor nominal voltage
   - motor nominal frequency
   - motor nominal speed
   - motor nominal current

   You will find the values needed for the parameters on the motor nameplate.

   Note: You can also run the Start-Up Wizard. See **Page 6-4**.
8. Perform run test without motor.

   Perform either Test A or Test B:

   Test A — Controls from the I/O terminals:
   - Turn the Start/Stop switch to ON position.
   - Change the frequency reference (potentiometer).
   - Check in the Monitoring Menu M1 that the value of Output Frequency changes according to the change of frequency reference.
   - Turn the Start/Stop switch to OFF position.

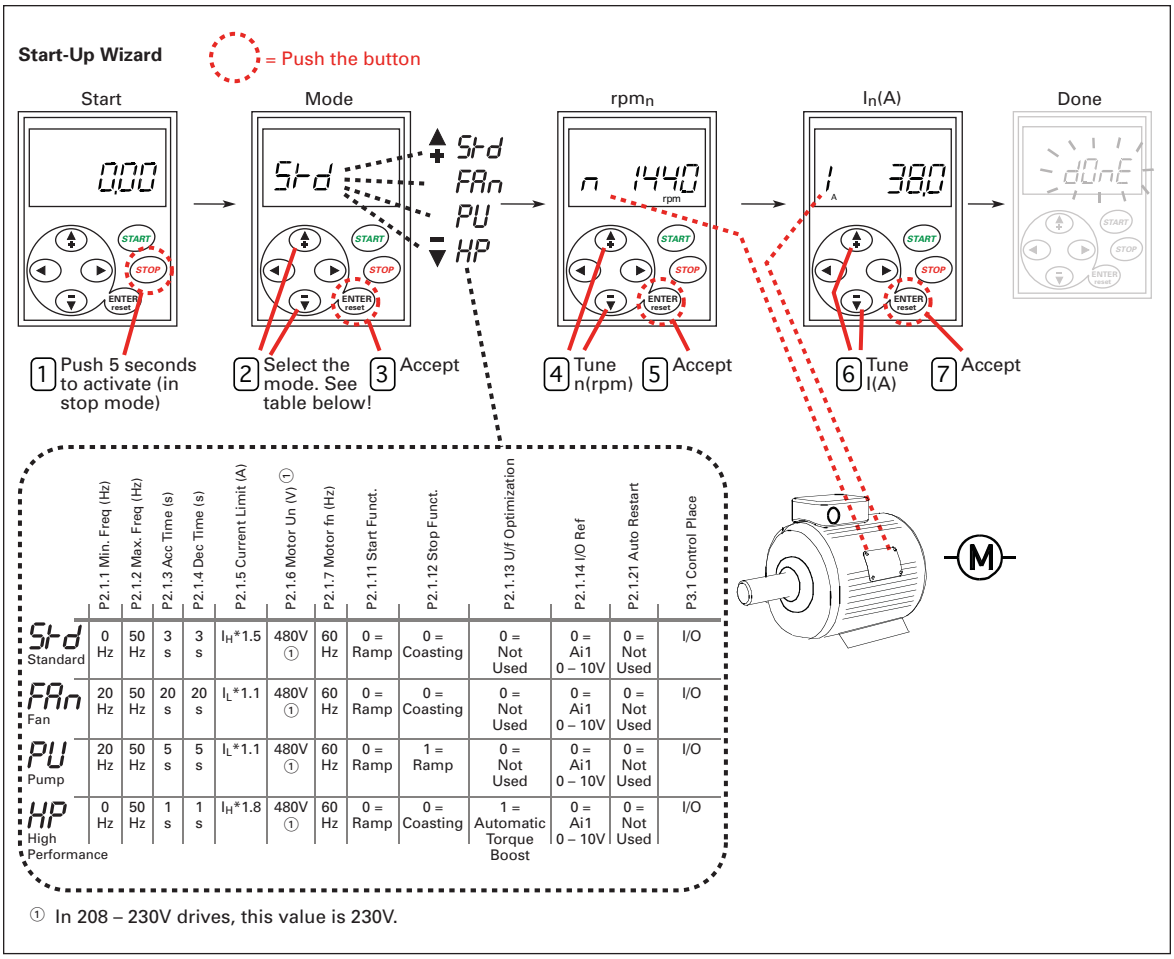
Test B— Control from the control keypad:

