Cutler-Hammer

9000X AF Drives for Cranes

Application Manual

September 2006
New Information

September 2006

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Cover Photo: Cutler-Hammer® 9000X AF Drives.

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Safety

Definitions and Symbols

WARNING

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

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

WARNING

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

CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the 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.

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® 9000X AF Drives from Eaton's electrical business.

Cautions

CAUTION

Be ABSOLUTELY sure not to connect two functions to the same output in order to avoid function overruns and to ensure flawless operation.

CAUTION

The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill.

CAUTION

Remove any External Start signals or permissives before resetting the fault to prevent an unintentional restart of the 9000X, which could result in personal injury or equipment damage.

Notices

Notice

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

September 2006

Chapter 1 — Overview

Introduction

This manual provides information on applying Cutler-Hammer® 9000X AF Drives from Eaton’s electrical business for crane applications.

For information on installation, maintenance, start-up and troubleshooting of 9000X drives, refer to the general user manual for 9000X AF Drives (MN04001004E).

How to Use This Application Manual

Read the safety guidelines at the beginning of this manual and the user manual information before operating the drive.

In Chapter 2, you will find a complete listing of the parameters used for the Multi-Purpose Crane Application and their range of settings. Note the identification number for each parameter listed under the table heading “ID”. A further discussion of each parameter is located in Chapter 3 numerically by these ID numbers.

Chapter 2 — Crane Application

Introduction

The Crane Application is based on the Multi-Purpose Control Software of the 9000X drive. The Multi-Purpose Control Application should be selected in System Menu **(M5).** See **Page 2-21**.

Multi-purpose control application provides a wide range of parameters for controlling motors. It can be used for various kinds of different processes, where wide flexibility of I/O signals is needed and PID control is not necessary.

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

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

Additional functions:

- Analog input signal range selection
- Two frequency limit supervisions
- Torque limit supervision
- Reference limit supervision
- Second ramps and S-shape ramp programming
- Programmable Start/Stop and Reverse logic
- DC brake at start and stop
- Three prohibit frequency areas
- Programmable U/f curve and switching frequency
- Autorestart
- Motor thermal and stall protection: fully programmable; off, warning, fault
- Motor underload protection
- Input and output phase supervision
- Joystick hysteresis
- Sleep function
- Different power limits for motoring and generating side
- Master Follower function
- Different torque limits for motoring and generating side
- Cooling monitor input from heat exchange unit
- Brake monitoring input and actual current monitor for immediate brake close
- Separate speed control tuning for different speeds and loads
- Inching function two different references
- Possibility to connect the FB Process data to any parameter and some monitoring values
- Identification parameter can be adjusted manually

The parameters of the Crane Application are explained in **Chapter 3** of this manual. The explanations are arranged according to the individual ID number of the parameter.

Control I/O

The following show typical crane wiring setups and drive configurations that can be used on crane hoist or travel motions. These are suggested starting points for the multitude of configurations possible with 9000X AF drives.

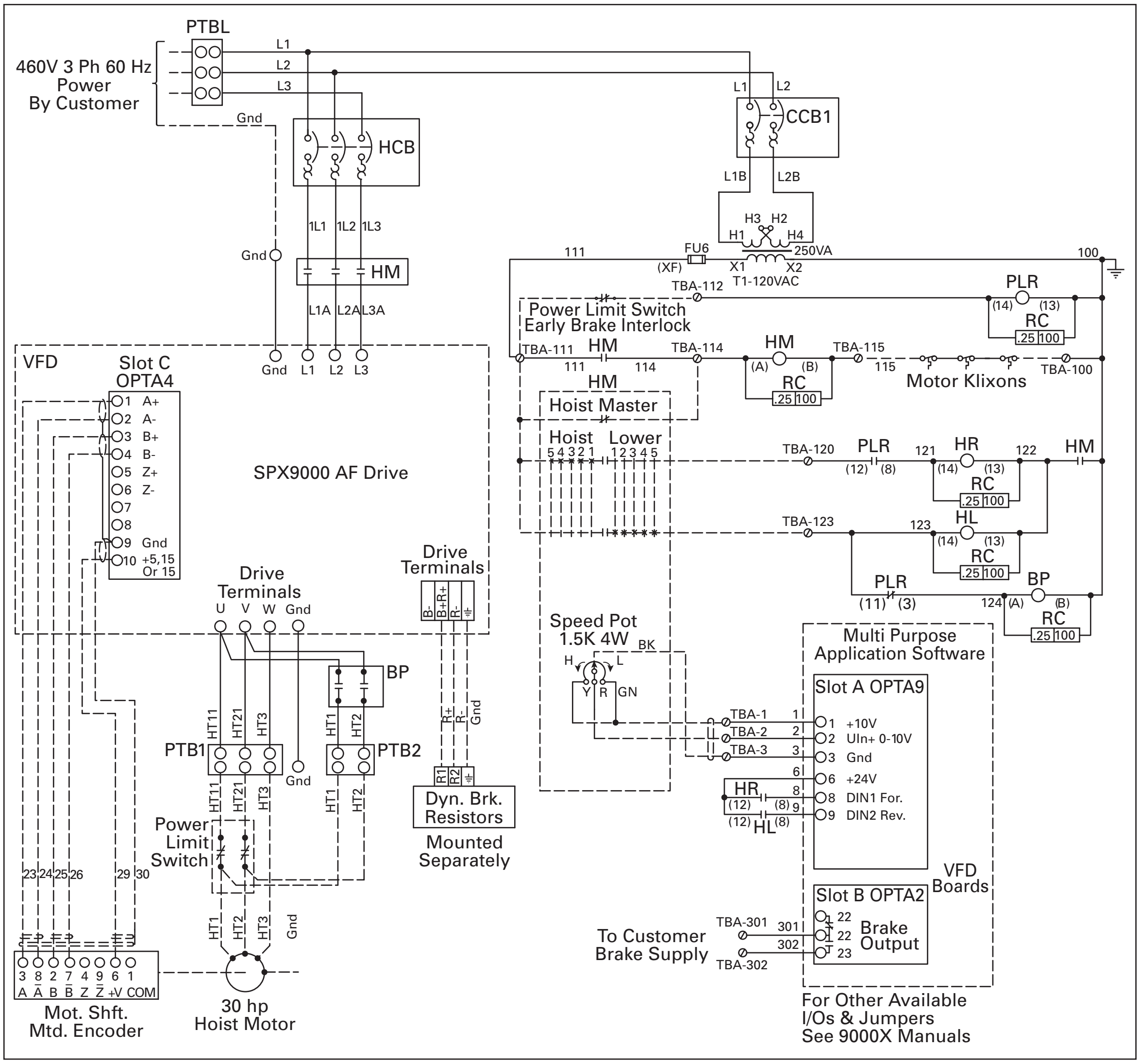
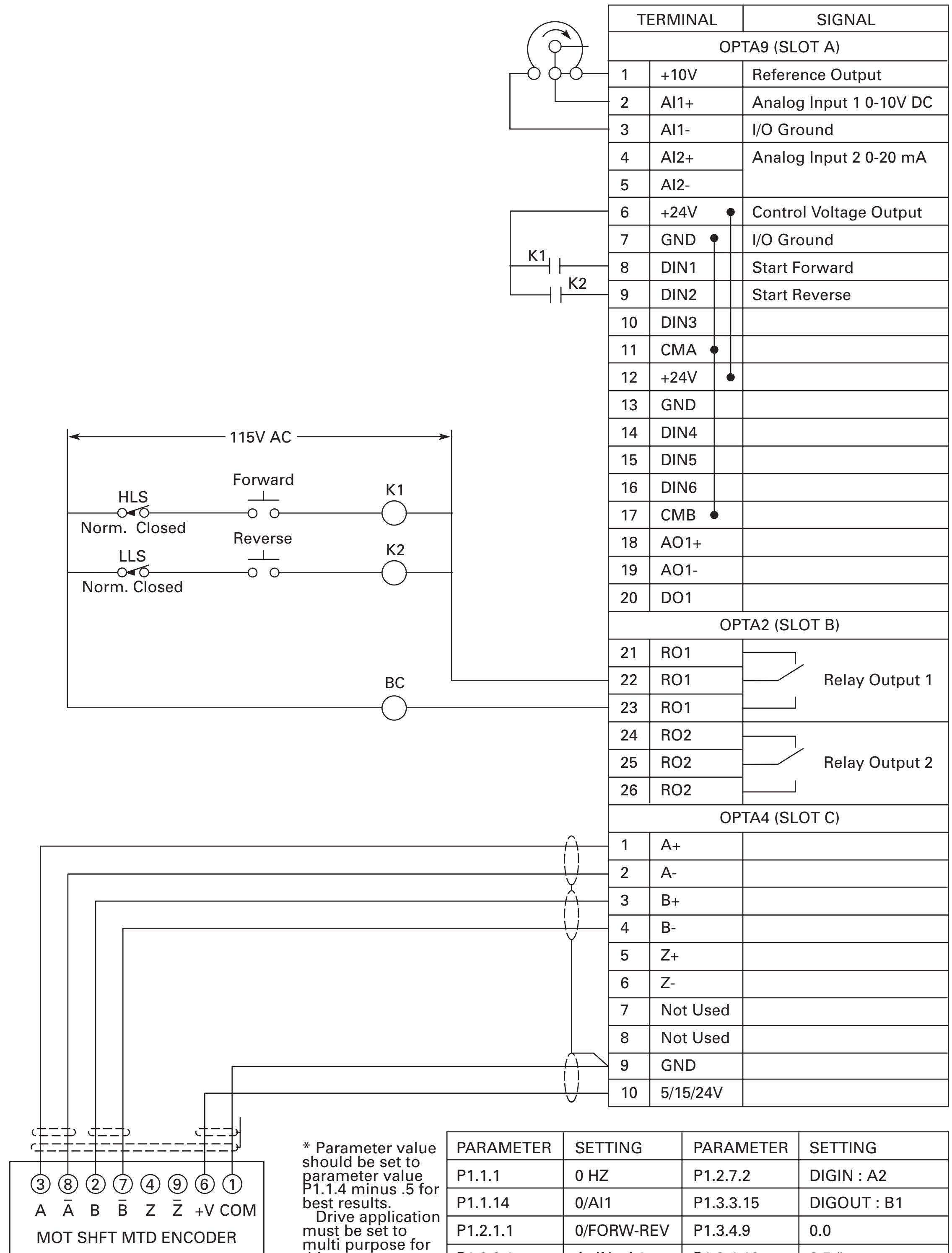


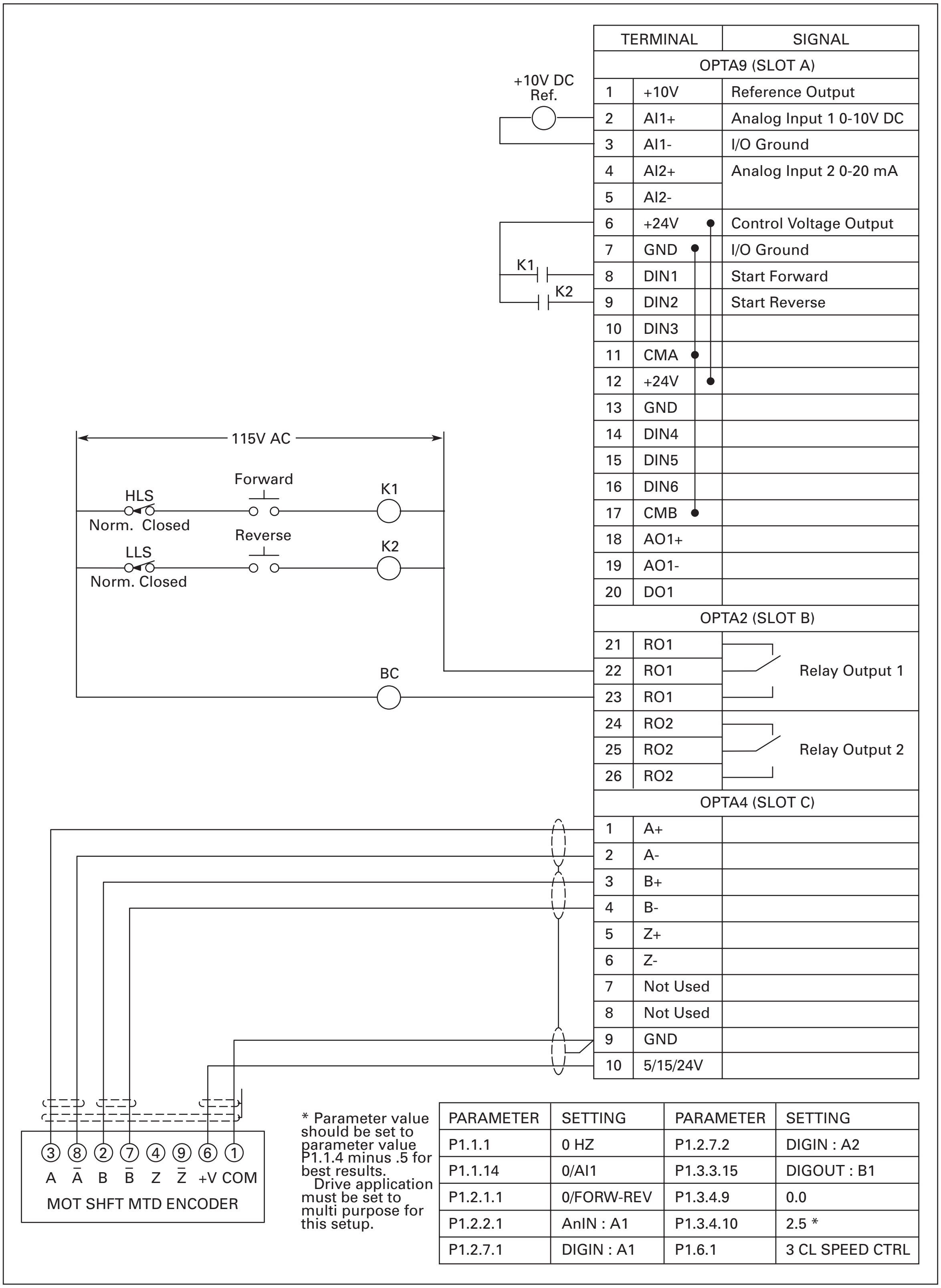
Figure 2-1: Typical NEMA ICS-8 AF Hoist Control



* Parameter value should be set to parameter value P1.1.4 minus .5 for best results.
Drive application must be set to multi purpose for this setup.

PARAMETER	SETTING	PARAMETER	SETTING
P1.1.1	0 HZ	P1.2.7.2	DIGIN : A2
P1.1.14	0/AI1	P1.3.3.15	DIGOUT : B1
P1.2.1.1	0/FORW-REV	P1.3.4.9	0.0
P1.2.2.1	AnIN : A1	P1.3.4.10	2.5 *
P1.2.7.1	DIGIN : A1	P1.6.1	3 CL SPEED CTRL

Figure 2-2: Hoist Joystick Control with Relays



PARAMETER	SETTING	PARAMETER	SETTING
P1.1.1	0 HZ	P1.2.7.2	DIGIN : A2
P1.1.14	0/AI1	P1.3.3.15	DIGOUT : B1
P1.2.1.1	0/FORW-REV	P1.3.4.9	0.0
P1.2.2.1	AnIN : A1	P1.3.4.10	2.5 *
P1.2.7.1	DIGIN : A1	P1.6.1	3 CL SPEED CTRL

Figure 2-3: Hoist Analog Control with Relays

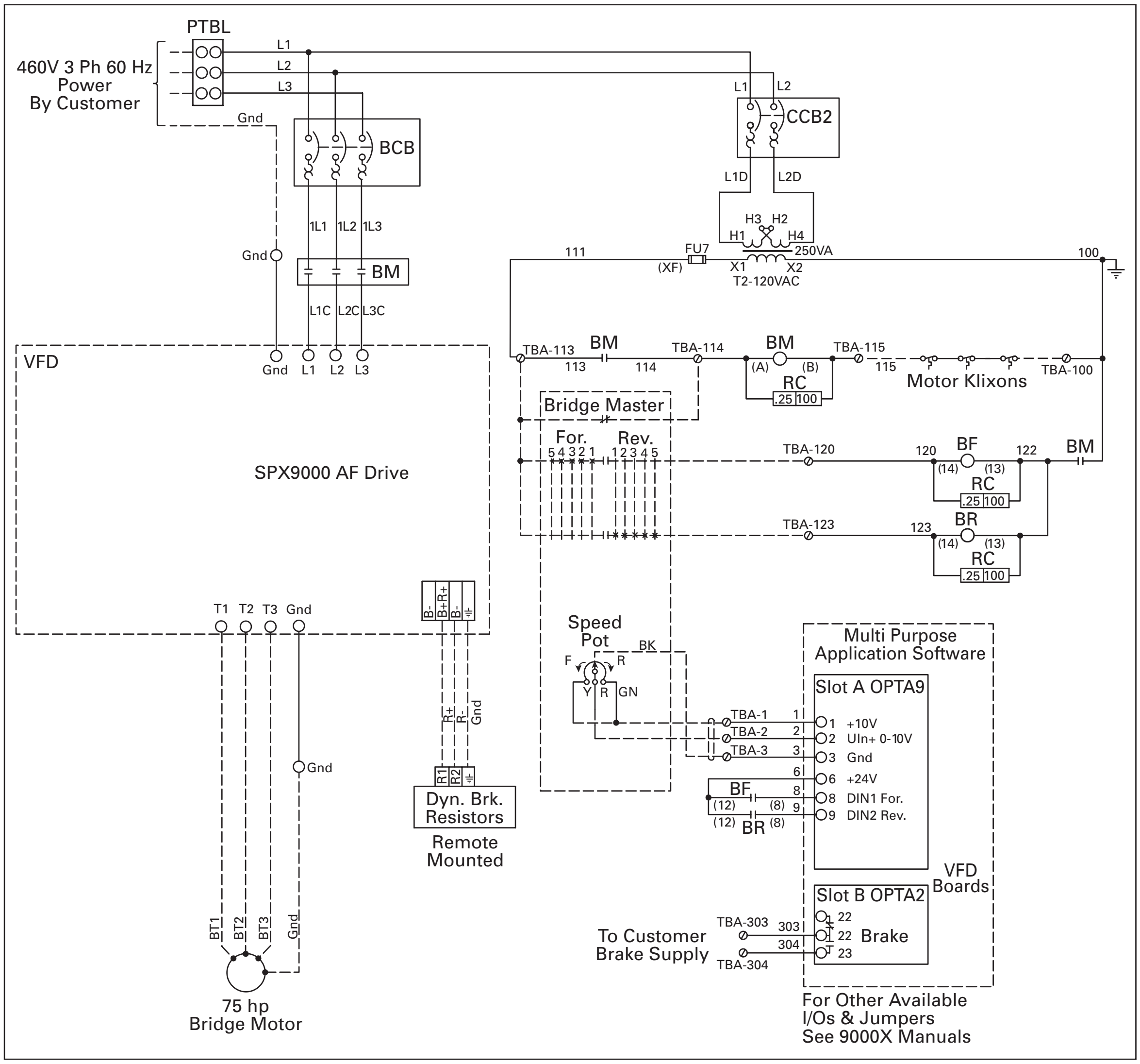
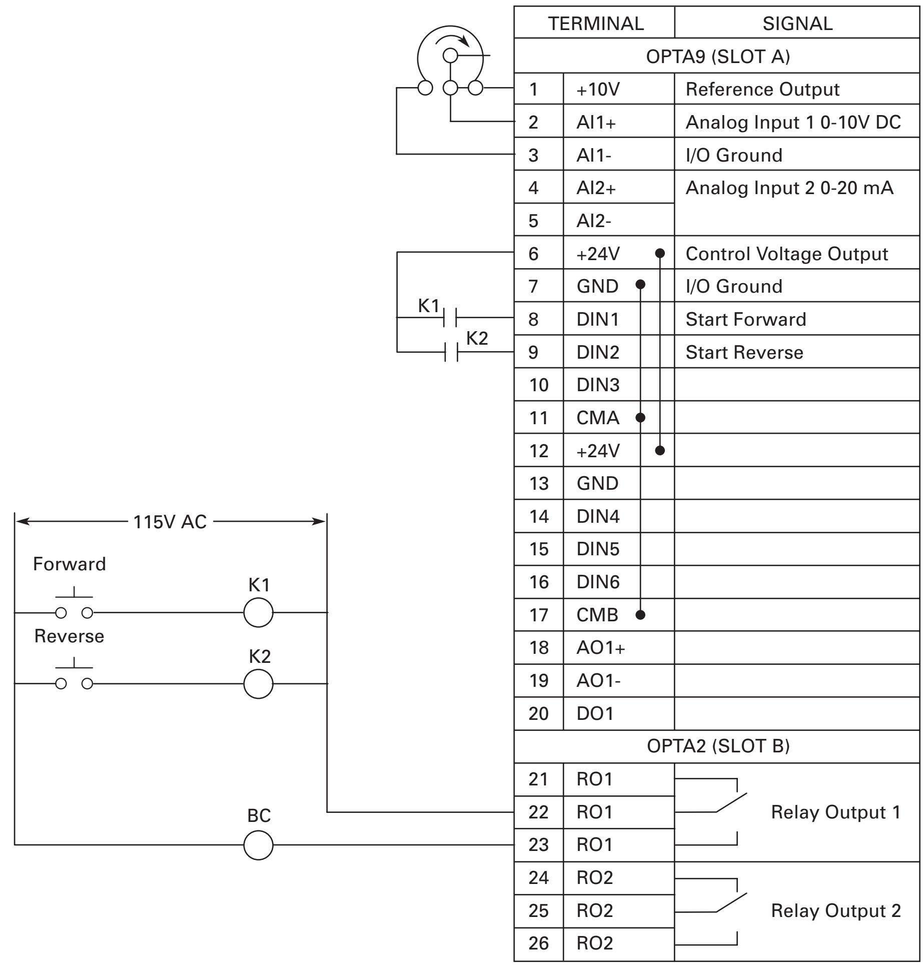


Figure 2-4: Typical NEMA ICS-8 AF Travel Control

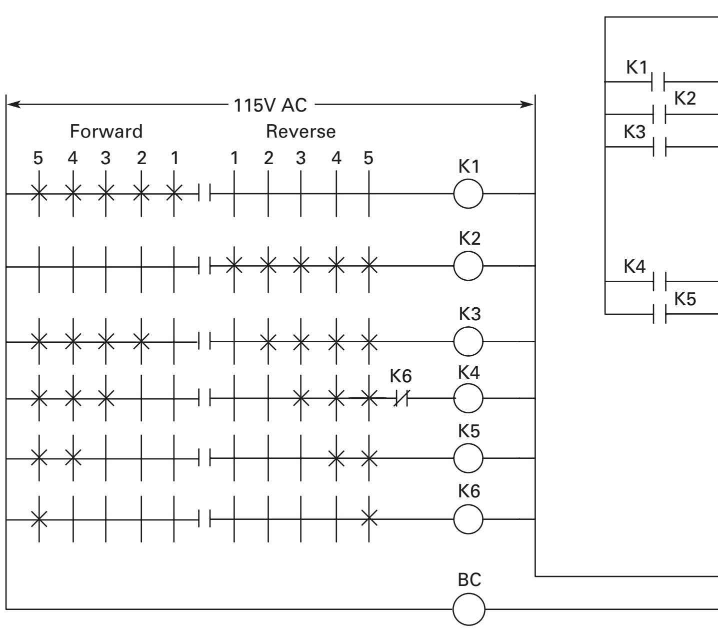


TERMINAL		SIGNAL
OPTA9 (SLOT A)		
1	+10V	Reference Output
2	AI1+	Analog Input 1 0-10V DC
3	AI1-	I/O Ground
4	AI2+	Analog Input 2 0-20 mA
5	AI2-	
6	+24V	Control Voltage Output
7	GND	I/O Ground
8	DIN1	Start Forward
9	DIN2	Start Reverse
10	DIN3	
11	CMA	
12	+24V	
13	GND	
14	DIN4	
15	DIN5	
16	DIN6	
17	CMB	
18	AO1+	
19	AO1-	
20	DO1	
OPTA2 (SLOT B)		
21	RO1	Relay Output 1
22	RO1	
23	RO1	
24	RO2	Relay Output 2
25	RO2	
26	RO2	

* Parameter value should be set to parameter value P1.1.4 minus .5 for best results.
Drive application must be set to multi purpose for this setup.

PARAMETER	SETTING	PARAMETER	SETTING
P1.1.1	0 HZ	P1.2.7.2	DIGIN : A2
P1.1.14	0/AI1	P1.3.3.15	DIGOUT : B1
P1.2.1.1	0/FORW-REV	P1.3.4.9	0.0
P1.2.2.1	AnIN : A1	P1.3.4.10	2.5 *
P1.2.7.1	DIGIN : A1		

Figure 2-5: Travel Joystick Control

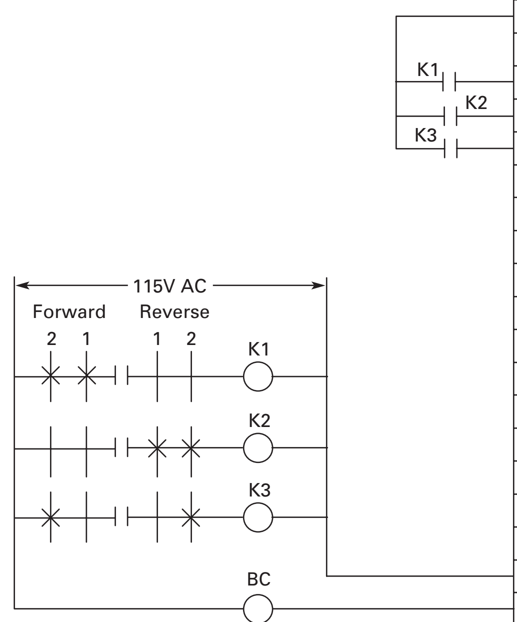


TERMINAL		SIGNAL
OPTA9 (SLOT A)		
1	+10V	Reference Output
2	AI1+	Analog Input 1 0-10V DC
3	AI1-	I/O Ground
4	AI2+	Analog Input 2 0-20 mA
5	AI2-	
6	+24V	Control Voltage Output
7	GND	I/O Ground
8	DIN1	Start Forward
9	DIN2	Start Reverse
10	DIN3	Ramp Up
11	CMA	
12	+24V	
13	GND	
14	DIN4	
15	DIN5	
16	DIN6	
17	CMB	
18	AO1+	
19	AO1-	
20	DO1	
OPTA2 (SLOT B)		
21	RO1	Relay Output 1
22	RO1	
23	RO1	
24	RO2	Relay Output 2
25	RO2	
26	RO2	

* Parameter value should be set to parameter value P1.1.4 minus .5 for best results.
Drive application must be set to multi purpose for this setup.

PARAMETER	SETTING	PARAMETER	SETTING	PARAMETER	SETTING
P1.1.1	5 HZ	P1.1.20	60 HZ	P1.2.7.5	DIGIN : A5
P1.1.15	5 HZ	P1.1.21	30 HZ	P1.2.7.6	DIGIN : A4
P1.1.16	5 HZ	P1.1.22	45 HZ	P1.2.7.7	DIGIN : A3
P1.1.17	5 HZ	P1.2.1.1	0/FORW-REV	P1.3.3.15	DIGOUT : B1
P1.1.18	5 HZ	P1.2.7.1	DIGIN : A1	P1.3.4.9	0.0
P1.1.19	15 HZ	P1.2.7.2	DIGIN : A2	P1.3.4.10	2.5 *

Figure 2-6: Travel 5-Speed Multi-Step

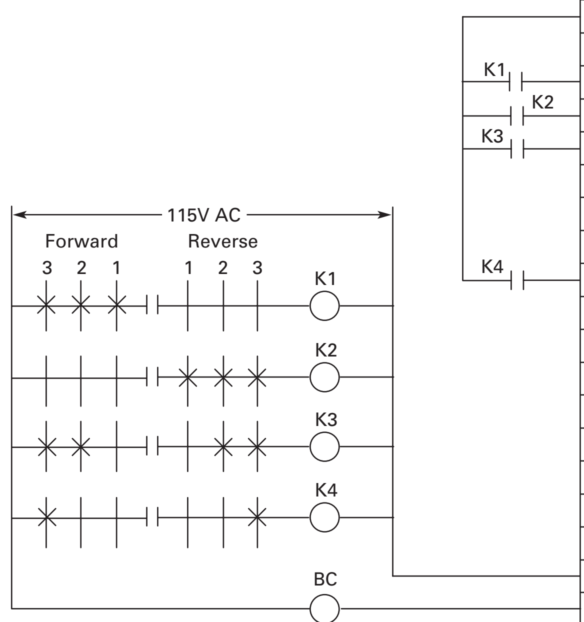


TERMINAL		SIGNAL
OPTA9 (SLOT A)		
1	+10V	Reference Output
2	AI1+	Analog Input 1 0-10V DC
3	AI1-	I/O Ground
4	AI2+	Analog Input 2 0-20 mA
5	AI2-	
6	+24V	Control Voltage Output
7	GND	I/O Ground
8	DIN1	Start Forward
9	DIN2	Start Reverse
10	DIN3	Ramp Up
11	CMA	
12	+24V	
13	GND	
14	DIN4	
15	DIN5	
16	DIN6	
17	CMB	
18	AO1+	
19	AO1-	
20	DO1	
OPTA2 (SLOT B)		
21	RO1	Relay Output 1
22	RO1	
23	RO1	
24	RO2	Relay Output 2
25	RO2	
26	RO2	

* Parameter value should be set to parameter value P1.1.4 minus .5 for best results.
Drive application must be set to multi purpose for this setup.

PARAMETER	SETTING	PARAMETER	SETTING
P1.1.1	5 HZ	P1.2.7.2	DIGIN : A2
P1.1.14	10/MOTOR POT	P1.2.7.9	DIGIN : A3
P1.2.1.1	0/FORW-REV	P1.3.3.15	DIGOUT : B1
P1.2.1.2	10.0	P1.3.4.9	0.0
P1.2.1.3	1/RES:STOP+PD	P1.3.4.10	2.5 *
P1.2.7.1	DIGIN : A1		

Figure 2-7: Travel 2-Contact Ramp and Hold



TERMINAL		SIGNAL
OPTA9 (SLOT A)		
1	+10V	Reference Output
2	AI1+	Analog Input 1 0-10V DC
3	AI1-	I/O Ground
4	AI2+	Analog Input 2 0-20 mA
5	AI2-	
6	+24V	Control Voltage Output
7	GND	I/O Ground
8	DIN1	Start Forward
9	DIN2	Start Reverse
10	DIN3	Hold
11	CMA	
12	+24V	
13	GND	
14	DIN4	Ramp Up
15	DIN5	
16	DIN6	
17	CMB	
18	AO1+	
19	AO1-	
20	DO1	
OPTA2 (SLOT B)		
21	RO1	Relay Output 1
22	RO1	
23	RO1	
24	RO2	Relay Output 2
25	RO2	
26	RO2	

* Parameter value should be set to parameter value P1.1.4 minus .5 for best results.
Drive application must be set to multi purpose for this setup.

PARAMETER	SETTING	PARAMETER	SETTING
P1.1.1	5 HZ	P1.2.7.2	DIGIN : A2
P1.1.14	10/MOTOR POT	P1.2.7.9	DIGIN : A4
P1.2.1.1	0/FORW-REV	P1.2.7.22	DIGIN : A3
P1.2.1.2	10.0	P1.3.3.15	DIGOUT : B1
P1.2.1.3	1/RES:STOP+PD	P1.3.4.9	0.0
P1.2.7.1	DIGIN : A1	P1.3.4.10	2.5 *

Figure 2-8: Travel 3-Contact Ramp and Hold

"Terminal To Function" (TTF) Programming Principle

The programming principle of the input and output signals in the **Crane Application** is different compared to the conventional method used in some other 9000X applications.

In the conventional programming method, *Function To Terminal programming method (FTT),* you have a fixed input or output that you define a certain function for. The Crane Application uses the *Terminal To Function programming method (TTF)* in which the programming process is carried out the other way around: Functions appear as parameters for which the operator defines a certain input/output. See *Caution* on **Page 2-11**.

Defining an Input/Output for a Certain Function on Keypad

Connecting a certain input or output with a certain function (parameter) is done by giving the parameter an appropriate value. The value is formed of the *Board slot* on the 9000X control board (see *9000X AF Drives User Manual*) and the *respective signal number* as shown in **Figure 2-9**.

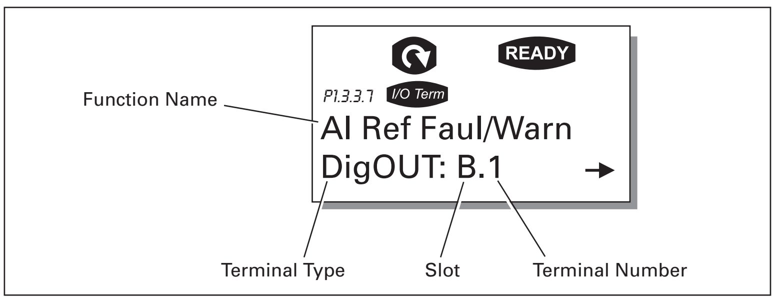


Figure 2-9: Defining Input/Output — Function

Example: You want to connect the digital output function *Reference fault/warning* (P1.3.3.7) to the digital output DO1 on the basic board OPTA1 (see *9000X AF Drives User Manual*, Chapter 4).

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

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

Once you have set the desired value, press the ENTER button once to confirm the change. See **Figure 2-10**.

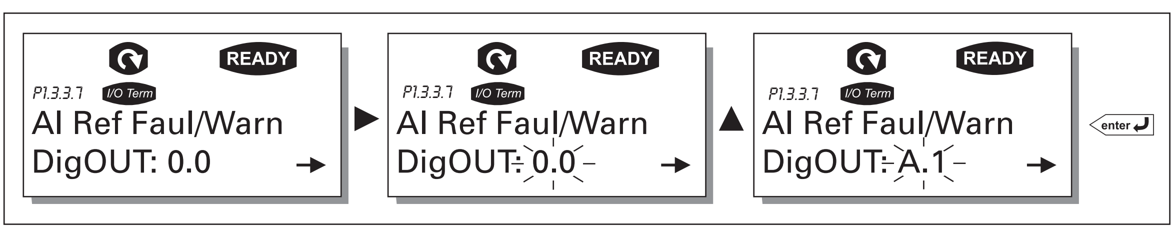


Figure 2-10: Defining Input/Output — Values

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

If you use the 9000X Drive Programming Tool for parameterizing, you will have to establish the connection between the function and input/output in the same way as with the control panel. Just pick the address code from the drop-down menu in the *Value* column (see **Figure 2-11**).

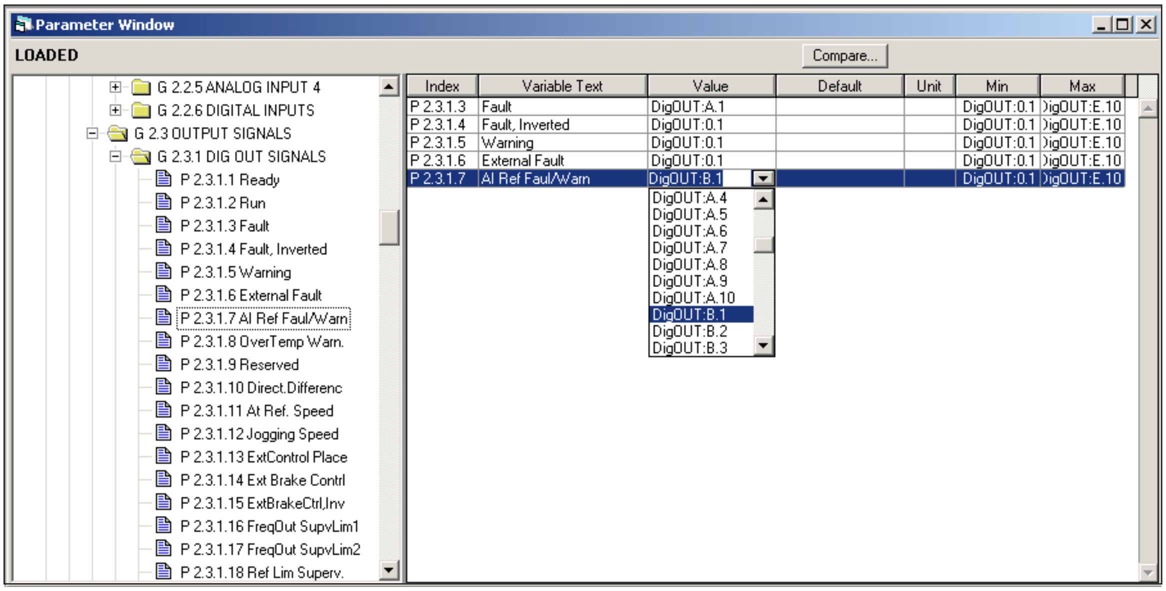


Figure 2-11: Screenshot of 9000X Drive Programming Tool; Entering the Address Code

CAUTION

Be ABSOLUTELY sure not to connect two functions to the same output in order to avoid function overruns and to ensure flawless operation.

Notice

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

Defining Unused Inputs/Outputs

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

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

Keypad Operation

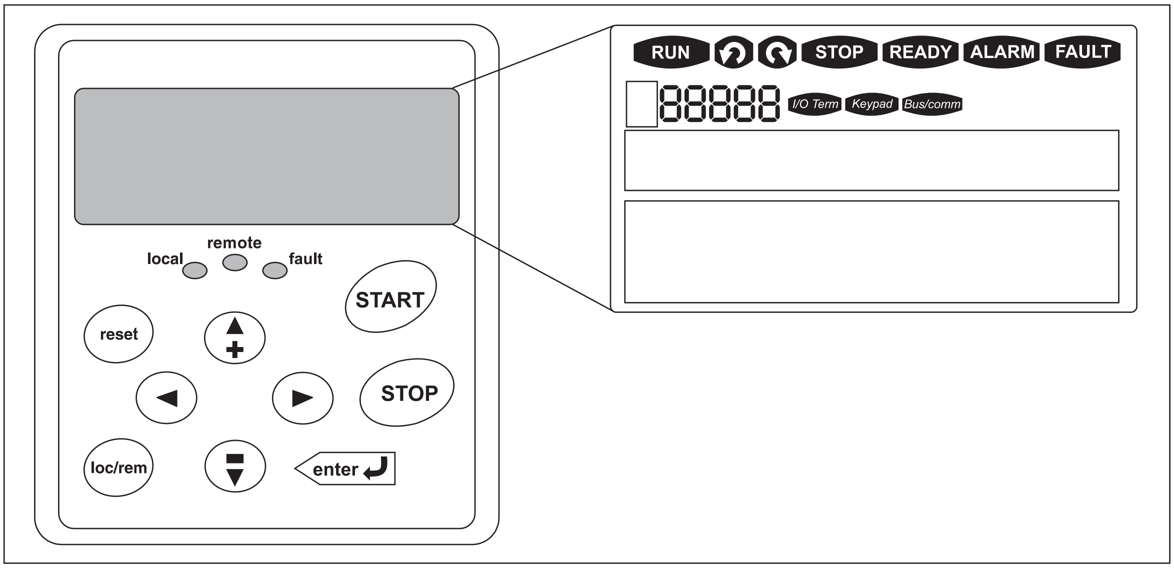


Figure 2-12: Keypad and Display

Table 2-1: LCD Status Indicators

Indicator	Description
RUN	**Run** Indicates that the 9000X is running and controlling the load. Blinks when a stop command has been given but the 9000X is still ramping down.
(counterclockwise symbol)	**Counterclockwise Operation** The output phase rotation is BAC, corresponding to counterclockwise rotation of most motors.
(clockwise symbol)	**Clockwise Operation** The output phase rotation is ABC, corresponding to clockwise rotation of most motors.
STOP	**Stop** Indicates that the 9000X is stopped and not controlling the load.
READY	**Ready** Indicates that the 9000X is ready to be started.
ALARM	**Alarm** Indicates that there is one or more active drive alarm(s).
FAULT	**Fault** Indicates that there is one or more active drive fault(s).
I/O Term	**I/O Terminal** Indicates that the I/O terminals have been chosen for control.
Keypad	**Keypad** Indicates that the keypad has been chosen for control.
Bus/comm	**Bus/Communications** Indicates that the communications bus control has been chosen for control.

Table 2-2: LED Status Indicators

Indicator	Description
local	**Local — Steady Illumination** Indicates that the 9000X is ready to be started and operated from the Local mode. **Local — Flashing** Indicates that the 9000X is ready for operating command to select Local or Remote operation.
remote	**Remote** Indicates that the 9000X is operating and controlling the load remotely.
fault	**Fault** Indicates that there is one or more active drive fault(s).

Table 2-3: Navigation Buttons

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

Table 2-3: Navigation Buttons (Continued)

Button	Description
◄	**Left Arrow** • navigation button, movement to left. • in parameter edit mode, exits mode, backs up one step. • cancels edited parameter (exit from a parameter edit mode). • When in "Operate" menu will move backward through menu. • At end of "Start-Up Wizard", repeats the "Start-Up Wizard" setup menu.
►	**Right Arrow** • navigation button, movement to right. • enter parameter group mode. • enter parameter mode from group mode. • When in "Operate" menu will move forward through menu.
▲+ ▼–	**Up and Down Arrows** • move either up or down a menu list to select the desired menu item. • editing a parameter/password, while the active digit/character is scrolled. • increase/decrease the reference value of the selected parameter. • in the "Operate" menu, will cause the display of the current reference source and value and allow its change if the keypad is the active reference source. Used to set the password (if defined) when leaving the "Operate" menu. • scroll through the "Active Faults" menu when the 9000X is stopped.

Menu Navigation

Navigation Tips

- To navigate within one level of a menu, use the up and down arrows.
- To move deeper into the menu structure and back out, use the right and left arrows.
- To edit a parameter, navigate to show that parameter's value, and press the right arrow button to enter the edit mode. In edit mode, the parameter value will flash.
- When in edit mode, the parameter value can be changed by pressing the up or down arrow keys.
- When in edit mode, pressing the right arrow a second time will allow you to edit the parameter value digit by digit.
- To confirm the parameter change you must press the ENTER button. *The value will not change unless the ENTER button is pushed*.
- Some parameters can not be changed while the 9000X is running. The screen will display LOCKED if you attempt to edit these parameters while the drive is running. Stop the drive to edit these parameters. See **Pages 2-30** – **2-51** for identification of these parameters specific to the Crane Application.

Main Menu

The data on the control keypad are arranged in menus and submenus. The first menu level consists of M1 to M8 and is called the Main Menu. The structure of these menus and their submenus is illustrated in **Figure 2-13.** Some of the submenus will vary for each application choice.