- Change the control from the I/O terminals to the keypad as advised on **Page 5-10**.
- Press the START button on the keypad.
- Move over to the Keypad Control Menu K3 and Keypad Reference submenu (see Keypad Reference on **Page 5-11**) and change the frequency reference with the Browser up and down buttons.
- Check in Monitoring Menu M1 that the value of Output Frequency changes according to the change of frequency reference.
- Press the STOP button on the keypad.

9. Run the start-up tests without the motor being connected to the process. If this is not possible, make sure that running each test is safe prior to running it. Inform your co-workers of the tests.
   - Switch off the supply voltage and wait until the drive has stopped as advised on **Page 6-1**, Safety Precautions.
   - Connect the motor cable to the motor and to the motor cable terminals of the drive.
   - Make sure that all Start/Stop switches are in Stop positions.
   - Switch the supply voltage ON.
   - Repeat test 8A or 8B.
10. Connect the motor to the process (if the start-up test was run without the motor being connected).
   - Before running the tests, make sure that this can be done safely.
   - Inform your co-workers of the tests.
   - Repeat test 8A or 8B.

Start-Up Wizard

SLX9000 has a built-in start-up wizard, that speeds up the programming of the drive. The wizard helps you choose between four different operating modes, Standard, Fan, Pump and High Performance. Each mode has automatic parameter settings optimized for the mode in question. The programming wizard is started by pressing the STOP button for 5 seconds, when the drive is in stop mode. See **Figure 6-1** for the procedure:



	P2.1.1 Min. Freq (Hz)	P2.1.2 Max. Freq (Hz)	P2.1.3 Acc Time (s)	P2.1.4 Dec Time (s)	P2.1.5 Current Limit (A)	P2.1.6 Motor Un (V) ①	P2.1.7 Motor fn (Hz)	P2.1.11 Start Funct.	P2.1.12 Stop Funct.	P2.1.13 U/f Optimization	P2.1.14 I/O Ref	P2.1.21 Auto Restart	P3.1 Control Place
Std Standard	0 Hz	50 Hz	3 s	3 s	I_H*1.5	480V ①	60 Hz	0 = Ramp	0 = Coasting	0 = Not Used	0 = Ai1 0 – 10V	0 = Not Used	I/O
FAn Fan	20 Hz	50 Hz	20 s	20 s	I_L*1.1	480V ①	60 Hz	0 = Ramp	0 = Coasting	0 = Not Used	0 = Ai1 0 – 10V	0 = Not Used	I/O
PU Pump	20 Hz	50 Hz	5 s	5 s	I_L*1.1	480V ①	60 Hz	0 = Ramp	1 = Ramp	0 = Not Used	0 = Ai1 0 – 10V	0 = Not Used	I/O
HP High Performance	0 Hz	50 Hz	1 s	1 s	I_H*1.8	480V ①	60 Hz	0 = Ramp	0 = Coasting	1 = Automatic Torque Boost	0 = Ai1 0 – 10V	0 = Not Used	I/O

① In 208 – 230V drives, this value is 230V.

Figure 6-1: SLX9000 Start-Up Wizard

IMPORTANT

Start-Up Wizard returns all other parameters to factory defaults!

Note: See the application manual for detailed parameter descriptions.

Chapter 7 — Basic Application

On the next pages you will find the list of parameters that are essential for the commissioning of the drive. You will find more details of these and other special parameters in the application manual.

Note: If you wish to edit the special parameters, you must set the value of par. 2.1.22 to 0.

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present param. 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	=	Customer's own setting
ID	=	ID number of the parameter (used with PC tools)
①	=	On the parameter code: parameter value can only be changed after the drive has been stopped.

Monitoring Values (Control Keypad: Menu M1)

The monitoring values are the actual values of parameters and signals as well as statuses and measurements. Monitoring values cannot be edited. See **Page 5-7** for more information.