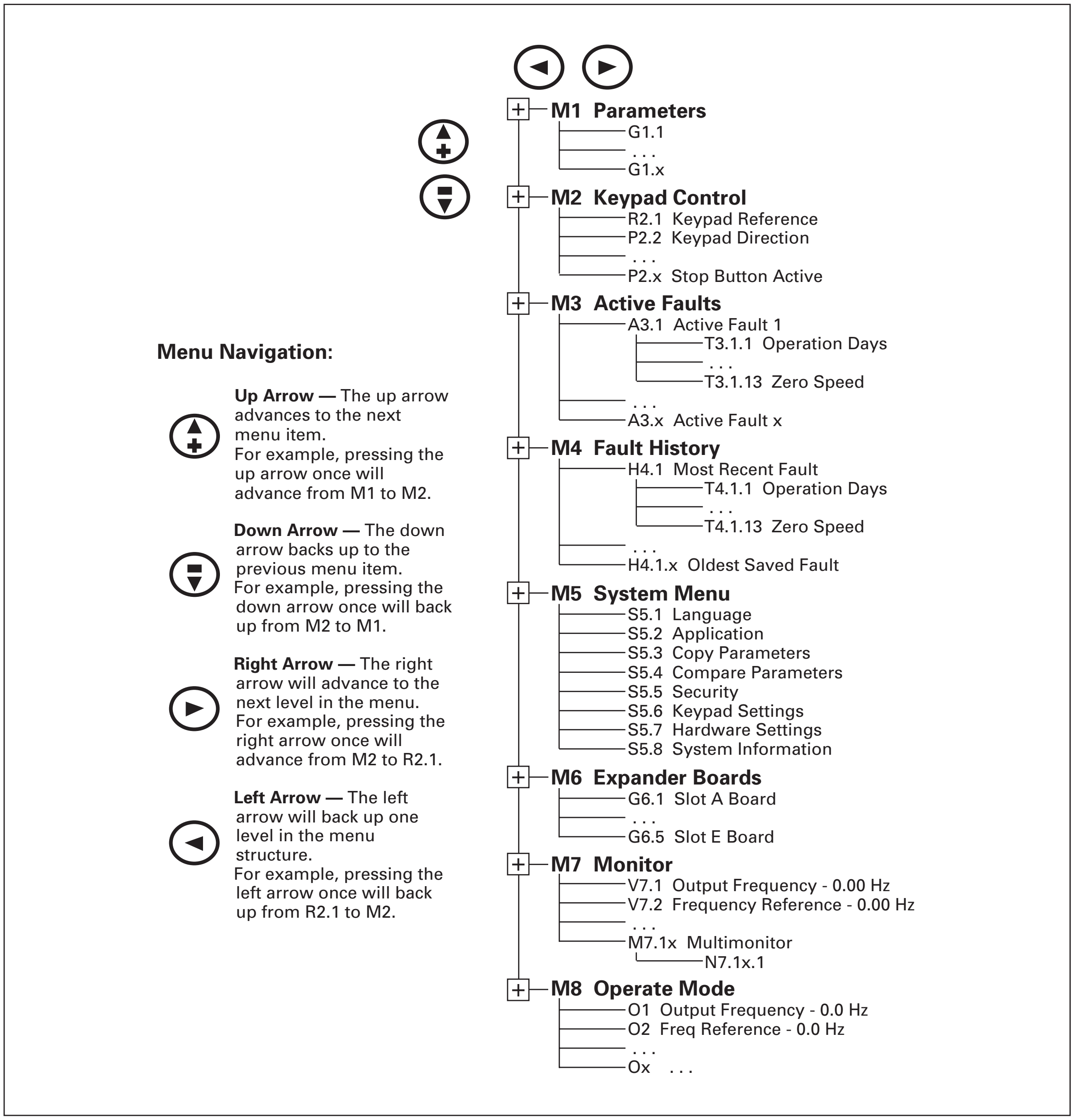


Figure 2-13: Main Menu Navigation

Parameter Menu (M1)

The Parameter Menu is a single or multi-level menu dependent upon the application in use, arranged by the parameter group items. **Figure 2-14** illustrates this for the Standard application. Parameters and parameter groups are explained in further detail later in this chapter.

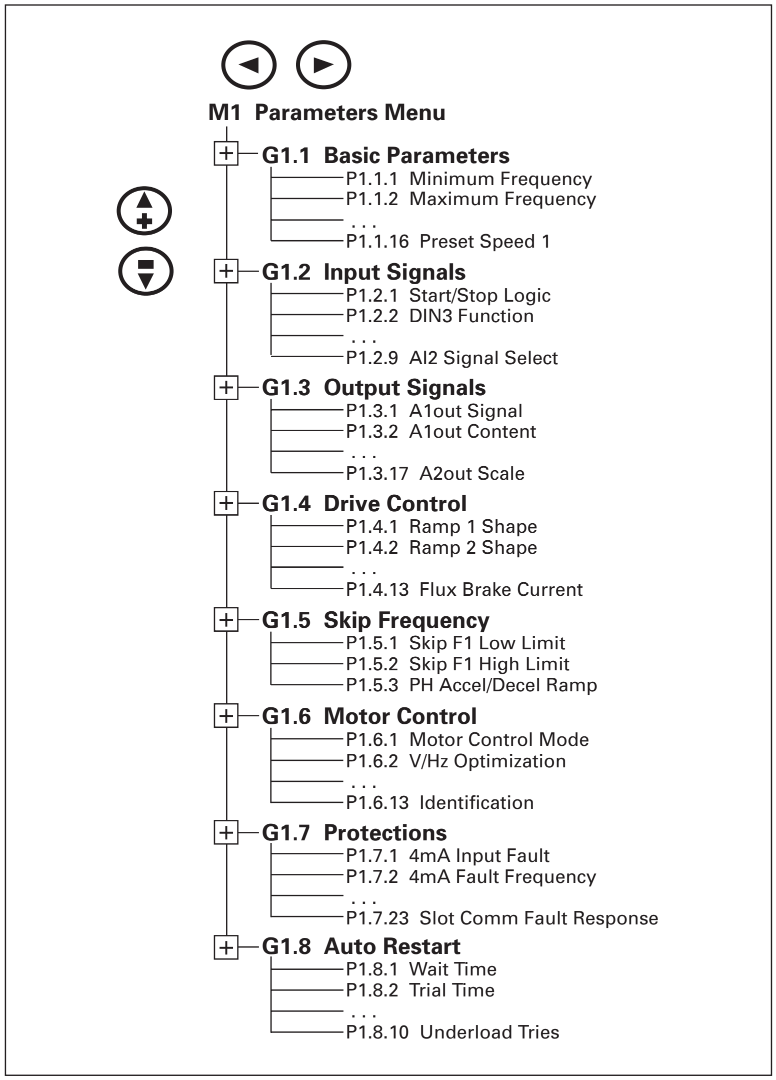


Figure 2-14: Parameter Menu Structure Example

Keypad Control Menu (M2)

In the Keypad Control Menu, you can set the frequency reference, choose the motor direction for keypad operation, and determine if the STOP button will be active at all times. See **Figure 2-15.**

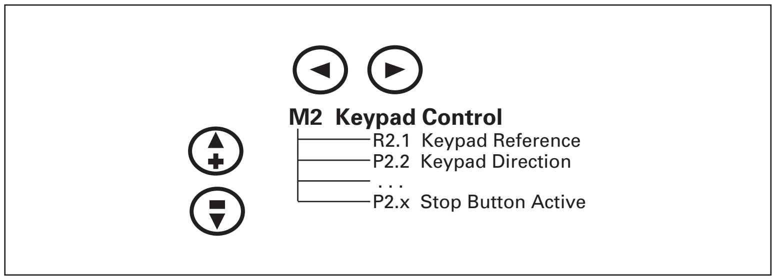


Figure 2-15: Keypad Control Menu

R2.1 Keypad Reference

Range: Min. Frequency — Max. Frequency
Units: Hertz
KEYPAD REFERENCE
This displays and allows the operator to edit the keypad frequency reference. A change takes place immediately. This reference value will not influence the output frequency unless the keypad has been selected as the active control place.

P2.2 Keypad Direction

Range: Forward, Reverse — Default: Forward
KEYPAD DIRECTION — **ID 123**
This allows the operator to change the rotation direction of the motor. This setting will not influence the rotation direction of the motor unless the keypad has been selected as the active control place.

P2.3 ① **Stop Button Active**

Range: Yes, No — Default: Yes
STOPBUTTONACTIVE — **ID 114**
By default, pushing the STOP button will **always** stop the motor regardless of the selected control place. If this parameter is set to **No**, the **STOP** button will stop the motor only **when the keypad has been selected as the active control place**.

① This parameter number varies for different applications.

Active Faults Menu (M3)

When a fault occurs, the 9000X stops. The sequence indication F1, the fault code, a short description of the fault and the fault type symbol will appear on the display. In addition, the indication FAULT or ALARM is displayed and, in case of a FAULT, the red LED on the keypad starts to blink. If several faults occur simultaneously, the sequence of active faults can be browsed with the Browser buttons. See **Figure 2-16**.

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

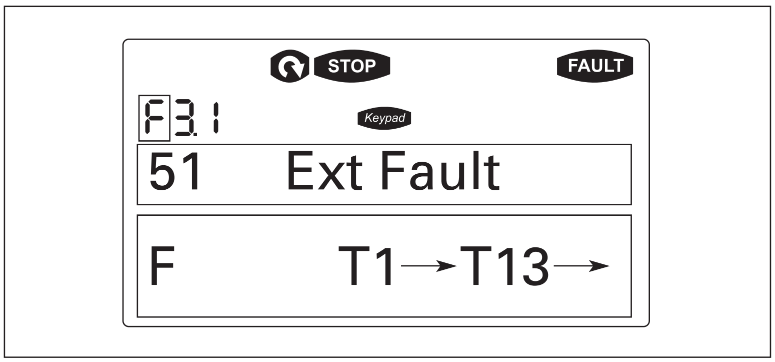


Figure 2-16: Active Fault Display Example

CAUTION

Remove any External Start signals or permissives before resetting the fault to prevent an unintentional restart of the 9000X, which could result in personal injury or equipment damage.

Fault Type

Range: A, F, AR, FT

FAULT TYPE

There are four different types of faults. These faults and their definitions are given in **Table 2-4**.

Table 2-4: Fault Types

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

Fault Code

Range: 1 – 54

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

Fault Time Data Record

Range: T.1 – T.13

In this menu, important data recorded at the time the fault is available. This feature is intended to help the user or the service person to determine the cause of fault. **Table 2-5** indicates the information that is recorded.

Table 2-5: Fault Time Data

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

① Real time record.

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

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

Fault History Menu (M4)

All faults are stored in the Fault History Menu, which can be viewed by using the Browser buttons. Additionally, the Fault time data record pages are accessible for each fault as in the Active Faults Menu described above. See **Figure 2-17**.

The 9000X's memory can store a maximum of 30 faults, in the order of appearance. If there are 30 uncleared faults in the memory, the next occurring fault will erase the oldest fault from the memory.

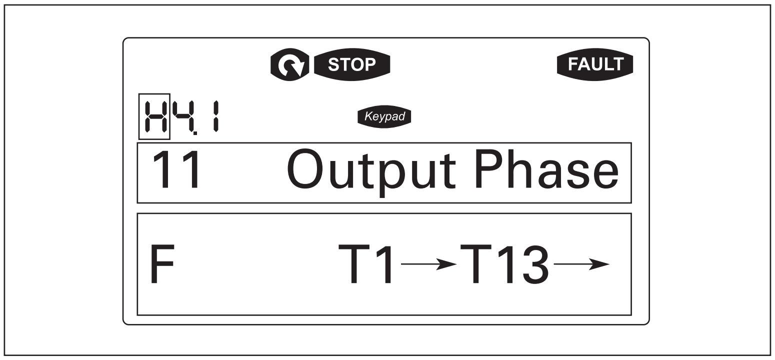


Figure 2-17: Sample Fault History Display

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

System Menu (M5)

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

Descriptions of the system menu parameters are illustrated in **Figure 2-18.**

- **S5.1 Language Selection**
- **S5.2 Application Selection**
- **S5.3 Copy Parameters**
  - S5.3.1 Parameter Sets
  - S5.3.2 Upload to Keypad
  - S5.3.3 Download from Keypad
  - S5.3.4 Automate Backup
- **S5.4 Parameter Comparison**
- **S5.5 Security**
  - S5.5.1 Password
  - P5.5.2 Parameter Lock
  - P5.5.3 Start-Up Wizard
  - P5.5.4 Multimonitor Items
- **S5.6 Keypad Settings**
  - P5.6.1 Default Page
  - P5.6.2 Default Page/Operating Menu
  - P5.6.3 Timeout Time
  - P5.6.4 Contrast Adjustment
  - P5.6.5 Backlight Time
- **S5.7 Hardware Settings**
  - P5.7.1 Internal Brake Resistor
  - P5.7.2 Fan Control
  - P5.7.3 HMI Acknowledge Timeout
  - P5.7.4 HMI Number of Retries
- **S5.8 System Information**
  - S5.8.1 Total Counters
    - C5.8.1.1 MWh Counter
    - C5.8.1.2 Power On Day Counter
    - C5.8.1.3 Power On Hour Counter
  - S5.8.2 Trip Counters
    - T5.8.2.1 MWh Counter
    - T5.8.2.2 Clear MWh Trip Counter
    - T5.8.2.3 Power On Day Counter
    - T5.8.2.4 Power On Hour Counter
    - T5.8.2.5 Clear Operating Time Counter
  - S5.8.3 Software Information
    - I5.8.3.1 Software Package
    - I5.8.3.2 System Software Version
    - I5.8.3.3 Firmware Interface
    - I5.8.3.4 System Load
  - S5.8.4 Applications
    - A5.8.4.# Name of Application
      - D5.8.4.#.1 Application ID
      - D5.8.4.#.2 Version
      - D5.8.4.#.3 Firmware Interface
  - S5.8.5 Hardware
    - I5.8.5.1 Nominal Unit Power
    - I5.8.5.2 Nominal Unit Voltage
    - E5.8.5.3 Brake Chopper
    - E5.8.5.4 Brake Resistor
  - S5.8.6 Expander Boards
  - S5.8.7 Debug Menu

Figure 2-18: System Menu Structure

System Menu Parameters

S5.1 Language Selection

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

LANGUAGE

This parameter offers the ability to control the 9000X through the keypad in the language of your choice. Available languages are: English, Spanish, French and Portuguese.

S5.2 Application Selection

Default: Basic

APPLICATION

This parameter sets the active application.

When changing applications, you will be asked if you want the parameters of the new application to be uploaded to the keypad. If you wish to load the new application parameters, push the ENTER button. Pushing any other button saves the parameters of the previously used application in the keypad.

System Menu Copy Parameter Options (S5.3)

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

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

S5.3.1 Parameter Sets

PARAMETER SETS

This parameter allows you to reload the factory default parameter values, and to store and load two customized parameter sets.

S5.3.2 Upload to Keypad

UP TO KEYPAD

This function uploads all existing parameter groups to the keypad.

S5.3.3 Download from Keypad

Range: 0 – 3 — Default: 0 (All parameters)

DOWN FROM KEYPAD

This function downloads one or all parameter groups from the keypad to the drive.

0 All parameters
1 All, no motor
2 Application parameters

S5.3.4 Automatic Backup

Range: Yes, No — Default: Yes

AUTO.BACKUP — **ID 820**

This parameter activates and deactivates the parameter backup function. When the Parameter backup function is activated, the keypad makes a copy of the parameters and settings in the currently active application. When applications are changed, you will be asked if you wish the parameters of the **new** application to be uploaded to the keypad. For this to happen, push the ENTER button. If you wish to keep the copy of the parameters of the **previously used** application saved in the keypad push any other button.

Note: Parameters saved in the parameter settings of S5.3.1 will be deleted when applications are changed. If you want to transfer the parameters from one application to another you have to upload them to the keypad first.

System Menu Parameter Comparison Options (S5.4)

S5.4 Parameter Comparison

PARAMETER COMPARISON

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

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

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

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

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

Security Menu Parameter Options (S5.5)

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

S5.5.1 Password

Range: 0 – 65535 Default: 0

PASSWORD

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

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

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

P5.5.2 Parameter Lock

Range: ChangeEnable, ChangeDisabl Default: ChangeDisabl

PARAMETER LOCK **ID 819**

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

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

P5.5.3 Start-Up Wizard

Range: Yes, No Default: No

START-UP WIZARD **ID 826**

The Start-Up Wizard facilitates commissioning the 9000X. If selected active, the Start-Up Wizard prompts the operator for the language and application desired and then advances through the start-up parameter list. After completion it allows the user to repeat the Start-Up Wizard or return to the default page, the Operate Menu. The Start-Up Wizard in always active for the initial power up of the 9000X.

P5.5.4 Multimonitor Items

Range: ChangeEnable, ChangeDisabl Default: ChangeEnable

MULTIMON.ITEMS **ID 822**

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

Keypad Settings (S5.6)

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

P5.6.1 Default Page

Default: 0

DEFAULT PAGE

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

P5.6.2 Default Page in the Operating Menu

DEFAULT PAGE/OM

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

P5.6.3 Timeout Time

Range: 0 – 65,535 Default: 30
Units: Seconds

TIMEOUT TIME **ID 804**

The ***Timeout Time*** setting defines the time after which the keypad display returns to the ***Default Page***.

Note: If the ***Default Page*** value is 0 the ***Timeout Time*** setting has no effect.

P5.6.4 Contrast Adjustment

CONTRAST ADJUSTMENT **ID 805**

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

P5.6.5 Backlight Time

Range: 1 – 65,535 or Forever Default: 10
Units: Minutes

BACKLIGHT TIME **ID 818**

This parameter determines how long the backlight stays on before going out. You can select any time between 1 and 65,535 minutes or "Forever".

Hardware Settings (S5.7)

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

P5.7.1
Internal Brake Resistor Connection

Range: Connected – Not Connected Default: Connected

INTERNBRAKERES **ID 821**

With this function you tell the 9000X whether the internal brake resistor is connected or not.

If your drive has an internal brake resistor, the default value of this parameter is "Connected". However, if it is necessary to increase braking capacity by installing an external brake resistor, or if the internal brake resistor is disconnected, it is advisable to change the value of this function to "Not Connected" in order to avoid unnecessary fault trips.

Note: The brake resistor is available as an option for all drives. It can be installed internally in frame sizes FR4 to FR6.

P5.7.2
Fan Control

Range: Continuous, Temperature Default: Continuous

FAN CONTROL **ID 825**

This function sets the control method of the 9000X's cooling fan. You can set the fan to run continuously when the power is switched on or to run based on the temperature of the unit. If the latter function has been selected, the fan is switched on automatically when the heatsink temperature reaches 60°C. The fan receives a stop command when the heatsink temperature falls to 55°C. The fan runs for about a minute after receiving the stop command or switching on the power, as well as after changing the value from "Continuous" to "Temperature".

Note: The fan runs continuously, regardless of this setting, when the 9000X is in RUN state.

P5.7.3
Keypad Acknowledge Timeout

Range: 200 – 5,000 Default: 200

Units: mseconds

KEYPAD ACK TIMEOUT **ID 823**

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

Note: If the 9000X has been connected to a PC with a serial cable, the default values of ***Keypad Acknowledge Timeout*** and ***Number of Retries to Receive Keypad Acknowledgement*** must not be changed.

If the 9000X has been connected to a PC via a modem and there is delay in transferring messages, the value of ***Keypad Acknowledge Timeout*** must be set according to the delay as follows:

Example:

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

  Retries = 5

  AckTimeOut = 1200

  TimeOut = 5000

It must also be considered that intervals shorter than the ***Keypad Acknowledge Timeout*** time cannot be used in 9000X drive monitoring.

P5.7.4 Number of Retries to Receive Keypad Acknowledgement

Range: 1 – 10 Default: 5

KEYPAD RETRY **ID 824**

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

System Information (S5.8)

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

S5.8.1 Total Counters

TOTAL COUNTERS

In the ***Total Counters*** page you will find information related to the 9000X operating times, i.e. the total numbers of MWh, operating days and operating hours. See **Table 2-6**.

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

Note: The Power On time counters, days and hours, operate whenever power is applied to the 9000X.

Table 2-6: Total Counters

Number	Name	Description
C5.8.1.1	MWh counter	Megawatt hours total operation time counter
C5.8.1.2	Power On day counter	Number of days the 9000X has been supplied with power
C5.8.1.3	Power On hour counter	Number of hours the 9000X has been supplied with power

S5.8.2 Trip Counters

TRIP COUNTERS

The ***Trip Counters*** are counters whose values can be reset to zero. The resettable counters are shown in **Table 2-7**.

Table 2-7: Trip Counters

Number	Name	Description
T5.8.2.1	MWh counter	Megawatts hours since last reset
P5.8.2.2	Clear MWh counter	Resets megawatts hours counter
T5.8.2.3	Power On day counter	Number of days the 9000X has been run since the last reset
T5.8.2.4	Power On hour counter	Number of hours the 9000X has been run since the last reset
P5.8.2.5	Clr Optime cntr	Resets the operating day and hour counters

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

S5.8.3 Software Information

SOFTWARE

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

Table 2-8: Software Information

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

S5.8.4 Application Information

APPLICATIONS

The Application information page includes information on not only the application currently in use but also all other applications loaded into the 9000X. The information available is shown in **Table 2-9**. Note that the "x" in the table refers to the sequential number of the application in the list.

Table 2-9: Application Information

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

S5.8.5 Hardware Information

HARDWARE

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

Table 2-10: Hardware Information

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

S5.8.6
Expander Board Information

EXPANDER BOARDS

This parameter and its sub-items provide information about the basic and option boards plugged into the control board as shown in **Table 2-11**. Note that the “x” in the table refers to the sequential number of the slot, with slot A being “1” and slot E being “5”.

Table 2-11: Expander Board Information

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

S5.8.7
Debug Menu

DEBUG

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

Expander Board Menu (M6)

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

- to see what expander boards are connected to the control board and
- to access and edit the parameters associated with the expander board.

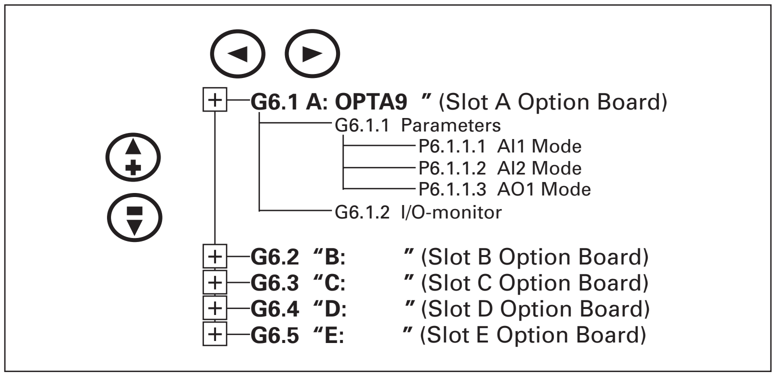


Figure 2-19: Expander Board Menu Structure

Example of Expander Board Parameters for Option Board A9

P6.1.1.1
AI1 Mode

Range: 1 – 5 Default: 3

AI1 MODE

Analog Input 1 input options:

1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V
5 -10 – +10VP

P6.1.1.2
AI2 Mode

Range: 1 – 5 Default: 1

AI2 MODE

Analog Input 2 input options:

1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V
5 -10 – +10VP

P6.1.1.3
AO1 Mode

Range: 1 – 4 Default: 1

AO1 MODE

Analog Output 1 output options:

1 0 – 20 mA
2 4 – 20 mA
3 0 – 10V
4 2 – 10V

Crane Application — Parameter Lists

Monitoring Values (Control Keypad: Menu M7)

The monitoring values are the actual values of parameters and signals, as well as statuses and measurements. Monitoring values cannot be edited.

See *9000X AF Drives User Manual*, Chapter 5 for more information.

Table 2-12: Monitoring Values, 9000X AF Crane Drives

Code	Parameter	Unit	ID	Description
V7.1	Output frequency	Hz	1	Output frequency to motor
P7.3	Motor speed	rpm	1018	
V7.2	Frequency reference	Hz	25	Frequency reference to motor control
V7.4	Motor current	A	3	
V7.5	Motor torque	%	4	Motor torque as a percentage
V7.6	Motor power	%	5	
V7.7	Motor voltage	V	6	Motor voltage in 0.1 Volts
V7.8	DC bus voltage	V	7	
V7.9	Unit temperature	°C	8	:=25
V7.10	Motor temperature	%	9	
V7.11	Analog input 1		13	
V7.12	Analog input 2		14	
V7.13	DIN1, DIN2, DIN3		15	Digital inputs: A1, A2 and A3 status
V7.14	DIN4, DIN5, DIN6		16	Digital inputs: B1, B2 and B3 status
V7.15	DO1, RO1, RO2		17	
V7.15	Analog Iout	mA	26	
V7.16	Analog input 3		27	
V7.17	Analog input 4		28	
V7.18	Torque reference	%	18	
V7.19	PT 100 temp	°C	42	
G7.20	Multi-monitor			

Multimonitor (G7.20)

This parameter allows the viewing and selection (if allowed by System menu item, P5.5.4) of three simultaneously monitored items from the Monitored Menu Items shown in **Table 2-1**. Use the right arrow key to select the item to be modified and then the up or down arrow keys to select the new item. Press the ENTER key to accept the change.

Operate Menu (M8)

The Operate Menu provides an easy-to-use method of viewing key numerical Monitoring Menu items. Some applications also support the setting of reference values in this menu. The items displayed vary by application. **Table 2-13** is an example for the Standard application.

Table 2-13: Operate Menu Items — Standard Application Example

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

The menu is navigated by using the left and right arrow buttons. If a reference level is available for setting, the up and down arrow buttons adjust the value. To exit the Operate Menu to access the other menus, depress the ENTER button for 2 seconds. While in the other menus, if there is no keypad activity, the display will return to the Operate Menu after 30 seconds. **Figure 2-20** illustrates the Operate Menu button function.

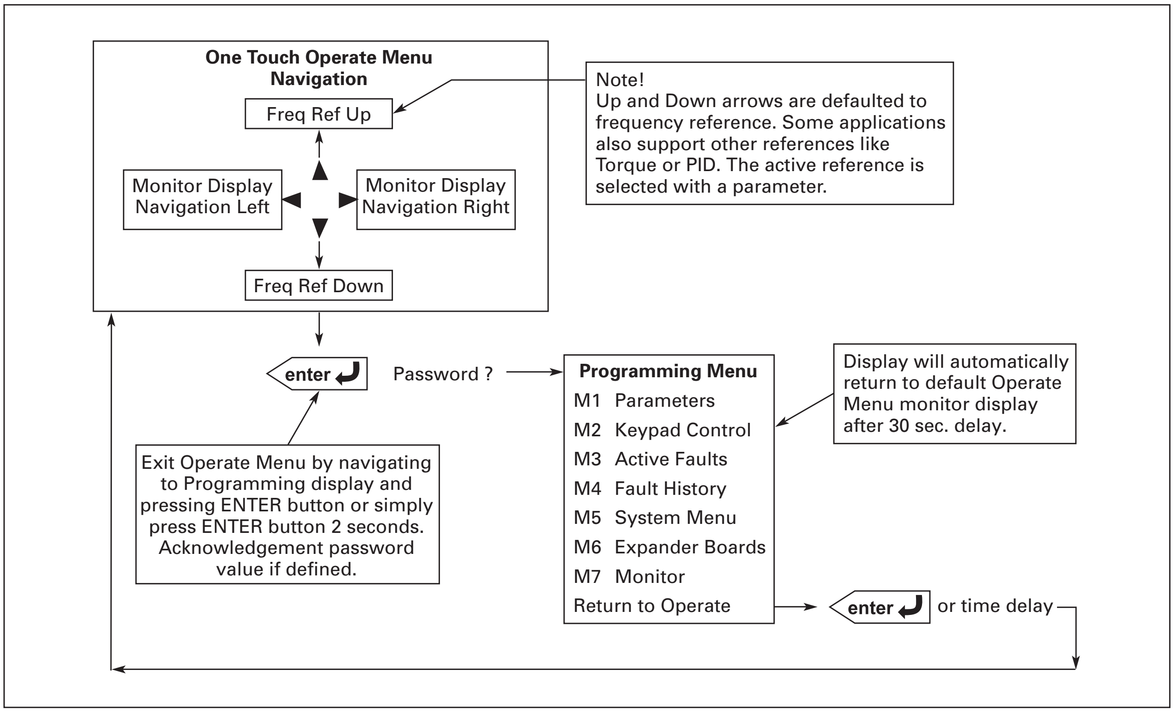


Figure 2-20: Operate Menu Navigation

Start-Up Wizard

Upon initial power up, the **Start-Up Wizard** guides the commissioner through the basic 9000X setup. The **Start-Up Wizard** may be set to function upon an application change by setting parameter P5.5.3.

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

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

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

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

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

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

Basic Parameters (Control Keypad: Menu M1 → G1.1)

Table 2-14: Basic Parameters — G1.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.1.1	Min frequency	0.00	Par. 1.1.2	Hz	0.00		101	
P1.1.2	Max frequency	Par. 1.1.1	320.00	Hz	60.00		102	**NOTE**: If f_{max} > than the motor synchronous speed, check suitability for motor and drive system.
P1.1.3	Acceleration time 1	0.1	3270.0	s	3.0		103	
P1.1.4	Deceleration time 1	0.1	3270.0	s	3.0		104	
P1.1.5	Current limit	0	2 x I_H	A	I_L		107	
P1.1.6 ①	Nominal voltage of the motor	180	690	V	SPX: 230V SPX: 460V SPX: 690V		110	
P1.1.7 ①	Nominal frequency of the motor	8.00	320.00	Hz	60.00		111	Check the rating plate of the motor.
P1.1.8 ①	Nominal speed of the motor	24	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size frequency converter.
P1.1.9 ①	Nominal current of the motor	0.1 x I_H	2 x I_H	A	I_H		113	Check the rating plate of the motor.
P1.1.10	Power Factor	0.30	1.00		0.85		120	Check the rating plate of the motor.
P1.1.11	Local control place	1	3		2		171	**1** = I/O Terminal **2** = Keypad **3** = Fieldbus
P1.1.12	Remote control place	1	3		1		172	**1** = I/O Terminal **2** = Keypad **3** = Fieldbus
P1.1.13	Local reference	0	14		8		173	**0** = AI1 **1** = AI2 **2** = AI1+AI2 **3** = AI1-AI2 **4** = AI2-AI1 **5** = AI1xAI2 **6** = AI1 Joystick **7** = AI2 Joystick **8** = Keypad **9** = Fieldbus **10** = Motor potentiometer **11** = AI1, AI2 minimum **12** = AI1, AI2 maximum **13** = Max frequency **14** = AI1/AI2 selection
P1.1.14	Remote reference	0	14		0		174	See par. 1.1.13
P1.1.15	Jog speed reference	0.00	Par. 1.1.2	Hz	5.00		124	Slow-down speed
P1.1.16	Preset speed 1	0.00	Par. 1.1.2	Hz	10.00		105	Multi-step speed 1
P1.1.17	Preset speed 2	0.00	Par. 1.1.2	Hz	15.00		106	Multi-step speed 2
P1.1.18	Preset speed 3	0.00	Par. 1.1.2	Hz	20.00		126	Multi-step speed 3
P1.1.19	Preset speed 4	0.00	Par. 1.1.2	Hz	25.00		127	Multi-step speed 4
P1.1.20	Preset speed 5	0.00	Par. 1.1.2	Hz	30.00		128	Multi-step speed 5
P1.1.21	Preset speed 6	0.00	Par. 1.1.2	Hz	40.00		129	Multi-step speed 6
P1.1.22	Preset speed 7	0.00	Par. 1.1.2	Hz	60.00		130	Multi-step speed 7

① Parameter value can only be changed when the drive is stopped.

Input Signals

Basic Settings (Control Keypad: Menu M1 ➜ G1.2.1)

Table 2-15: Input Signals: Basic Settings — G1.2.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.1.1 ①	Start/Stop logic selection	0	7		0		300	Start signal **1** (Default: DIN1) / Start signal **2** (Default: DIN2) **0** Start forw. / Start rev. **1** Start/Stop / Reverse **2** Start/Stop / Run enable **3** Start pulse / Stop pulse **4** Start / Mot.pot.UP **5** Fwd pulse / Rev pulse **6** Start pulse / Rev pulse **7** Start pulse / Enabl pulse
P1.2.1.2 ①	Motor potentiometer ramp time	0.1	2000.0	Hz/s	10.0		331	
P1.2.1.3 ①	Motor potentiometer frequency reference memory reset	0	2		1		367	**0** = No reset **1** = Reset if stopped or powered down **2** = Reset if powered down
P1.2.1.4 ①	Adjust input	0	5		0		493	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus (FBProcessDataIN3)
P1.2.1.5	Adjust minimum	0.0	100.0	%	0.0		494	
P1.2.1.6	Adjust maximum	0.0	100.0	%	0.0		495	

① Parameter value can only be changed when the drive is stopped.

Analog Input 1 (Control Keypad: Menu M1 ➜ G1.2.2)

Table 2-16: Analog Input 1 Parameters — G1.2.2

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

② Programmed using the *Terminal to Function* (TTF) method. See **Page 2-10**.
③ Remember to place jumpers of block X2 accordingly. See *9000X AF Drives User Manual, Chapter 4*.

Table 2-16: Analog Input 1 Parameters — G1.2.2 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.2.7	AI1 reference scaling. maximum value	0.00	320.00	Hz	0.00		304	Selects the frequency that corresponds to the max. reference signal
P1.2.2.8	AI1 joystick hysteresis	0.00	20.00	%	0.00		384	
P1.2.2.9	AI1 sleep limit	0.00	100.00	%	0.00		385	
P1.2.2.10	AI1 sleep delay	0.00	320.00	s	0.00		386	
P1.2.2.11	AI1 joystick offset	-50.00	50.00	%	0.00		165	

Analog Input 2 (Control Keypad: Menu M1 ➜ G1.2.3)

Table 2-17: Analog Input 2 Parameters — G1.2.3

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

① Parameter value can only be changed when drive is stopped.
② Remember to place jumpers of block X2 accordingly. See *9000X AF Drives User Manual, Chapter 4*.

Analog Input 3 (Control Keypad: Menu M1 ➜ G1.2.4)

Table 2-18: Analog Input 3 Parameters — G1.2.4

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

① Programmed using the *Terminal to Function* (TTF) method. See **Page 2-10**.

Analog Input 4 (Control Keypad: Menu M1 ➜ G1.2.5)

Table 2-19: Analog Input 4 Parameters — G1.2.5

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

② Programmed using the *Terminal to Function* (TTF) method. See **Page 2-10**.

Free Analog Input Signal Selection (Keypad: Menu M1 ➜ G1.2.6)

Table 2-20: Free Analog Input Signal Selection — G1.2.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.2.6.1	Scaling of current limit	0	5		0		399	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = Fieldbus (FBProcessDataIN2)
P1.2.6.2	Scaling of DC-braking current	0	5		0		400	See par. 1.2.6.1
P1.2.6.3	Reducing of acc./ dec. times	0	5		0		401	See par. 1.2.6.1
P1.2.6.4	Reducing of torque supervision limit	0	5		0		402	See par. 1.2.6.1
P1.2.6.5	Torque limit	0	5		0		485	See par. 1.2.6.1

Digital Inputs (Control Keypad: Menu M1 ➜ G1.2.7)

Table 2-21: Digital Input Signals — G1.2.7

Code	Parameter	Min.	Default	Cust	ID	Note
P1.2.7.1 ①	Start signal 1	0	A.1		403	
P1.2.7.2 ①	Start signal 2	0	A.2		404	
P1.2.7.3 ①	Run enable	0	0.2		407	Motor start enabled (cc) ②
P1.2.7.4 ①	Reverse	0	0.1		412	Direction forward (oc) ② Direction reverse (cc) ②
P1.2.7.5 ①	Preset speed 1	0	0.1		419	
P1.2.7.6 ①	Preset speed 2	0	0.1		420	
P1.2.7.7 ①	Preset speed 3	0	0.1		421	
P1.2.7.8 ①	Motor potentiometer reference DOWN	0	0.1		417	Mot.pot. reference decreases (cc) ②
P1.2.7.9 ①	Motor potentiometer reference UP	0	0.1		418	Mot.pot. reference increases (cc) ②
P1.2.7.10 ①	Fault reset	0	0.1		414	All faults reset (cc) ②
P1.2.7.11 ①	External fault (close)	0	0.1		405	Ext. fault displayed (cc) ②
P1.2.7.12 ①	External fault (open)	0	0.2		406	Ext. fault displayed (oc) ②
P1.2.7.13 ①	Acc/Dec time selection	0	0.1		408	Acc/Dec time 1 (oc) ② Acc/Dec time 2 (cc) ②

① Programmed using the *Terminal to Function* (TTF) method. See **Page 2-10**.
② cc = closing contact; oc = opening contact.

Table 2-21: Digital Input Signals — G1.2.7 (Continued)

Code	Parameter	Min.	Default	Cust	ID	Note
P1.2.7.14 ①	Acc/Dec prohibit	0	0.1		415	Acc/Dec prohibited (cc) ②
P1.2.7.15 ①	DC braking	0	0.1		416	DC braking active (cc) ②
P1.2.7.16 ①	Jogging speed	0	A.4		413	Jogging speed selected for frequency reference (cc) ②
P1.2.7.17 ①	AI1/AI2 selection	0	0.1		422	
P1.2.7.18 ①	Force local	0	0.1		176	Force control place to I/O terminal (cc) ②
P1.2.7.19 ①	Force remote	0	0.1		177	Force control place to keypad (cc) ②
P1.2.7.20 ①	Parameter set 1/set 2 selection	0	0.1		496	Closed cont. = Set 2 is used Open cont. = Set 1 is used
P1.2.7.21 ①	Motor control mode 1/2	0	0.1		164	Closed cont. = Mode 2 is used Open cont. = Mode 1 is used See par. 1.6.1, 1.6.12
P1.2.7.22 ①	3 contact hold	0	0.1			Holds drive speed at present speed reference.

① Programmed using the *Terminal to Function* (TTF) method. See **Page 2-10**.
② cc = closing contact; oc = opening contact.

Output Signals

Delayed Digital Output 1 (Keypad: Menu M1 ➔ G1.3.1)

Table 2-22: Delayed Digital Output 1 Parameters — G1.3.1

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

① Parameter value can only be changed when the drive is stopped.

Delayed Digital Output 2 (Keypad: Menu M1 ➔ G1.3.2)

Table 2-23: Delayed Digital Output 2 Parameters — G1.3.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.2.1 ②	Digital output 2 signal selection	0			0.1		489	
P1.3.2.2	Digital output 2 function	0	26		0		490	See par. 1.3.1.2
P1.3.2.3	Digital output 2 on delay	0.00	320.00	s	0.00		491	**0.00** = delay not in use
P1.3.2.4	Digital output 2 off delay	0.00	320.00	s	0.00		492	**0.00** = delay not in use

② Programmed using the *Terminal to Function* (TTF) method. See **Page 2-10**.

Digital Output Signals (Control Keypad: Menu M1 ➜ G1.3.3)

Table 2-24: Digital Output Signals — G1.3.3

Code	Parameter	Min.	Default	Cust	ID	Note
P1.3.3.1 ①	Ready	0	A.1		432	Ready to run
P1.3.3.2 ①	Run	0	B.1		433	Running
P1.3.3.3 ①	Fault	0	B.2		434	Drive in fault state
P1.3.3.4 ①	Inverted fault	0	0.1		435	Drive not in fault state
P1.3.3.5 ①	Warning	0	0.1		436	Warning active
P1.3.3.6 ①	External fault	0	0.1		437	External fault active
P1.3.3.7 ①	Reference fault/warning	0	0.1		438	4 mA fault active
P1.3.3.8 ①	Overtemperature warning	0	0.1		439	Drive overtemperature active
P1.3.3.9 ①	Reverse	0	0.1		440	Output frequency < 0 Hz
P1.3.3.10 ①	Unrequested direction	0	0.1		441	Reference <> Output frequency
P1.3.3.11 ①	At speed	0	0.1		442	Reference = Output frequency
P1.3.3.12 ①	Jogging speed	0	0.1		443	Jogging or preset speed command active
P1.3.3.13 ①	External control place	0	0.1		178	IO control active
P1.3.3.14 ①	External brake control	0	0.1		445	See explanations on Page [?]
P1.3.3.15 ①	External brake control inverted	0	0.1		446	See explanations on Page [?]
P1.3.3.16 ①	Output frequency limit 1 supervision	0	0.1		447	See ID315
P1.3.3.17 ①	Output frequency limit 2 supervision	0	0.1		448	See ID346
P1.3.3.18 ①	Reference limit supervision	0	0.1		449	See ID350
P1.3.3.19 ①	Temperature limit supervision	0	0.1		450	See ID354
P1.3.3.20 ①	Torque limit supervision	0	0.1		451	See ID348
P1.3.3.21 ①	Motor thermal protection	0	0.1		452	
P1.3.3.22 ①	Analog input supervision limit	0	0.1		453	See ID356
P1.3.3.23 ①	Motor regulator activation	0	0.1		454	
P1.3.3.24 ①	Fieldbus input data 1	0	0.1		455	FB CW B11
P1.3.3.25 ①	Fieldbus input data 2	0	0.1		456	FB CW B12
P1.3.3.26 ①	Fieldbus input data 3	0	0.1		457	FB CW B13
P1.3.3.27 ①	Fieldbus input data 4	0	0.1		169	FB CW B14
P1.3.3.28 ①	Fieldbus input data 5	0	0.1		170	FB CW B15

① Programmed using the *Terminal to Function* (TTF) method. See **Page 2-10**.

⚠ CAUTION

Be ABSOLUTELY sure not to connect two functions to the same output in order to avoid function overruns and to ensure flawless operation.

Limit Settings (Control Keypad: Menu M1 ➔ G1.3.4)

Table 2-25: Limit Settings — G1.3.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.4.1	Output frequency limit 1 supervision	0	3		0		315	**0** = No limit **1** = Low limit supervision **2** = High limit supervision **3** = Brake-on control
P1.3.4.2	Output frequency limit 1; Supervised value	0.00	Par. 1.1.2	Hz	0.00		316	
P1.3.4.3	Output frequency limit 2 supervision	0	4		0		346	**0** = No limit **1** = Low limit supervision **2** = High limit supervision **3** = Brake-off control **4** = Brake on/off-control
P1.3.4.4	Output frequency limit 2; Supervised value	0.00	Par. 1.1.2	Hz	0.00		347	
P1.3.4.5	Torque limit supervision	0	3		0		348	**0** = Not used **1** = Low limit supervision **2** = High limit supervision **3** = Brake-off control
P1.3.4.6	Torque limit supervision value	-1000.0	1000.0	%	100.0		349	
P1.3.4.7	Reference limit supervision	0	2		0		350	**0** = Not used **1** = Low limit **2** = High limit
P1.3.4.8	Reference limit supervision value	0.00	Par. 1.1.2	Hz	0.00		351	
P1.3.4.9	External brake-off delay	0.0	100.0	s	0.5		352	
P1.3.4.10	External brake-on delay	0.0	100.0	s	1.5		353	
P1.3.4.11	FC temperature supervision	0	2		0		354	**0** = Not used **1** = Low limit **2** = High limit
P1.3.4.12	FC temperature supervised value	-10	75	°C	0		355	

Table 2-25: Limit Settings — G1.3.4 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.4.13	On/Off control signal	0	4		0		356	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4
P1.3.4.14	On/Off control low limit	0	Par. 1.3.4.15	%	10.00		357	
P1.3.4.15	On/Off control high limit	Par. 1.3.4.14	100.00	%	90.00		358	

Analog Output 1 (Control Keypad: Menu M1 → G1.3.5)

Table 2-26: Analog Output 1 Parameters — G1.3.5

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

Analog Output 2 (Control Keypad: Menu M1 ➜ G1.3.6)

Table 2-27: Analog Output 2 Parameters — G1.3.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.6.1 ①	Analog output 2 signal selection	0			0.1		471	
P1.3.6.2	Analog output 2 function	0	13		4		472	See par. 1.3.5.2
P1.3.6.3	Analog output 2 filter time	0.00	10.00	s	1.00		473	**0** = No filtering
P1.3.6.4	Analog output 2 inversion	0	1		0		474	**0** = Not inverted **1** = Inverted
P1.3.6.5	Analog output 2 minimum	0	1		0		475	**0** = 0 mA **1** = 4 mA
P1.3.6.6	Analog output 2 scale	10	1000	%	100		476	
P1.3.6.7	Analog output 2 offset	-100.00	100.00	%	0.00		477	

① Programmed using the *Terminal to Function* (TTF) method. See **Page 2-10**.

Analog Output 3 (Control Keypad: Menu M1 ➜ G1.3.7)

Table 2-28: Analog Output 3 Parameters — G1.3.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.3.7.1	Analog output 3 signal selection	0			0.1		478	
P1.3.7.2	Analog output 3 function	0	13		5		479	See par. 1.3.5.2
P1.3.7.3	Analog output 3 filter time	0.00	10.00	s	1.00		480	**0** = No filtering
P1.3.7.4	Analog output 3 inversion	0	1		0		481	**0** = Not inverted **1** = Inverted
P1.3.7.5	Analog output 3 minimum	0	1		0		482	**0** = 0 mA **1** = 4 mA
P1.3.7.6	Analog output 3 scale	10	1000	%	100		483	
P1.3.7.7	Analog output 3 offset	-100.00	100.00	%	0.00		484	

Drive Control Parameters (Control Keypad: Menu M1 → G1.4)

Table 2-29: Drive Control Parameters — G1.4

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

① Parameter value can only be changed when the drive is stopped.