Table 7-1: Monitoring Values

Code	Parameter	Unit	ID	Description
V1.1	Output frequency	Hz	1	Frequency to the motor
V1.2	Frequency reference	Hz	25	
V1.3	Motor speed	rpm	2	Calculated motor speed
V1.4	Motor current	A	3	Measured motor current
V1.5	Motor torque	%	4	Calculated actual torque/nominal torque of the unit
V1.6	Motor power	%	5	Calculated actual power/nominal power of the unit
V1.7	Motor voltage	V	6	Calculated motor voltage
V1.8	DC-link voltage	V	7	Measured DC-link voltage
V1.9	Unit temperature	°C	8	Heatsink temperature
V1.10	Analog input 1	V	13	AI1
V1.11	Analog input 2		14	AI2
V1.12	Analog output current		26	AO1
V1.13	Analog output current 1, expander board	mA	31	
V1.14	Analog output current 2, expander board	mA	32	
V1.15	DIN1, DIN2, DIN3		15	Digital input statuses
V1.16	DIE1, DIE2, DIE3		33	I/O expander board: Digital input statuses
V1.17	RO1		34	Relay output 1 status
V1.18	ROE1, ROE2, ROE3		35	I/O exp. board: Relay output statuses
V1.19	DOE1		36	I/O exp. board: Digital output 1 status
V1.20	PID Reference	%	20	In percent of the maximum frequency
V1.21	PID Actual value	%	21	In percent of the maximum actual value
V1.22	PID Error value	%	22	In percent of the maximum error value
V1.23	PID Output	%	23	In percent of the maximum output value
V1.24	Autochange outputs 1, 2, 3		30	Used only in pump and fan control
V1.25	Mode		66	Shows the current drive configuration mode selected with start-up wizard: **0** = No mode selected (Default) **1** = Standard **2** = Fan **3** = Pump **4** = High performance

Parameter List

Table 7-2: Basic Parameters (Control Keypad: Menu P2 → B2.1)

Code	Parameter	Min.	Max.	Unit	Default	Cust.	ID	Note
P2.1.1	Min. frequency	0.00	Par. 2.1.2	Hz	0.00		101	
P2.1.2	Max. frequency	Par. 2.1.1	320.00	Hz	50.00		102	**NOTE**: If f_{max} > than the motor synchronous speed, check suitability for motor and drive system
P2.1.3	Acceleration time 1	0.1	3000.0	s	1.0		103	
P2.1.4	Deceleration time 1	0.1	3000.0	s	1.0		104	
P2.1.5	Current limit	0.1 x I_L	1.5 x I_L	A	I_L		107	**NOTE**: Formulas apply approximately for drives up to MF3. For greater sizes, consult the factory.
P2.1.6 ①	Nominal voltage of the motor	180	690	V	240V:230V 480V:400V		110	
P2.1.7 ①	Nominal frequency of the motor	30.00	320.00	Hz	50.00		111	Check the rating plate of the motor
P2.1.8 ①	Nominal speed of the motor	300	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size drive.
P2.1.9 ①	Nominal current of the motor	0.3 x I_L	1.5 x I_L	A	I_L		113	Check the rating plate of the motor
P2.1.10 ①	Motor cosφ	0.30	1.00		0.85		120	Check the rating plate of the motor
P2.1.11 ①	Start function	0	1		0		505	**0** = Ramp **1** = Flying start
P2.1.12	Stop function	0	1		0		506	**0** = Coasting **1** = Ramp
P2.1.13	V/f optimisation	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P2.1.14	I/O reference	0	4		0		117	**0** = AI1 **1** = AI2 **2** = Keypad reference **3** = Fieldbus reference (FBSpeedReference) **4** = Motor potentiometer
P2.1.15	AI2 signal range	1	2		2		390	Not used if AI2 Custom min >0% or AI2 custom max. <100% **1** = 0 – 20 mA **2** = 4 – 20 mA **3** = 0 – 10V **4** = 2 – 10V