Prohibit Frequency Parameters (Control Keypad: Menu M1 ➜ G1.5)

Table 2-30: Prohibit Frequency Parameters — G1.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.5.1	Prohibit frequency range 1 low limit	0.00	Par. 1.5.2	Hz	0.00		509	**0** = Not used
P1.5.2	Prohibit frequency range 1 high limit	0.00	Par. 1.1.2	Hz	0.00		510	**0** = Not used
P1.5.3	Prohibit frequency range 2 low limit	0.00	Par. 1.5.4	Hz	0.00		511	**0** = Not used
P1.5.4	Prohibit frequency range 2 high limit	0.00	Par. 1.1.2	Hz	0.00		512	**0** = Not used
P1.5.5	Prohibit frequency range 3 low limit	0.00	Par. 1.5.6	Hz	0.00		513	**0** = Not used
P1.5.6	Prohibit frequency range 3 high limit	0.00	Par. 1.1.2	Hz	0.00		514	**0** = Not used
P1.5.7	Prohibit acc./dec. ramp	0.1	10.0	Times	1.0		518	

Motor Control Parameters (Control Keypad: Menu M1 ➜ G1.6)

Table 2-31: Motor Control Parameters — G1.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.1 ①	Motor control mode	0	2/6		0		600	**SVX:** **0** = Frequency control **1** = Speed control **2** = Torque control **Additionally for SPX:** **3** = Closed loop speed ctrl **4** = Closed loop torque ctrl **5** = Adv. open loop freq. control **6** = Advanced open loop speed control
P1.6.2 ①	V/Hz optimization	0	1		0		109	**0** = Not used **1** = Automatic torque boost
P1.6.3 ①	V/Hz ratio selection	0	3		0		108	**0** = Linear **1** = Squared **2** = Programmable **3** = Linear with flux optim.
P1.6.4 ①	Field weakening point	8.00	320.00	Hz	60.00		602	
P1.6.5 ①	Voltage at field weakening point	10.00	200.00	%	100.00		603	n% x U_{nmot}
P1.6.6 ①	V/Hz curve midpoint frequency	0.00	par. 1.6.4	Hz	60.00		604	
P1.6.7 ①	V/Hz curve midpoint voltage	0.00	100.00	%	100.00		605	n% x U_{nmot} Parameter max. value = par. 1.6.5
P1.6.8 ①	Output voltage at zero frequency	0.00	40.00	%	0.00		606	n% x U_{nmot}

① Parameter value can only be changed when the drive is stopped.

Table 2-31: Motor Control Parameters — G1.6 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.6.9	Switching frequency	1.0	Varies	kHz	Varies		601	See **Table 3-10** on **Page 3-36** for exact values
P1.6.10 ①	Overvoltage controller	0	2		1		607	**0** = Not used **1** = Used (no ramping) **2** = Used (ramping)
P1.6.11	Undervoltage controller	0	1		1		608	**0** = Not used **1** = Used
P1.6.12	Motor control mode 2	0	2/6		2		521	See par. 1.6.1
P1.6.13	Speed controller P gain (open loop)	0	32767		3000		637	
P1.6.14	Speed controller I gain (open loop)	0	32767		300		638	
P1.6.15	Load Drooping	0.00	100.00		0.01		620	Drooping % of nominal speed at nominal torque
P1.6.16	Identification	0	1		0		631	**0** = Not used **1** = Used
Closed Loop parameter group 1.6.17 (SPX only)								
P1.6.17.1	Magnetizing current	0.00	100.00	A	0.00		612	
P1.6.17.2	Speed control P gain	0	1000		30		613	
P1.6.17.3	Speed control I time	0.0	500.0	ms	30.0		614	
P1.6.17.4	Load drooping	0.00	100.00	%	0.00		620	
P1.6.17.5	Acceleration compensation	0.00	300.00	s	0.00		626	
P1.6.17.6	Slip adjust	0	500	%	100		619	
P1.6.17.7	Magnetizing current at start	MotCurr Min	MotCurr Max	A	0.00		627	
P1.6.17.8	Magnetizing time at start	0.0	600.0	s	0.0		628	
P1.6.17.9	0-speed time at start	0	32000	ms	100		615	
P1.6.17.10	0-speed time at stop	0	32000	ms	100		616	
P1.6.17.11	Start-up torque	0	3		0		621	**0** = Not used **1** = Torque memory **2** = Torque reference **3** = Start-up torque fwd/rev
P1.6.17.12	Start-up torque FWD	-300.0	300.0	s	0.0		633	
P1.6.17.13	Start-up torque REV	-300.0	300.0	s	0.0		634	
P1.6.17.15	Encoder filter time	0	1000	ms	0		618	
P1.6.17.17	Current control P gain	0.00	100.00	%	40.00		617	

① Parameter value can only be changed when the drive is stopped.

Table 2-31: Motor Control Parameters — G1.6 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
Advanced Open Loop parameter group 1.6.18 (SPX only)								
P1.6.18.1	Zero speed current	0.0	250.0	%	120.0		625	
P1.6.18.2	Minimum current	0.0	100.0	%	80.0		622	
P1.6.18.3	Flux reference	0.0	100.0	%	80.0		623	
P1.6.18.4	Frequency limit	0.0	100.0	%	20.0		635	
P1.6.18.5	V/Hz boost	0	1		0		632	

Protections (Control Keypad: Menu M1 ➜ G1.7)

Table 2-32: Protections — G1.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.1	Response to 4mA reference fault	0	5		0		700	**0** = No response **1** = Warning **2** = Warning+Previous Freq. **3** = Wrng+PresetFreq 1.7.2 **4** = Fault.stop acc. to 1.4.7 **5** = Fault.stop by coasting
P1.7.2	4mA reference fault frequency	0.00	Par. 1.1.2	Hz	0.00		728	
P1.7.3	Response to external fault	0	3		2		701	**0** = No response **1** = Warning **2** = Fault.stop acc. to 1.4.7 **3** = Fault.stop by coasting
P1.7.4	Input phase supervision	0	3		0		730	
P1.7.5	Response to undervoltage fault	1	3		2		727	
P1.7.6	Output phase supervision	0	3		2		702	
P1.7.7	Earth fault protection	0	3		2		703	
P1.7.8	Thermal protection of the motor	0	3		2		704	
P1.7.9	Motor ambient temperature factor	-100.0	100.0	%	0.0		705	
P1.7.10	Motor cooling factor at zero speed	0.0	150.0	%	40.0		706	
P1.7.11	Motor thermal time constant	1	200	min	45		707	
P1.7.12	Motor duty cycle	0	100	%	100		708	
P1.7.13	Stall protection	0	3		0		709	**0** = No response **1** = Warning **2** = Fault.stop acc. to 1.4.7 **3** = Fault.stop by coasting
P1.7.14	Stall current	0.1	I_{nMotor} x 2	A	I_L		710	
P1.7.15	Stall time limit	1.00	120.00	s	15.00		711	

Table 2-32: Protections — G1.7 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.7.16	Stall frequency limit	1.0	Par. 1.1.2	Hz	25.0		712	
P1.7.17	Underload protection	0	3		0		713	**0** = No response **1** = Warning **2** = Fault.stop acc. to 1.4.7 **3** = Fault.stop by coasting
P1.7.18	Field weakening area load	10.0	150.0	%	50.0		714	
P1.7.19	Zero frequency load	5.0	150.0	%	10.0		715	
P1.7.20	Underload protection time limit	2.00	600.00	s	20.00		716	
P1.7.21	Response to thermistor fault	0	3		2		732	**0** = No response **1** = Warning **2** = Fault.stop acc. to 1.4.7 **3** = Fault.stop by coasting
P1.7.22	Response to fieldbus fault	0	3		2		733	See P1.7.21
P1.7.23	Response to slot fault	0	3		2		734	See P1.7.21
P1.7.24	No. of PT100 inputs	0	3		0		739	
P1.7.25	Response to PT100 fault	0	3		2		740	**0** = No response **1** = Warning **2** = Fault.stop acc. to 1.4.7 **3** = Fault.stop by coasting
P1.7.26	PT100 warning limit	-30.0	200.0	C°	120.0		741	
P1.7.27	PT100 fault limit	-30.0	200.0	C°	130.0		742	

Autorestart Parameters (Control Keypad: Menu M1 ➜ G1.8)

Table 2-33: Autorestart Parameters — G1.8

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.8.1	Wait time	0.10	10.00	s	0.50		717	
P1.8.2	Trial time	0.00	60.00	s	0.10		718	
P1.8.3	Start mode	0	2		0		719	**0** = Ramp **1** = Flying start **2** = According to par. 1.4.6
P1.8.4	Number of tries after undervoltage trip	0	10		0		720	
P1.8.5	Number of tries after overvoltage trip	0	10		0		721	
P1.8.6	Number of tries after overcurrent trip	0	3		0		722	
P1.8.7	Number of tries after reference trip	0	10		0		723	
P1.8.8	Number of tries after motor temperature fault trip	0	10		0		726	
P1.8.9	Number of tries after external fault trip	0	10		0		725	
P1.8.10	Number of tries after underload fault trip	0	10		1		738	

Fieldbus Parameters (Control Keypad: Menu M1 ➜ G1.9)

Table 2-34: Fieldbus Parameters — G1.9

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

Table 2-34: Fieldbus Parameters — G1.9 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.9.9	Fieldbus data out 7 selection	0	10000		7		858	Choose monitoring data with parameter ID
P1.9.10	Fieldbus data out 8 selection	0	10000		37		859	Choose monitoring data with parameter ID

Torque Control Parameters (Control Keypad: Menu M1 ➜ G1.10)

Table 2-35: Torque Control Parameters — G1.10

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P1.10.1	Torque limit	0.0	400.0	%	400.0		609	
P1.10.2	Torque limit control P-gain	0.0	32000		3000		610	
P1.10.3	Torque limit control I-gain	0.0	32000		200		611	
P1.10.4	Torque reference selection	0	8		0		641	**0** = Not used **1** = AI1 **2** = AI2 **3** = AI3 **4** = AI4 **5** = AI1 joystick **6** = AI2 joystick **7** = Torque reference from keypad, R2.4 **8** = Fieldbus
P1.10.5	Torque reference max.	-300.0	300.0	%	100		642	
P1.10.6	Torque reference min.	-300.0	300.0	%	0.0		643	
P1.10.7	Torque speed limit	0	2		1		644	**0** = Max frequency **1** = Selected freq. reference **2** = Preset speed 7
P1.10.8	Minimum frequency for open loop torque control	0.00	par.1.1.1	Hz	3.00		636	
P1.10.9	Torque controller P gain	0	32000		150		639	
P1.10.10	Torque controller I gain	0	32000		10		640	

Keypad Control (Control Keypad: Menu M2)

The parameters for the selection of control place and direction on the keypad are listed below. See the Keypad control menu on **Page 2-17**.

Table 2-36: Keypad Control Parameters — M2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
R2.1	Keypad reference	Par. 1.1.1	Par. 1.1.2	Hz	0.00			
P2.2	Direction (on keypad)	0	1		0		123	**0** = Forward **1** = Reverse
P2.3	Stop button	0	1		0		114	**0** = Limited function of Stop button **1** = Stop button always enabled
R2.4	Torque reference	0.0	100.0	%	0.0			

Chapter 3 — Description of Parameters

Introduction

On the following pages you will find the parameter descriptions arranged according to the individual ID number of the parameter. A parameter ID number with a ② footnote (e.g. **418**② **Motor potentiometer UP**) indicates that the *TTF programming method* shall be applied to this parameter (see **Page 2-10**).

101 Minimum frequency (P1.1.1)
102 Maximum frequency (P1.1.2)

Defines the frequency limits of the drive. The maximum value for these parameters is 320 Hz. Minimum frequency must be 0 Hz for proper operation of load float and brake proving. The software will automatically check the values of ID105, ID106, ID315 and ID728.

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

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

105 Preset speed 1 (P1.1.16)
106 Preset speed 2 (P1.1.17)

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

Table 3-1: Preset Speed

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

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

This parameter determines the maximum motor current from the frequency converter. The parameter value range differs from size to size.

108 V/Hz Ratio Selection (P1.6.3)

Linear:

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

Squared:

1 The voltage of the motor changes following a squared curve form with the frequency in the area from 0 Hz to the field weakening point where the nominal voltage is supplied to the motor. The motor runs under magnetized below the field weakening point and produces less torque and electromechanical noise. A squared V/Hz ratio can be used in applications where the torque demand of the load is proportional to the square of the speed, e.g. in centrifugal fans and pumps. **Not normally recommended for Crane applications.**

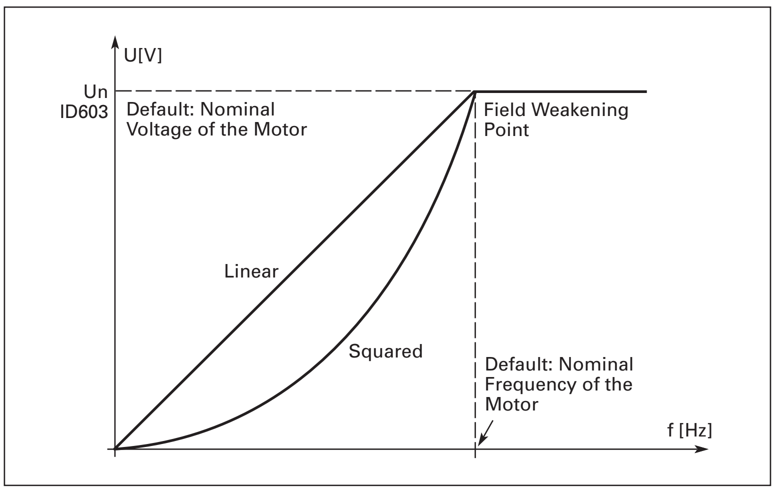


Figure 3-1: Linear and Squared Change of Motor Voltage

Programmable V/Hz curve:

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

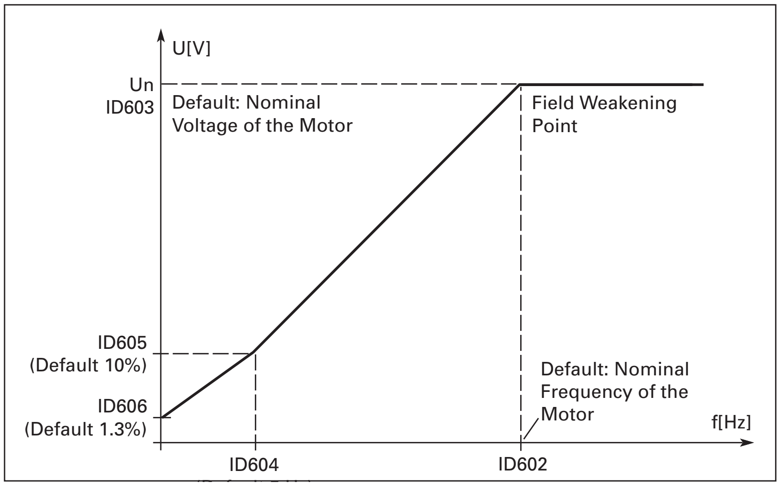


Figure 3-2: Programmable V/Hz Curve

Linear with flux optimization:

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

109 V/Hz optimization (P1.6.2)

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

Example:

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

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

Option 1: Activate the Automatic torque boost.

Option 2: Programmable V/Hz curve

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

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

110 Nominal voltage of the motor (P1.1.6)

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

111 Nominal frequency of the motor (P1.1.7)

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

112 Nominal speed of the motor (P1.1.8)

Find this value n_n on the nameplate of the motor.

113 Nominal current of the motor (P1.1.9)

Find this value I_n on the nameplate of the motor.

120 Motor Power Factor (P1.1.10)

Find this value "Power Factor" on the nameplate of the motor.

124 Jogging speed reference (P1.1.15)

Defines the jogging speed selected with the DIN3 digital input which can be programmed for Jogging speed.

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

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

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

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

Table 3-2: Preset Speeds 3 to 7

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

141② **AI3 signal selection** (P1.2.4.1)

Connect the AI3 signal to the analog input of your choice with this parameter. For more information, see **Page 2-10**, "Terminal to Function" (TTF) programming principle.

142 AI3 signal filter time (P1.2.4.2)

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

143 AI3 signal range (P1.2.4.3)

With this parameter you can select the AI3 signal range.

Table 3-3: Selections for ID143

Select	Crane Application
0	0 – 100%
1	20 – 100%
2	-10 – +10V
3	Customized

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

Set the custom minimum and maximum levels for the AI3 signal from 0 to 100%.

151 AI3 signal inversion (P1.2.4.6)

0 = No inversion
1 = Signal inverted

152 ② **AI4 signal selection** (P1.2.5.1)

See ID141.

153 AI4 filter time (P1.2.5.2)

See ID142.

154 AI4 signal range (P1.2.5.3)

See ID143.

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

See ID144 and ID145.

162 AI4 signal inversion (P1.2.5.6)

See ID151.

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

Contact is open = Motor control mode 1 is selected.
Contact is closed = Motor control mode 2 is selected.
See ID600 and ID521.

165 AI1 joystick offset (P1.2.2.11)

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

166 AI2 joystick offset (P1.2.3.11)

See ID165.

169 Fieldbus input data 4 (FBFixedControlWord, bit 6) (P1.3.3.27)

170 Fieldbus input data 5 (FBFixedControlWord, bit 7) (P1.3.3.28)

The data from the fieldbus (FBFixedControlWord) can be led to the digital outputs of the drive.

171 &172 Local & Remote Control Place (P1.1.11 & P1.1.12)

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

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

Table 3-4: Selections for ID171 and ID172

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

173 &174 Local & Remote reference selection (P1.1.13 & P1.1.14)

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

Table 3-5: Selections for ID173 and ID174

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

176 Force local (P1.2.7.18)

Forces control place to I/O terminal.

177 Force remote (P1.2.7.19)

Forces control place to keypad.

178 Remote active (P1.3.3.13)

Remote control is active.

300 Start/Stop logic selection (P1.2.1.1)

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

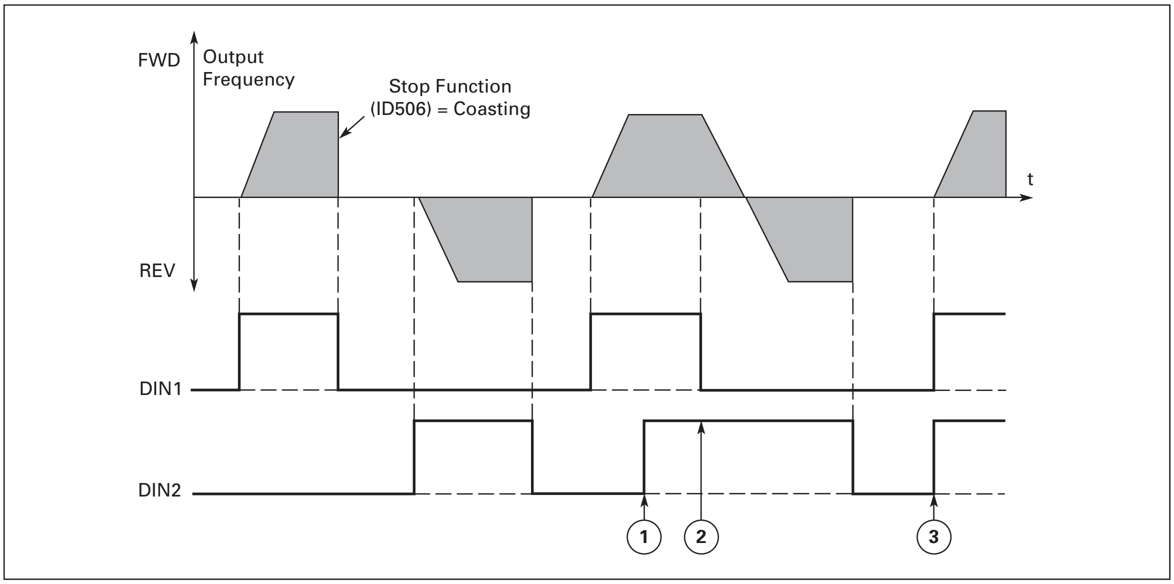


Figure 3-3: Start Forward/Start Reverse

① The first selected direction has the highest priority.
② When the DIN1 contact opens the direction of rotation starts to change.
③ If Start forward (DIN1) and Start reverse (DIN2) signals are active simultaneously the Start forward signal (DIN1) has priority.

1 DIN1: closed contact = start — open contact = stop
DIN2: closed contact = reverse — open contact = forward, see **Figure 3-4.**

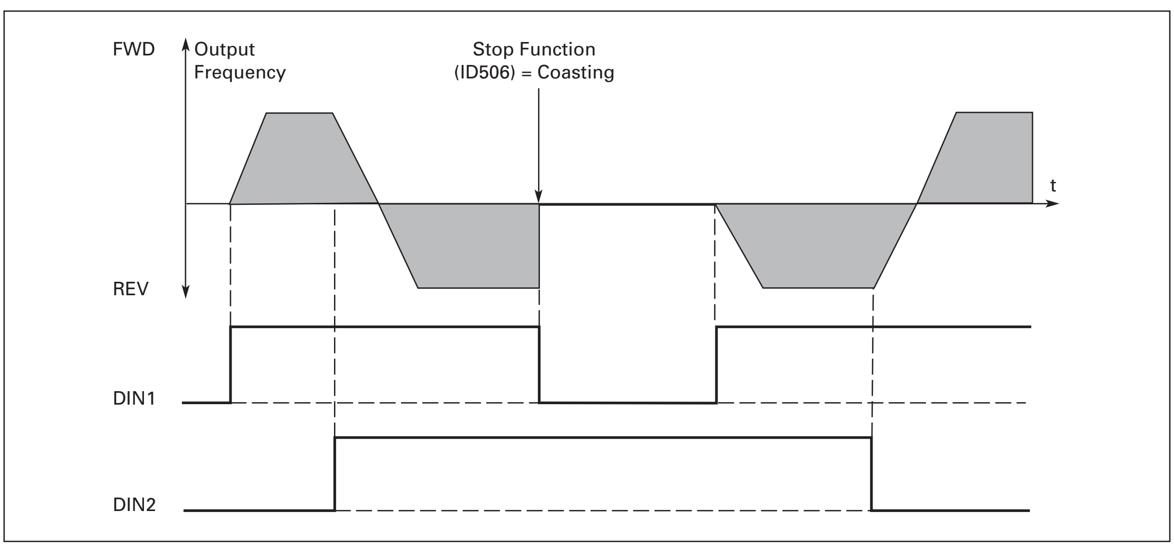


Figure 3-4: Start, Stop and Reverse

2 DIN1: closed contact = start — open contact = stop
DIN2: closed contact = start enabled — open contact = start disabled and drive stopped if running, see **Figure 3-5**.

3 3-wire connection (pulse control):
DIN1: closed contact = start pulse
DIN2: open contact = stop pulse
(DIN3 can be programmed for reverse command), see **Figure 3-5**.

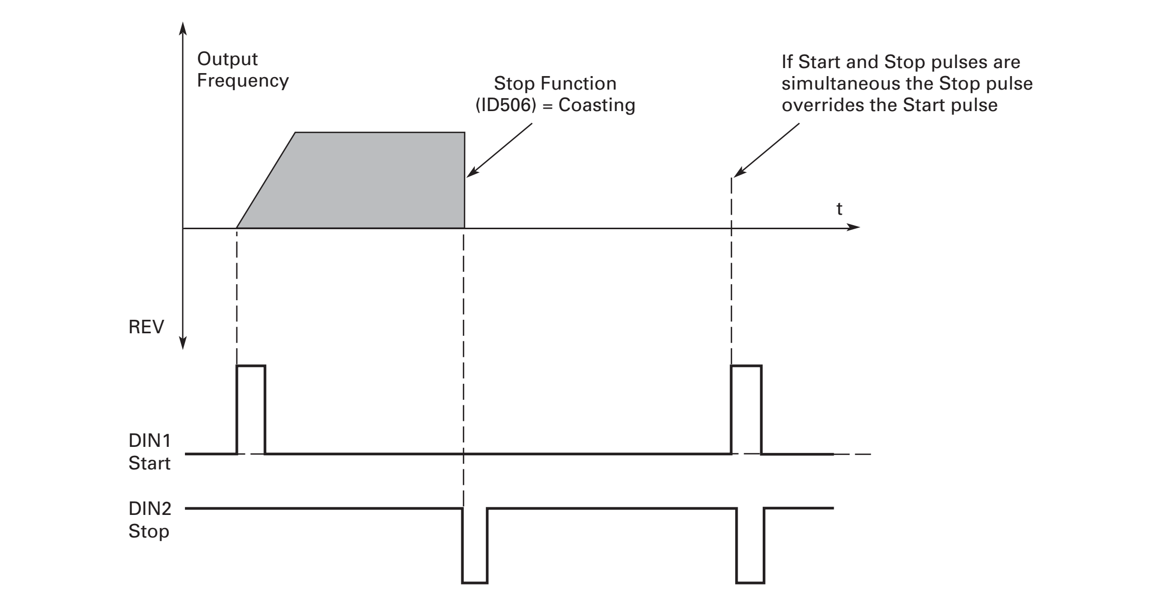


Figure 3-5: Start Pulse/Stop Pulse

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

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

5 DIN1: closed contact = start forward **(Rising edge required to start)**
DIN2: closed contact = start reverse **(Rising edge required to start)**

6 DIN1: closed contact = start **(Rising edge required to start)**
open contact = stop
DIN2: closed contact = reverse — open contact = forward

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

303 Reference scaling, minimum value (P1.2.2.6)

304 Reference scaling, maximum value (P1.2.2.7)

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

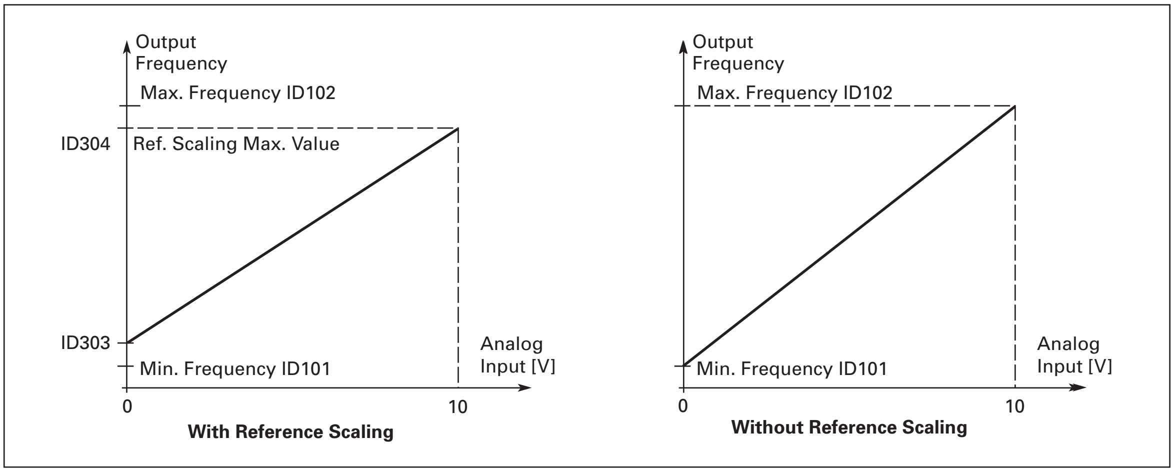


Figure 3-6: With and Without Reference Scaling

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

307 Analog output function (P1.3.5.2)

This parameter selects the desired function for the analog output signal.

308 Analog output filter time (P1.3.5.3)

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

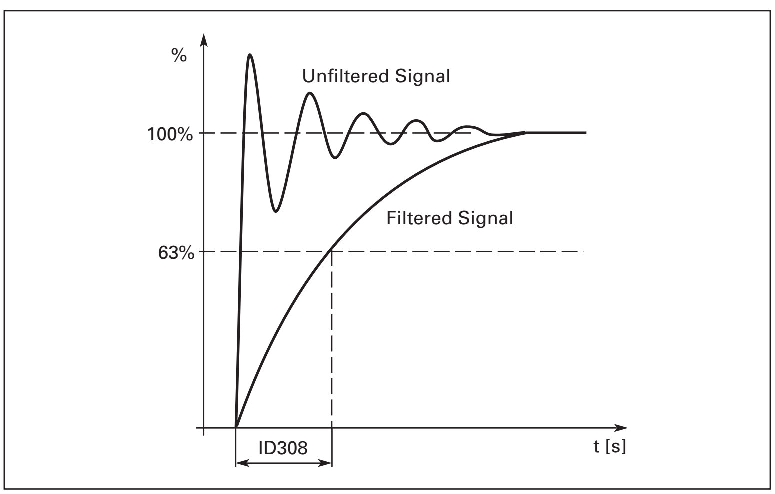


Figure 3-7: Analog Output Filtering

309 Analog output inversion (P1.3.5.4)

Inverts the analog output signal:

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

See ID311 in **Figure 3-8**.

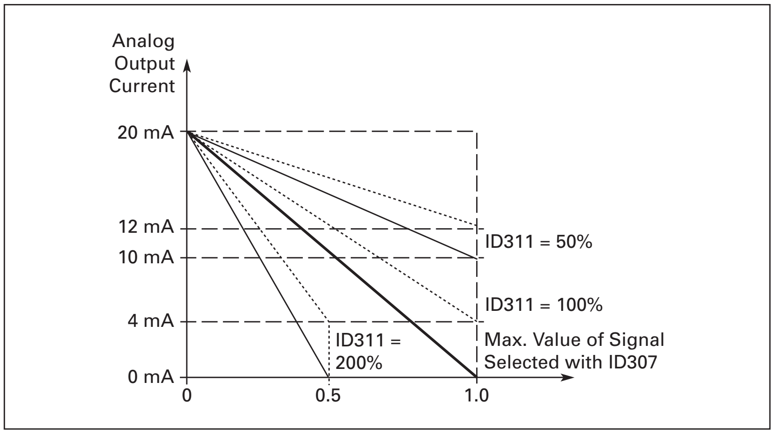


Figure 3-8: Analog Output Invert

310 Analog output minimum (P1.3.5.5)

Defines the signal minimum to be either 0 mA or 4 mA ("living zero"). Note the difference in analog output scaling in ID311 (**Figure 3-9**).

0 Set minimum value to 0 mA

1 Set minimum value to 4 mA

311 Analog output scale (P1.3.5.6)

Scaling factor for analog output.

Table 3-6: Analog Output Scaling

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

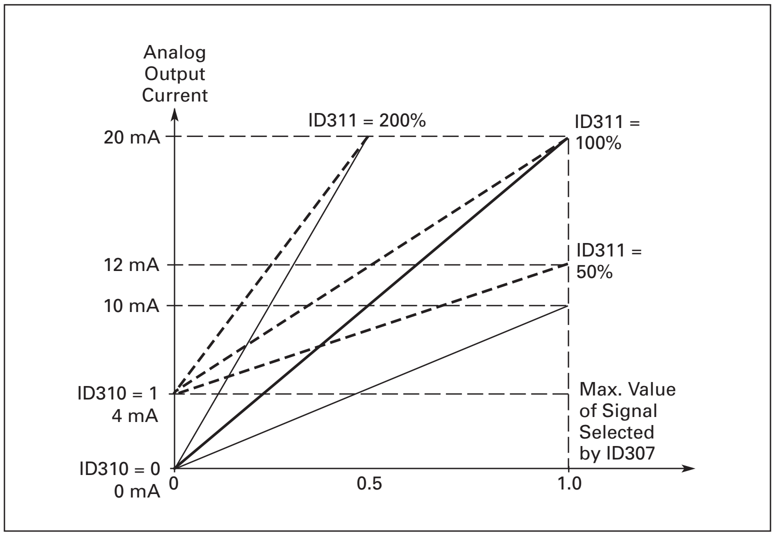


Figure 3-9: Analog Output Scaling

312 Digital output content (P1.3.1.2)

Table 3-7: Output Signals Via DO1 and Output Relays RO1 and RO2

Setting value	Signal content
0 = Not used	Out of operation
Digital output DO1 sinks current and programmable relay (RO1, RO2) is activated when:	
1 = Ready	The drive is ready to operate
2 = Run	The drive is operating (motor is running)
3 = Fault	A fault trip has occurred
4 = Fault inverted	A fault trip not occurred
5 = Overheat warning	The heatsink temperature exceeds +70°C
6 = External fault or warning	Fault or warning depending on ID701
7 = Reference fault or warning	Fault or warning depending on ID700 • if analog reference is 4 – 20 mA and signal is <4 mA
8 = Warning	Always if a warning exists
9 = Reversed	The reverse command has been selected
10 = Jogging speed	The jogging speed has been selected with digital input
11 = At speed	The output frequency has reached the set reference
12 = Motor regulator activated	Overvoltage or overcurrent regulator was activated
13 = Output frequency limit supervision	The output frequency is outside the set supervision low limit/high limit (ID315 and ID316)
14 = Output frequency limit 2 supervision	The output frequency goes outside the set supervision low limit/high limit (ID346 and ID347)
15 = Torque limit supervision	The motor torque is beyond the set supervision low limit/ high limit (ID348 and ID349).
16 = Reference limit supervision	Active reference goes beyond the set supervision low limit/ high limit (ID350 and ID351)
17 = External brake control	External brake ON/OFF control with programmable delay (ID352 and ID353)
18 = Control from I/O terminals	External control mode (Menu **M2**; ID125)
19 = Drive temperature limit supervision	Drive heatsink temperature goes beyond the set supervision limits (ID354 and ID355).
20 = Reference inverted	
21 = External brake control inverted	External brake ON/OFF control (ID352 and ID353); Output active when brake control is OFF
22 = Thermistor fault or warning	The thermistor input of option board indicates overtemperature. Fault or warning depending on ID732.
23 = On/Off control	Selects the analog input to be monitored. (ID356, ID357, ID358 and ID463)
24 = Fieldbus input data 1	Fieldbus data (FBFixedControlWord) to DO/RO
25 = Fieldbus input data 2	Fieldbus data (FBFixedControlWord) to DO/RO
26 = Fieldbus input data 3	Fieldbus data (FBFixedControlWord) to DO/RO

315 Output frequency limit supervision function (P1.3.4.1)

0 No supervision
1 Low limit supervision
2 High limit supervision
3 Brake-on control, see **Page A-1**.

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

316 Output frequency limit supervision value (P1.3.4.2)

Selects the frequency value supervised by ID315. See **Figure 3-10**.

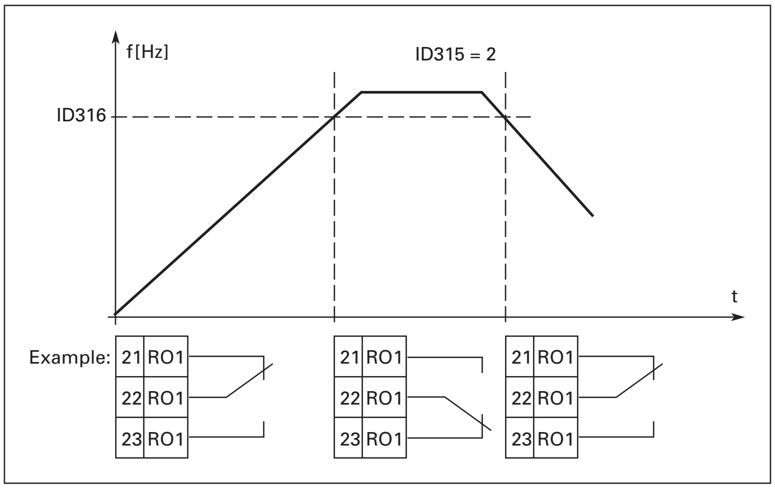


Figure 3-10: Output Frequency Supervision

320 AI1 signal range (P1.2.2.3)

Table 3-8: Selections for ID320

Select	Crane Application
0	0 – 100%
1	4 mA / 20 – 100%
2	-10 to +10V
3	Customized

For selection "Customized", see ID321 and ID322.

321 AI1 custom setting minimum (P1.2.2.4)
322 AI1 custom setting maximum (P1.2.2.5)

These parameters set the analog input signal for any input signal span within -100 to 100%.

324 AI1 signal filter time (P1.2.2.2)

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

A long filtering time makes the regulation response slower. See **Figure 3-11.**

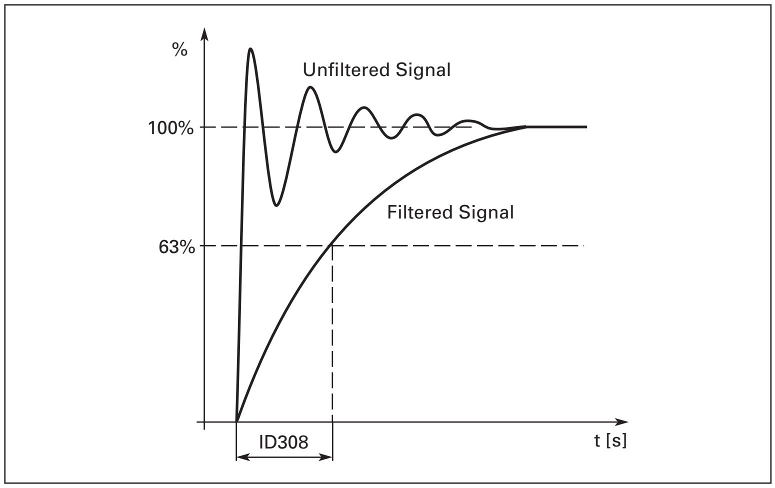


Figure 3-11: AI1 Signal Filtering

325 Analog input AI2 signal range (P1.2.3.3)

Table 3-9: Selections for Parameter ID325

Select	Crane Application
0	0 – 100%
1	4 mA / 20 – 100%
2	-10 to +10V
3	Customized

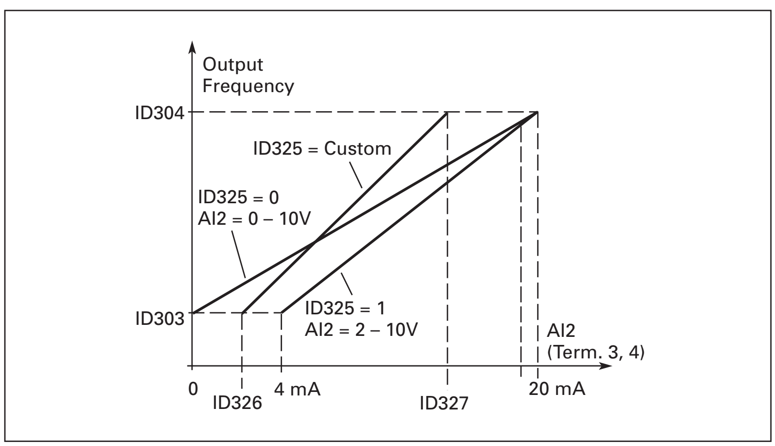


Figure 3-12: Analog Input AI2 Scaling

326 Analog input AI2 custom setting min. (P1.2.3.4)

327 Analog input AI2 custom setting max. (P1.2.3.5)

These parameters set AI2 for any input signal span within -100 to 100%.

329 Analog input AI2 (I_{in}) filter time (P1.2.3.2)

See ID324.

331 Motor potentiometer ramp time (P1.2.1.2)

Defines the speed of change of the motor potentiometer value.

346 Output freq. limit 2 supervision function (P1.3.4.3)

0	No supervision
1	Low limit supervision
2	High limit supervision
3	Brake-on control, see **Page A-1**
4	Brake-on/off control, see **Page A-1**

If the output frequency goes under/over the set limit (ID347) this function generates a warning message via the digital output DO1 or relay outputs RO1 or RO2 depending on which output the supervision signals (ID447 and ID448) are connected to.

347 Output frequency limit 2 supervision value (P1.3.4.4)

Selects the frequency value supervised by ID346. See **Figure 3-10**.

348 Torque limit, supervision function (P1.3.4.5)

0	No supervision
1	Low limit supervision
2	High limit supervision
3	Brake-off control, see **Page A-1**

If the calculated torque value falls below or exceeds the set limit (ID349) this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on which output the supervision signal (ID451) is connected to.

349 Torque limit, supervision value (P1.3.4.6)

Selects the torque value to be supervised by ID348.

350 Reference limit, supervision function (P1.3.4.7)

0 No supervision
1 Low limit supervision
2 High limit supervision

If the reference value falls below or exceeds the set limit (ID351), this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on which output the supervision signal (ID451) is connected to.

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

351 Reference limit, supervision value (P1.3.4.8)

Selects the frequency value to be supervised by ID350.

352 External brake-off delay (P1.3.4.9)
353 External brake-on delay (P1.3.4.10)

The function of the external brake can be timed to the start and stop control signals with these parameters. See **Figure 3-13** and **Page A-1**.

The brake control signal can be programmed via digital output DO1 or via one of the relay outputs RO1 and RO2, see ID445.

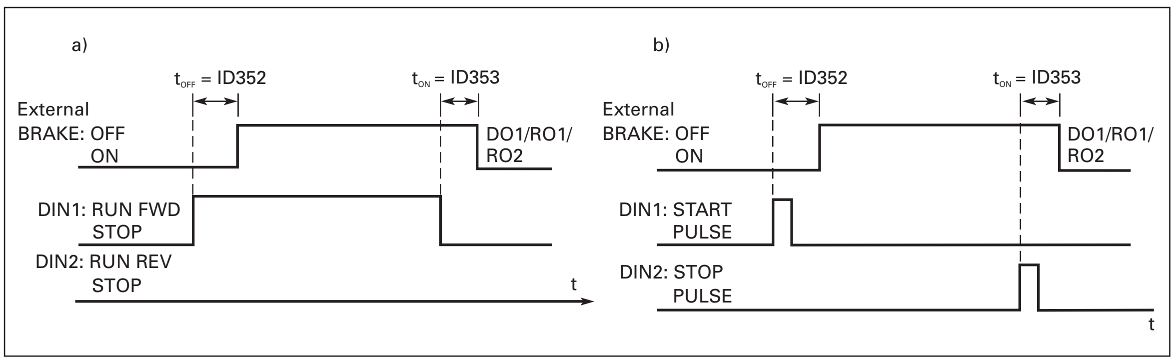


Figure 3-13: External Brake Control

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

354 Drive temperature limit supervision (P1.3.4.11)

0 No supervision
1 Low limit supervision
2 High limit supervision

If the temperature of the drive falls below or exceeds the set limit (ID355), this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on which output the supervision signal (ID451) is connected to.

355 Drive temperature limit value (P1.3.4.12)

This temperature value is supervised by ID354.

356 Analog input supervision (P1.3.4.13)

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

0 Not used
1 AI1
2 AI2
3 AI3
4 AI4

357 Analog input low limit (P1.3.4.14)
358 Analog input high limit (P1.3.4.15)

These parameters set the low and high limits of the signal selected with ID356. See **Figure 3-14.**

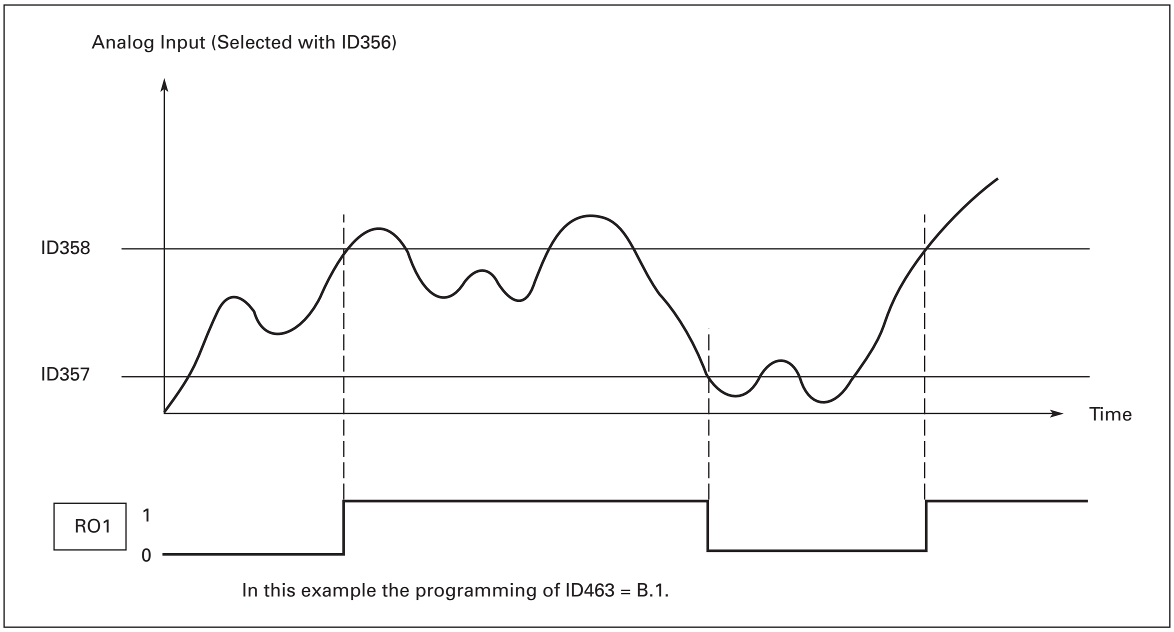


Figure 3-14: Example of Analog Input

367 Motor potentiometer memory reset (frequency reference) (P1.2.1.3)

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

375 Analog output offset (P1.3.5.7)

Add -100.0 to 100.0% to the analog output.