Table 7-2: Basic Parameters (Control Keypad: Menu P2 → B2.1) (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust.	ID	Note
P2.1.16	Analog output function	0	12		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-link volt (0 – U_{nMotor}) **9** = PI controller ref. value **10** = PI contr. act. value 1 **11** = PI contr. error value **12** = PI controller output
P2.1.17 ①	DIN2 function	0	10		1		319	**0** = Not used **1** = Start Reverse **2** = Reverse **3** = Stop pulse **4** = External fault, cc **5** = External fault, oc **6** = Run enable **7** = Preset speed 2 **8** = Motor pot. UP (cc) **9** = Disable PID (Direct freq. reference) **10** = Interlock 1
P2.1.18 ①	DIN3 function	0	16		6		301	**0** = Not used **1** = Reverse **2** = External fault, cc **3** = External fault, oc **4** = Fault reset **5** = Run enable **6** = Preset speed 1 **7** = Preset speed 2 **8** = DC-braking command **9** = Motor pot. UP (cc) **10** = Motor pot. DOWN (cc) **11** = Disable PID (PID control selection) **12** = PID Keypad ref. 2 selection **13** = Interlock 2 **14** = Thermistor input (See **Page 4-6**) **15** = Force CP to I/O **16** = Force CP to Fieldbus
P2.1.19	Preset speed 1	0.00	Par. 2.1.2	Hz	10.00		105	
P2.1.20	Preset speed 2	0.00	Par. 2.1.2	Hz	50.00		106	
P2.1.21	Automatic restart	0	1		0		731	**0** = Not used **1** = Used
P2.1.22	Parameter conceal	0	1		1		115	**0** = All parameters and menus visible **1** = Only group P2.1 and menus M1 – H5 visible

Appendix A — Fault Codes

When a fault is detected by the drive's control electronics, the drive is stopped and the symbol F together with the ordinal number of the fault, the fault code and a short fault description appear on the display. The fault can be reset with the RESET button on the control keypad or via the I/O terminal. The faults are stored in the Fault History Menu M5, which can be browsed. **Table A-1** contains all the fault codes.

Table A-1: Fault Codes

Fault Code	Fault	Possible Cause	Solution
1	Overcurrent	Drive has detected too high a current (>4xI_n) in the motor cable: • sudden heavy load increase • short circuit in motor cables • unsuitable motor	Check loading. Check motor. Check cables.
2	Overvoltage	The DC-link voltage has exceeded the limits defined in **Table 1-4**: • too short a deceleration time • high overvoltage spikes in supply	Set the deceleration time longer.
3	Ground Fault ①	Current measurement has detected that the sum of motor phase currents is not zero. • insulation failure in cables or motor	Check motor cable and motor.
8	System fault	• component failure • faulty operation	Reset the fault and restart. Should the fault reoccur, contact your Cutler-Hammer distributor.
9	Undervoltage ①	DC-link voltage is under the voltage limits defined in • most probable cause: too low a supply voltage • drive internal fault	In case of temporary supply voltage break, reset the fault and restart the drive. Check the supply voltage. If it is adequate, an internal failure has occurred. Contact your Cutler-Hammer distributor.
11	Output phase supervision ①	Current measurement has detected that there is no current in one motor phase.	Check motor cable and motor.
13	Drive undertemperature	Heatsink temperature is under -10°C	
14	Drive overtemperature	Heatsink temperature is over 90°C. Overtemperature warning is issued when the heatsink temperature exceeds 85°C.	Check the correct amount and flow of cooling air. Check the heatsink for dust. Check the ambient temperature. Make sure that the switching frequency is not too high in relation to ambient temperature and motor load.
15	Motor stalled ①	Motor stall protection has tripped.	Check motor.

① Programmable.