377 ② **AI1 signal selection** (P1.2.2.1)

Connect the AI1 signal to the analog input of your choice with this parameter. For more information about the TTF programming method, see **Page 2-10**.

384 **AI1 joystick hysteresis** (P1.2.2.8)

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

If the value of this parameter is 0, the frequency starts to increase linearly immediately when the joystick/potentiometer is turned towards the forward command from the middle position. When the control is changed from forward to reverse, the frequency follows the same pattern the other way round. See **Figure 3-15**.

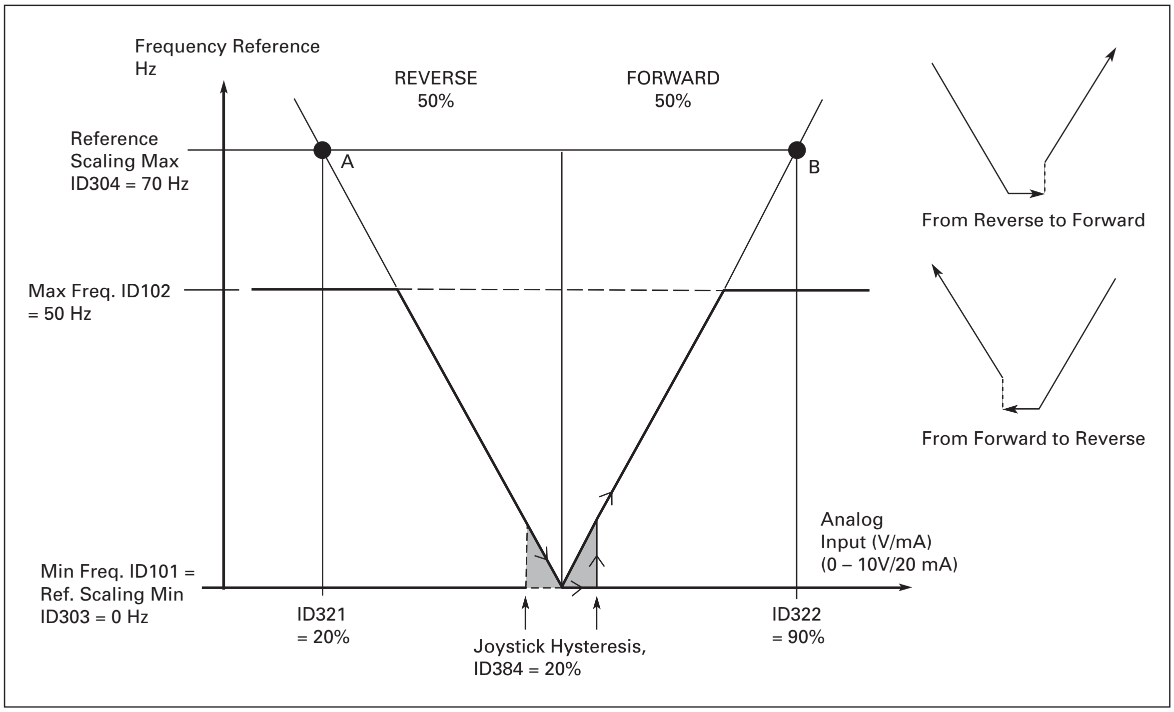


Figure 3-15: Example of Joystick Hysteresis

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

385 **AI1 sleep limit** (P1.2.2.9)

The drive is automatically stopped if the AI signal level falls below the Sleep limit defined with this parameter. See **Figure 3-16**.

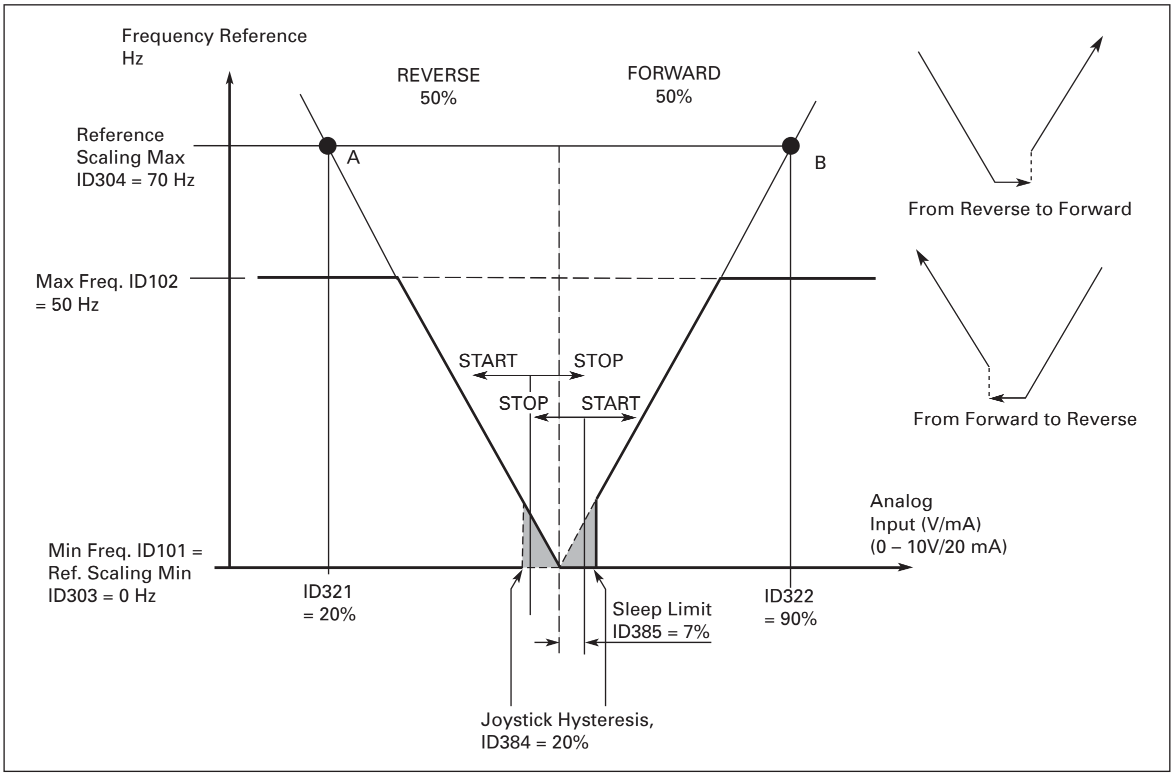


Figure 3-16: Example of Sleep Limit Function

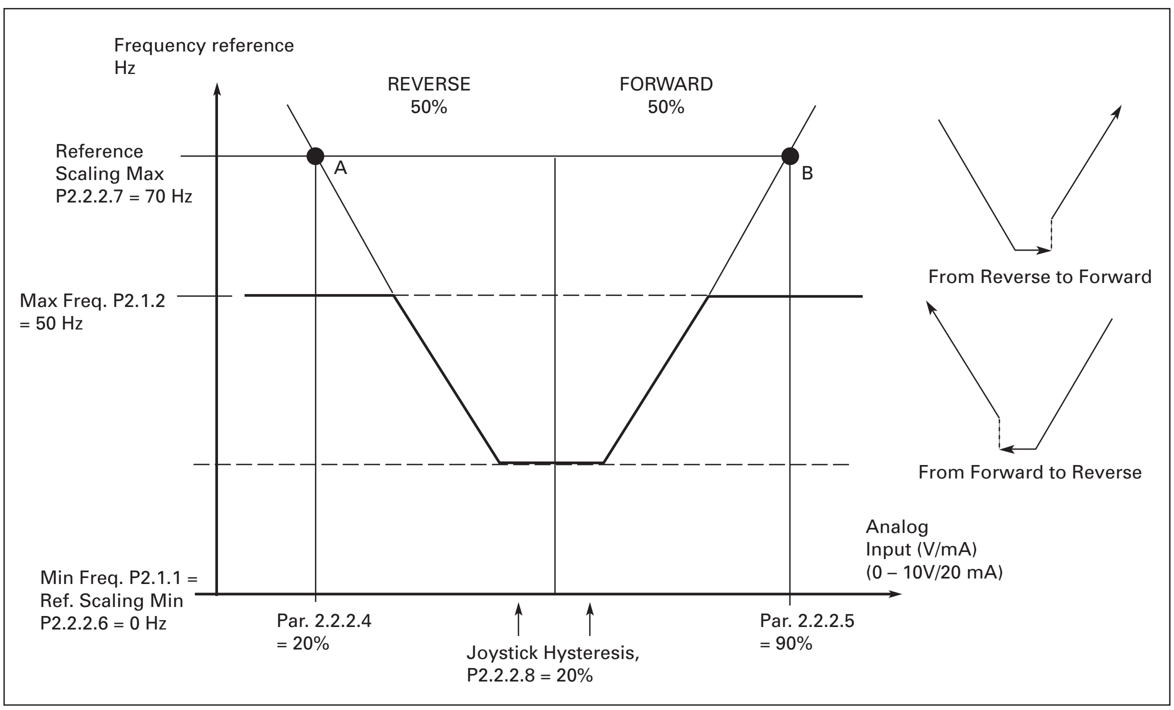


Figure 3-17: Joystick Hysteresis with Minimum Frequency at 35 Hz

386 AI1 sleep delay (P1.2.2.10)

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

388 ② **AI2 signal selection** (P1.2.3.1)

Connect the AI2 signal to the analog input of your choice with this parameter. For more information about the TTF programming method, see **Page 2-10**.

393 AI2 reference scaling, minimum value (P1.2.3.6)

394 AI2 reference scaling, maximum value (P1.2.3.7)

See ID303 and ID304.

395 AI2 joystick hysteresis (P1.2.3.8)

See ID384.

396 AI2 sleep limit (P1.2.3.9)

See ID385.

397 AI2 sleep delay (P1.2.3.10)

See ID386.

399 Scaling of current limit (P1.2.6.1)

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

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

See ID399 for the selections.

DC-braking current can be reduced with the free analog input signal between current 0.4 x I_H and the current set with ID507. See **Figure 3-18.**

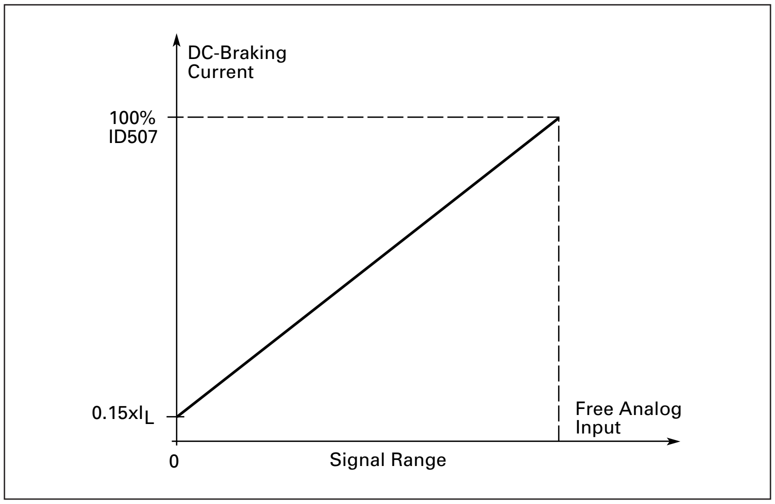


Figure 3-18: Scaling of DC-Braking Current

401 Reducing of acceleration and deceleration ramp (P1.2.6.3)

See ID399.

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

Reduced time = Set accel./decel. time (ID103, ID104; ID502, ID503) divided by the factor R from **Figure 3-19.**

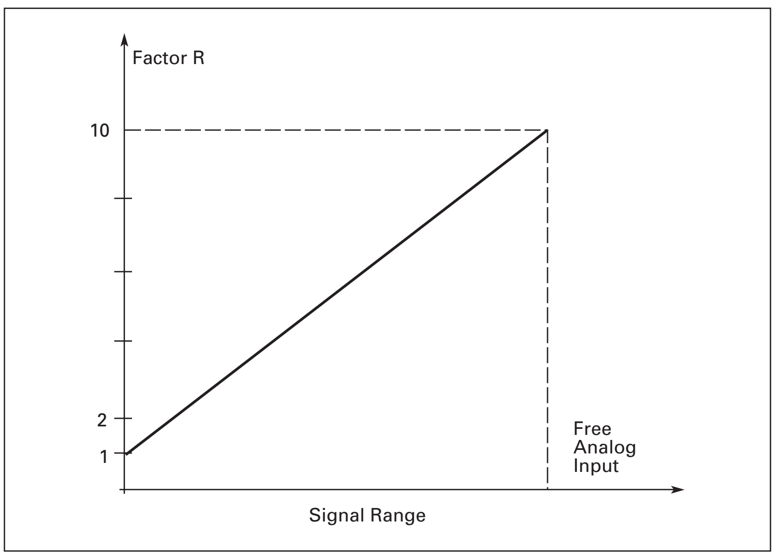


Figure 3-19: Reducing Acceleration and Deceleration Times

402 Scaling of torque supervision (P1.2.6.4)

See ID399.

The set torque supervision limit can be reduced with the free analog input signal between 0 and the set supervision limit, ID349. See **Figure 3-20.**

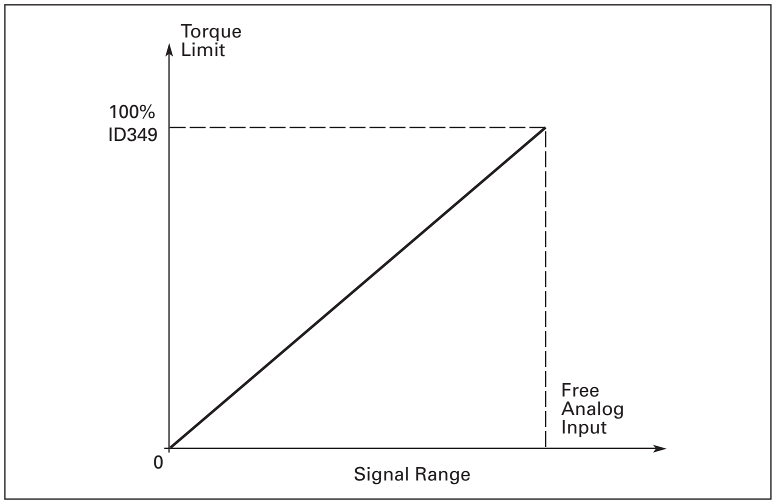


Figure 3-20: Scaling Torque Supervision

403 ② **Start signal 1** (P1.2.7.1)

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

404 ② **Start signal 2** (P1.2.7.2)

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

405 ② **External fault (close)** (P1.2.7.11)

Contact closed: Fault is displayed and motor stopped

406 ② **External fault (open)** (P1.2.7.12)

Contact open: Fault is displayed and motor stopped

407 ② **Run enable** (P1.2.7.3)

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

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

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

412 ② **Reverse** (P1.2.7.4)

Contact open: Direction forward
Contact closed: Direction reverse

413 ② **Jogging speed** (P1.2.7.16)

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

414 ② **Fault reset** (P1.2.7.10)

Contact closed: All faults are reset.

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

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

416 ② **DC braking** (P1.2.7.15)

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

417 ② **Motor potentiometer DOWN** (P1.2.7.18)

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

418 ② **Motor potentiometer UP** (P1.2.7.19)

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

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

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

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

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

432 ② **Ready** (P1.3.3.1)

The drive is ready to operate.

433 ② **Run** (P1.3.3.2)

The drive is operating (motor is running).

434 ② **Fault** (P1.3.3.3)

A fault trip has occurred.
Default programming: 21.

435 ② **Inverted fault** (P1.3.3.4)

No fault trip has occurred.

436 ② **Warning** (P1.3.3.5)

General warning signal.

437 ② **External fault or warning** (P1.3.3.6)

Fault or warning depending on ID701.

438 ② **Reference fault or warning** (P1.3.3.7)

Fault or warning depending on ID700.

439 ② **Overtemperature warning** (P1.3.3.8)

The heatsink temperature exceeds +70°C.

440 ② **Reverse** (P1.3.3.9)

The Reverse command has been selected.

441 ② **Unrequested direction** (P1.3.3.10)

Motor rotation direction is different from the requested one.

442 ② **At speed** (P1.3.3.11)

The output frequency has reached the set reference.

443 ② **Jogging speed** (P1.3.3.12)

Jogging speed selected.

445 ② **External brake control** (P1.3.3.14)

External brake ON/OFF control with programmable delay.

446 ② **External brake control, inverted** (P1.3.3.15)

External brake ON/OFF control; Output active when brake control is OFF.

447 ② **Output frequency limit 1 supervision** (P1.3.3.16)

The output frequency is outside the set supervision low limit/high limit (see ID315 and ID316).

448 ② **Output frequency limit 2 supervision** (P1.3.3.17)

The output frequency is outside the set supervision low limit/high limit (see ID346 and ID347).

449 ② **Reference limit supervision** (P1.3.3.18)

Active reference is beyond the set supervision low limit/high limit (see ID350 and ID351).

450 ② **Temperature limit supervision** (P1.3.3.19)

The drive heatsink temperature is beyond the set supervision limits (see ID354 and ID355).

451 ② **Torque limit supervision** (P1.3.3.20)

The motor torque is beyond the set supervision limits (see ID348 and ID349).

452 ② **Motor thermal protection** (P1.3.3.21)

Motor thermistor initiates an overtemperature signal which can be tied to a digital output.

Note: This parameter will not work unless you have an OPTA3 or OPTB2 (thermistor relay board) connected.

453 ② **Analog input supervision limit** (P1.3.3.22)

Selects the analog input to be monitored. See ID356.

454 ② **Motor regulator activation** (P1.3.3.23)

Overvoltage or overcurrent regulator has been activated.

455 ② **Fieldbus input data 1 (FBFixedControlWord, bit 3)** (P1.3.3.24)

456 ② **Fieldbus input data 2 (FBFixedControlWord, bit 4)** (P1.3.3.25)

457 ② **Fieldbus input data 3 (FBFixedControlWord, bit 5)** (P1.3.3.26)

The data from the fieldbus (FBFixedControlWord) can be tied to drive digital outputs.

464 ② **Analog output 1 signal selection** (P1.3.5.1)

Connect the AO1 signal to the analog output of your choice with this parameter. For more information about the TTF programming method, see **Page 2-10**.

471 ② **Analog output 2 signal selection** (P1.3.6.1)

Connect the AO2 signal to the analog output of your choice with this parameter. For more information about the TTF programming method, see **Page 2-10**.

472 Analog output 2 function (P1.3.6.2)
473 Analog output 2 filter time (P1.3.6.3)
474 Analog output 2 inversion (P1.3.6.4)
475 Analog output 2 minimum (P1.3.6.5)
476 Analog output 2 scaling (P1.3.6.6)

For more information on these five parameters, see the corresponding parameters for the analog output 1, ID307 to ID311.

477 Analog output 2 offset (P1.3.6.7)

Add -100.0 to 100.0% to the analog output.

478 ② Analog output 3, signal selection (P1.3.7.1)

See ID464.

479 Analog output 3, function (P1.3.7.2)

See ID307.

480 Analog output 3, filter time (P1.3.7.3)

See ID308.

481 Analog output 3 inversion (P1.3.7.4)

See ID309.

482 Analog output 3 minimum (P1.3.7.5)

See ID310.

483 Analog output 3 scaling (P1.3.7.6)

See ID311.

484 Analog output 3 offset (P1.3.7.7)

See ID375.

485 Torque limit (P1.2.6.5)

See ID399 for the selections.

486 ② Digital output 1 signal selection (P1.3.1.1)

Connect the delayed DO1 signal to the digital output of your choice with this parameter. For more information about the TTF programming method, see **Page 2-10**.

487 Digital output 1 ON delay (P1.3.1.3)
488 Digital output 1 OFF delay (P1.3.1.4)

With these parameters you can set ON and OFF delays for digital outputs. See **Figure 3-21**

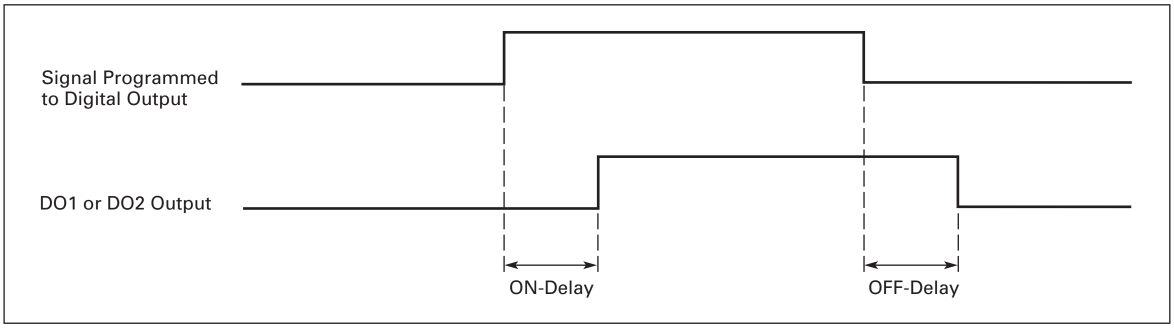


Figure 3-21: Digital Outputs 1 and 2, ON and OFF Delays

489 ② **Digital output 2 signal selection** (P1.3.2.1)

See ID486.

490 Digital output 2 function (P1.3.2.2)

See ID312.

491 Digital output 2 ON delay (P1.3.2.3)

See ID487.

492 Digital output 2 OFF delay (P1.3.2.4)

See ID488.

493 Adjust input (P1.2.1.4)

With this parameter you can select the signal, according to which the frequency reference to the motor is fine adjusted.