Table A-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
16	Motor overtemperature ①	• motor overheating has been detected by drive motor temperature model • motor is overloaded	Decrease the motor load. If no motor overload exists, check the temperature model parameters.
17	Motor underload ①	Motor underload protection has tripped.	
22	EEPROM checksum fault	Parameter save fault • faulty operation • component failure	Contact your Cutler-Hammer distributor.
24	Counter fault ②	Values displayed on counters are incorrect.	
25	Microprocessor watchdog fault	• faulty operation • component failure	Reset the fault and restart. Should the fault re-occur, contact your Cutler-Hammer distributor.
29	Thermistor fault ①	The thermistor input of option board has detected increase of the motor temperature.	Check motor cooling and loading. Check thermistor connection. (If thermistor input of the option board is not in use, it has to be short circuited.)
34	Internal bus communication	Ambient interference or defective hardware	Should the fault re-occur, contact your Cutler-Hammer distributor.
35	Application fault	Selected application does not function	Contact your Cutler-Hammer distributor.
39	Device removed ②	• option board removed • drive removed	Reset
40	Device unknown	Unknown option board or drive.	Contact your Cutler-Hammer distributor.
41	IGBT temperature	IGBT Inverter Bridge overtemperature protection has detected too high a motor current.	Check loading. Check motor size.
44	Device change ②	• option board changed • option board has default settings	Reset.
45	Device added ②	• option board changed • option board has default settings	Reset.
50	Analog input I_{in} <4 mA (selected signal range 4 to 20 mA) ①	Current at the analog input is < 4 mA. • control cable is broken or loose • signal source has failed.	Check the current loop circuitry.
51	External fault	Digital input failed. Digital input has been programmed as external fault input and this input is active.	Check the programming and the device indicated by the external fault information. Check also the cabling of this device.

① Programmable.
② "A" faults only.

Table A-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
52	Keypad communication fault	The connection between the control keypad and the drive is broken.	Check the keypad connection and keypad cable.
53	Fieldbus fault ①	The data connection between the fieldbus master and the fieldbus board is broken.	Check installation. If installation is correct contact your Cutler-Hammer distributor.
54	Slot fault ①	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.
55	Actual value supervision ①	Actual value has exceeded or fallen below (depending on para. 2.7.22) the actual value supervision limit (para. 2.7.23)	

① Programmable.

Appendix B — Expander Board OPTAA

Description of Expander Board OPTAA

Description: I/O expander board with one relay output, one open collector output and three digital inputs.

Allowed slots: SLX9000 board slot E

Type ID: 16705

Terminals: Two terminal blocks; screw terminals (M2.6 and M3); no coding

Jumpers: None

Board parameters: None

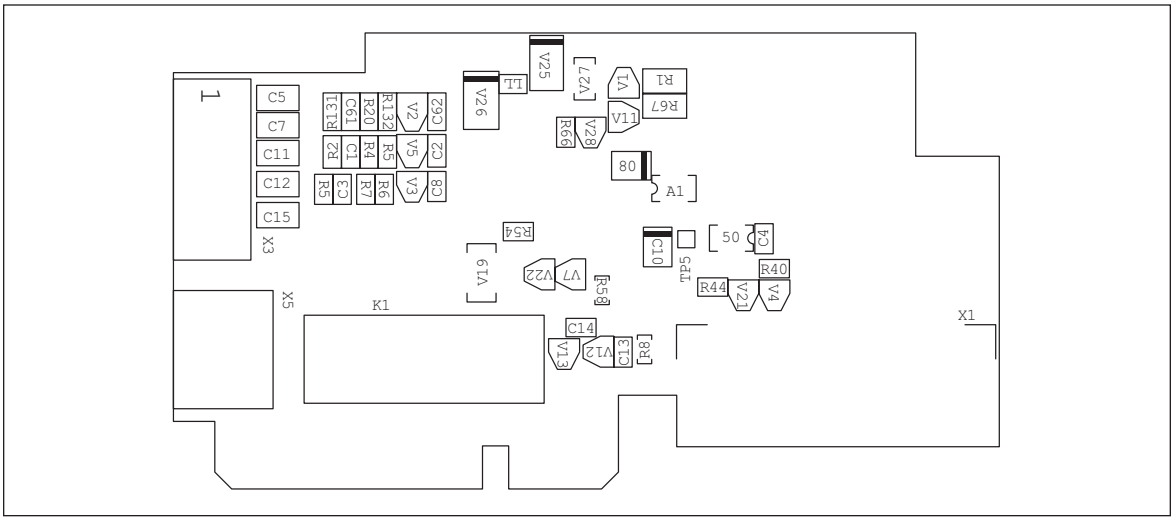


Figure B-1: Expander Board OPTAA

I/O Terminals on OPTAA

Table B-1: I/O Terminals of Board OPTAA

Terminal		Parameter Setting	Description
X3			
1	+24V		Control voltage output; voltage for switches etc., max. 150 mA
2	GND		Ground for controls, e.g. for +24V and DO
3	DIN1	DIGIN:x.1	Digital input 1
4	DIN2	DIGIN:x.2	Digital input 2
5	DIN3	DIGIN:x.3	Digital input 3
6	DO1	DIOUT:x.1	Open collector output, 50 mA/48V
X5			
24	RO1/NC	DIOUT:x.2	Relay output 1 (NO) Switching capacity: 24V DC/8A 250V AC/8A 125V DC/.4A
25	RO1/C		
26	RO1/NO		

Note: The +24V control voltage terminal can also be used to power the control module (but not the power module).

Appendix C — Expander Board OPTAI

Description of Expander Board OPTAI

Description: I/O expander board with one relay output (NO), three digital inputs and one thermistor input for SLX9000 drives.

Allowed slots: SLX9000 board slot E

Type ID: 16713

Terminals: Two terminal blocks; screw terminals; no coding

Jumpers: None

Board parameters: None

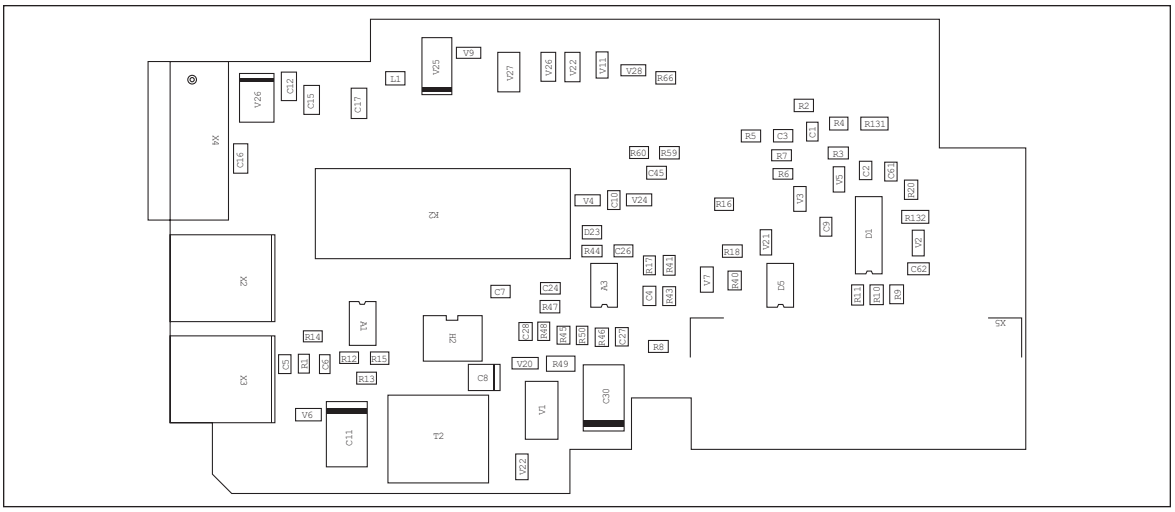


Figure C-1: Expander Board OPTAI

I/O Terminals on OPTAI

Table C-1: I/O Terminals of Board OPTAI

Terminal		Parameter Setting	Description
X4			
12	+24V		Control voltage output; voltage for switches etc., max. 150 mA
13	GND		Ground for controls, e.g. for +24V and DO
14	DIN1	DIGIN:B.1	Digital input 1
15	DIN2	DIGIN:B.2	Digital input 2
16	DIN3	DIGIN:B.3	Digital input 3
X2			
24	RO1/ Common	DIOUT:B.1	Relay output 1 (NO) Switching capacity: 24V DC/8A 250V AC/8A 125V DC/.4A
25	RO1/Normal Open		
X3			
28	TI+	DIGIN:B.4	Thermistor input; Rtrip = 4.7 kΩ (PTC)
29	TI-		

Note: The +24V control voltage terminal can also be used to power the control module (but not the power module).

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Company Information

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