0 Not used
1 Analog input 1
2 Analog input 2
3 Analog input 3
4 Analog input 4
5 Signal from fieldbus (FBProcessDataIN)

494 Adjust minimum (P1.2.1.5)
495 Adjust maximum (P1.2.1.6)

These parameters define the minimum and maximum of adjusted signals. See **Figure 3-22.**

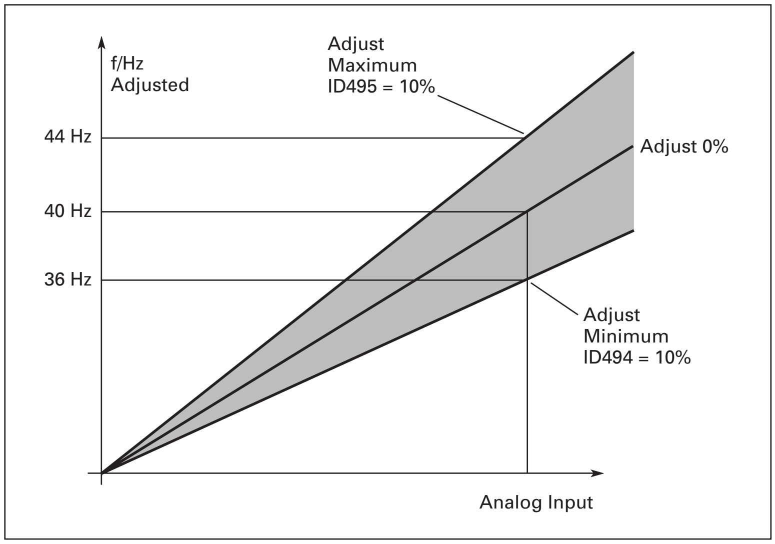


Figure 3-22: Example of Adjust Input

496 ② **Parameter Set 1/Set 2 selection** (P1.2.7.20)

With this parameter you can select between Parameter Set 1 and Set 2. The input for this function can be selected from any slot. The procedure of selecting between the sets is explained in the *SVX9000 AF Drives User Manual, Chapter 5*.

Digital input = FALSE:

- The active set is saved to set 2
- Set 1 is loaded as the active set

Digital input = TRUE:

- The active set is saved to set 1
- Set 2 is loaded as the active set

Note: The parameter values can be changed in the active set only.

500 Acceleration/Deceleration ramp 1 shape (P1.4.1)

501 Acceleration/Deceleration ramp 2 shape (P1.4.2)

The start and end of the acceleration and deceleration ramps can be smoothed with these parameters. Setting a value of **0.0** gives a linear ramp shape which causes acceleration and deceleration to react immediately to the changes in the reference signal.

Setting a value from 0.1 – 10 seconds for this parameter produces an S-shaped acceleration/deceleration. The acceleration time is determined with ID103 and ID104 (ID502 and ID503).

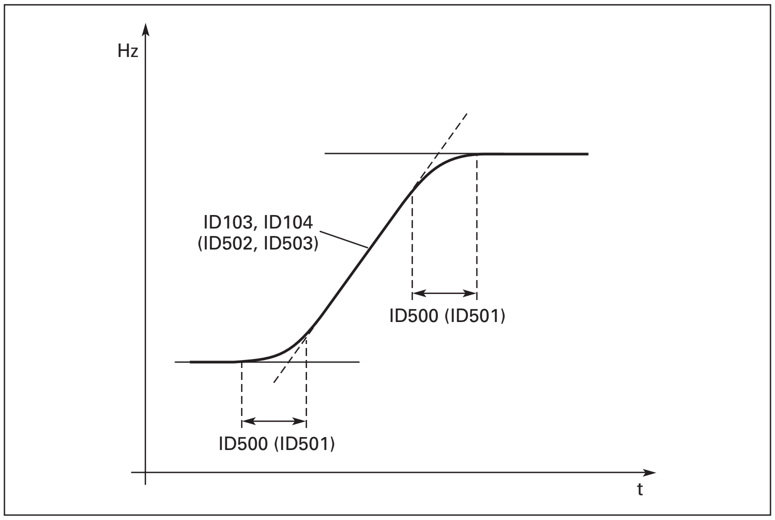


Figure 3-23: Acceleration/Deceleration (S-shaped)

502 Acceleration time 2 (P1.4.3)
503 Deceleration time 2 (P1.4.4)

These values correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (ID102). These parameters provide the possibility to set two different acceleration/deceleration time sets for one application. The active set can be selected with the programmable signal DIN3 (ID301).

504 Brake chopper (P1.4.5)

0 No brake chopper used
1 Brake chopper in use and tested when running. Can be tested also in READY state
2 External brake chopper (no testing)
3 Used and tested in READY state and when running
4 Used when running (no testing)

When the drive is decelerating the motor, the inertia of the motor and the load is fed into an external brake resistor. This enables the drive to decelerate the load with a torque equal to that of acceleration (provided that the correct brake resistor has been selected). See the separate Brake resistor installation manual. External resistors are always required for crane applications and must include separate sensing controls to activate the unit.

505 Start Function (P1.4.6)

Ramp:

0 The drive starts from 0 Hz and accelerates to the set reference frequency within the set acceleration time. (Load inertia or starting friction may cause prolonged acceleration times.)

Flying start:

1 The drive is able to start into a running motor by applying a small torque to motor and searching for the frequency corresponding to the speed the motor is running at. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. Thereafter, the output frequency will be increased/decreased to the set reference value according to the set acceleration/deceleration parameters.

Use this mode if the motor is coasting when the start command is given with the flying start, it is possible to ride through short utility voltage interruptions. **This mode is not recommended for crane applications.**

506 Stop Function (P1.4.7)

Coasting:

0 The motor coasts to a halt, without any control from the drive, after the Stop command. **Not recommended for crane applications.**

Ramp:

1 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high, it may be necessary to use an external braking resistor for faster deceleration.

Normal stop: Ramp/ Run Enable stop: coasting

2 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. However, when Run Enable is selected, the motor coasts to a halt without any control from the drive.

Normal stop: Coasting/ Run Enable stop: ramping

3 The motor coasts to a halt without any control from the drive. However, when Run Enable signal is selected, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high, it may be necessary to use an external braking resistor for faster deceleration.

507 DC-braking current (P1.4.8)

Defines the current injected into the motor during DC-braking.

508 DC braking time at stop (P1.4.9)

Determines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping. The function of the DC-brake depends on the stop function, ID506.

0.0 DC-brake is not used

>0.0 DC-brake is in use and its function depends on the Stop function, (ID506). The DC-braking time is determined with this parameter.

Par. ID506 = 0; Stop function = Coasting:

After the stop command, the motor coasts to a stop with the drive off.

With DC-injection, the motor can be electrically stopped in the shortest possible time, without using an optional external braking resistor.

The braking time is scaled according to the frequency when the DC-braking starts. If the frequency is ≥ the nominal frequency of the motor, the set value of parameter ID508 determines the braking time. When the frequency is ≤10% of the nominal, the braking time is 10% of the set value of ID508. See **Figure 3-24.**

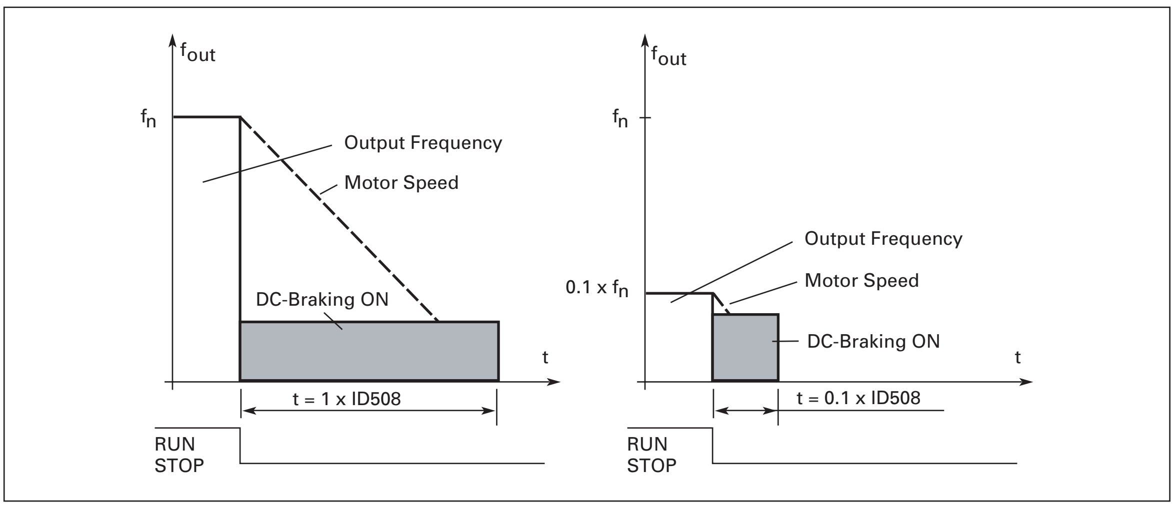


Figure 3-24: DC Braking Time when Stop Mode = Coasting

Par. ID506 = 1; Stop function = Ramp:

After the Stop command, the speed of the motor is reduced according to the set deceleration parameters, as fast as possible, to the speed defined with ID515, where the DC-braking starts.

The braking time is defined with ID508. If high inertia exists, use an external braking resistor for faster deceleration. See **Figure 3-25.**

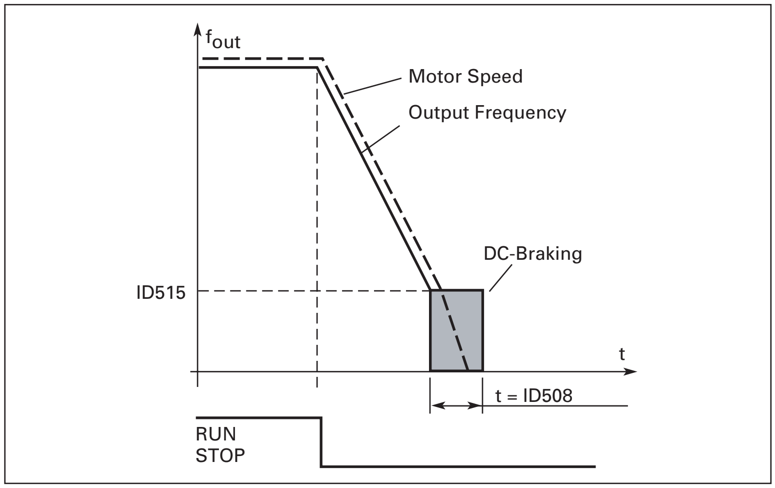


Figure 3-25: DC Braking Time when Stop Mode = Ramp

509 Prohibit frequency area 1; Low limit (P1.5.1)

510 Prohibit frequency area 1; High limit (P1.5.2)

511 Prohibit frequency area 2; Low limit (P1.5.3)

512 Prohibit frequency area 2; High limit (P1.5.4)

513 Prohibit frequency area 3; Low limit (P1.5.5)

514 Prohibit frequency area 3; High limit (P1.5.6)

In some systems it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters limits are set for the “skip frequency” regions. See **Figure 3-26.**

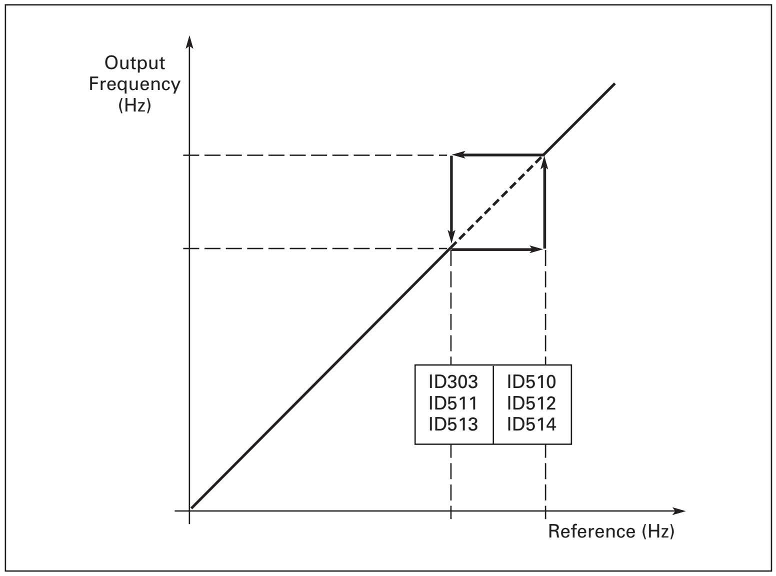


Figure 3-26: Example of Prohibit Frequency Area Setting

515 DC braking frequency at stop (P1.4.10)

The output frequency at which the DC-braking is applied. See **Figure 3-26**.

516 DC braking time at start (P1.4.11)

DC brake is activated when the start command is given. This parameter defines the time before the brake is released. After the brake is released, the output frequency increases according to the set start function by ID505.

518 Acceleration/deceleration ramp speed scaling ratio between prohibit frequency limits (P1.5.7)

Defines the acceleration/deceleration time when the output frequency is between the selected prohibit frequency range limits (ID509 and ID510). The ramping speed (selected acceleration/deceleration time 1 or 2) is multiplied with this factor. For example, value 0.1 makes the acceleration time 10 times shorter than outside the prohibit frequency range limits. See **Figure 3-27**.

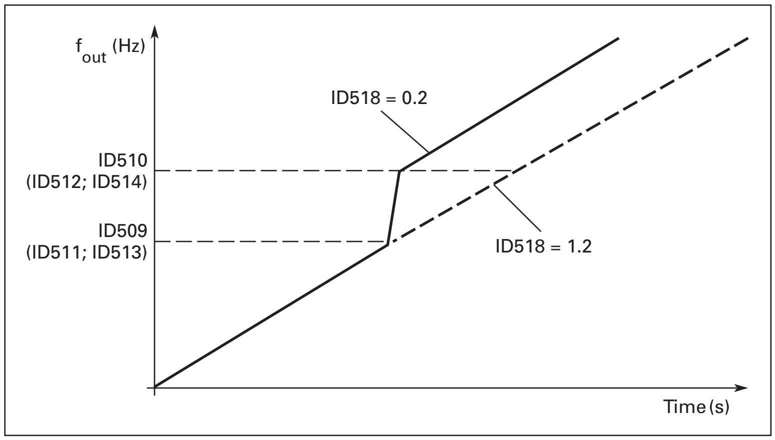


Figure 3-27: Ramp Speed Scaling between Prohibit Frequencies

519 Flux braking current (P1.4.13)

Defines the flux braking current value. This value can be set between MotorCurrent Min and the Unit I_L Current.

520 Flux brake (P1.4.12)

Instead of DC braking, flux braking is a useful form of braking for motors ≤ 15 kW. When braking is needed, the frequency is reduced and the flux in the motor is increased, which in turn increases the motor's capability to brake. Unlike DC braking, the motor speed remains controlled during braking.

The flux braking can be set ON or OFF.

0 Flux braking OFF
1 Flux braking ON

Note: Flux braking converts the energy into heat in the motor, and should be used intermittently to avoid motor damage.

521 Motor control mode 2 (P1.6.12)

With this parameter you can set another motor control mode. The mode which is used is determined by ID164.

For the available selections, see ID600.

600 Motor control mode (P1.6.1)

SVX:

0 Frequency control: The I/O terminal and keypad references are frequency references and the frequency converter controls the output frequency (output frequency resolution = 0.01 Hz)

1 Speed control: The I/O terminal and keypad references are speed references and the frequency converter controls the motor speed compensating for motor slip (accuracy ± 0.5%).

The following selections are available for SPX drives only, except for selection **2** which is available in the Multi-Purpose Control Application for SVX drives also.

2 Torque control: In torque control mode, the references are used to control the motor torque.

3 Speed control (closed loop): The I/O terminal and keypad references are speed references and the frequency converter controls the motor speed very accurately comparing the actual speed received from the tachometer to the speed reference (accuracy ± 0.01%).

4 Torque control (closed loop): The I/O terminal and keypad references are torque references and the frequency converter controls the motor torque.

5 Frequency control (advanced open loop): Frequency control with better performance at lower speeds.

6 Speed control (advanced open loop): Speed control with better performance at lower speeds.

601 Switching frequency (P1.6.9)

Motor noise can be minimized using a high switching frequency. Increasing the switching frequency reduces the capacity of the frequency converter unit. The range of this parameter depends on the size of the frequency converter:

Table 3-10: Size-Dependent Switching Frequencies

Type	Min. [kHz]	Max. [kHz]	Default [kHz]
0003 – 0061 SPX_5 0003 – 0061 SPX_2	1.0	16.0	10.0
0072 – 0520 SPX_5	1.0	10.0	3.6
0041 – 0062 SPX_6 0144 – 0208 SPX_6	1.0	6.0	1.5

602 Field weakening point (P1.6.4)

The field weakening point is the output frequency at which the output voltage reaches the set (ID603) maximum value.

603 Voltage at field weakening point (P1.6.5)

Above the frequency at the field weakening point, the output voltage remains at the set maximum value. Below the frequency at the field weakening point, the output voltage depends on the setting of the V/Hz curve parameters. See ID109, ID108, ID604 and ID605.

When the parameters ID110 and ID111 (nominal voltage and nominal frequency of the motor) are set, the parameters ID602 and ID603 are automatically set to the corresponding values. If you need different values for the field weakening point and the maximum output voltage, change these parameters **after** setting ID110 and ID111.

604 V/Hz curve, middle point frequency (P1.6.6)

If the programmable V/Hz curve has been selected with ID108 this parameter defines the middle point frequency of the curve. See **Figure 3-28.**

605 V/Hz curve, middle point voltage (P1.6.7)

If the programmable V/Hz curve has been selected with the ID108 this parameter defines the middle point voltage of the curve. See **Figure 3-28.**

606 Output voltage at zero frequency (P1.6.8)

If the programmable V/Hz curve has been selected with the ID108 this parameter defines the zero frequency voltage of the curve. See **Figure 3-28.**

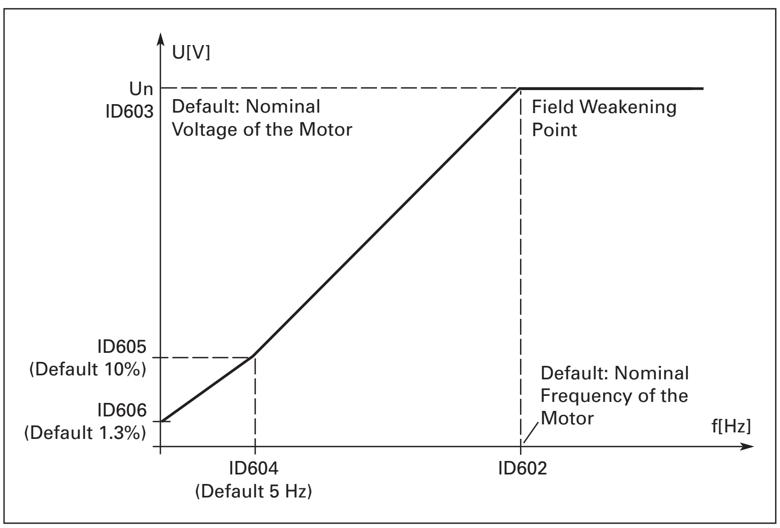


Figure 3-28: Programmable V/Hz Curve

607 Overvoltage controller (P1.6.10)

These parameters allow the under/overvoltage controllers to be switched ON or OFF. This may be useful, for example, if the main supply voltage varies more than -15% to +10% and the application requires a constant speed. In this case, the regulator controls the output frequency, taking the supply fluctuations into account.

- **0** Controller switched off
- **1** Controller switched on (no ramping) = Minor adjustments of OP frequency are made
- **2** Controller switched on (with ramping) = Controller adjusts OP freq. up to max. freq.

608 Undervoltage controller (P1.6.11)

See ID607.

Note: Over/undervoltage trips may occur when the controllers are switched off.

- **0** Controller switched off
- **1** Controller switched on

609 Torque limit (P1.10.1)

With this parameter you can set the torque limit control between 0.0 – 1000.0%.

610 Torque limit control P-gain (P1.10.2)

This parameter defines the gain of the torque limit controller.

611 Torque limit control I gain (P1.10.3)

This parameter determines the I-gain of the torque limit controller.

612 CL: Magnetizing current (P1.6.17.1)

Sets the motor magnetizing current (no-load condition). See **Page A-3.**

613 CL: Speed control P gain (P1.6.17.2)

Sets the gain for the speed controller in % per Hz. See **Page A-3.**

614 CL: Speed control I time (P1.6.17.3)

Sets the integral time constant for the speed controller. Increasing the I-time increases stability but lengthens the speed response time. See **Page A-3.**

615 CL: Zero speed time at start (P1.6.17.9)

After giving the start command the drive will remain at zero speed for the time defined by this parameter. The ramp will be released to follow the set frequency/ speed reference after this time has elapsed from the instant where the command is given. See **Page A-3.**

616 CL: Zero speed time at stop (P1.6.17.10)

The drive will remain at zero speed with controllers active for the time defined by this parameter after reaching the zero speed when a stop command is given. This parameter has no effect if the selected stop function (ID506) is Coasting. See **Page A-3**.

617 CL: Current control P gain (P1.6.17.17)

Sets the gain for the current controller. This controller is active only in closed loop and advanced open loop modes. The controller generates the voltage vector reference to the modulator. See **Page A-3**.

618 CL: Encoder filter time (P1.6.17.15)

Sets the filter time constant for speed measurement.

The parameter can be used to eliminate encoder signal noise. Too high a filter time reduces speed control stability. See **Page A-3**.

619 CL: Slip adjust P1.6.17.6)

The motor nameplate speed is used to calculate the nominal slip. This value is used to adjust the voltage of motor when loaded. The nameplate speed is sometimes a little inaccurate and this parameter can therefore be used to trim the slip. Reducing the slip adjust value increases the motor voltage when the hoist is loaded. See **Page A-3**.

620 CL: Load drooping (P1.6.15, P1.6.17.4)

The drooping function enables speed drop as a function of load. This parameter sets that amount corresponding to the nominal torque of the motor. See **Page A-3**.

621 CL: Startup torque (P1.6.17.11)

Chooses the startup torque.

Torque Memory is used in crane applications. Startup torque FWD/REV can be used in other applications to help the speed controller. See **Page A-3**.

0	Not used
1	Torque memory
2	Torque reference
3	Torque Fwd/Rev

622 AOL: M5 Minimum current (P1.6.18.2)

Minimum current to the motor in the current control frequency region. Larger value gives more torque, but increases losses. See **Page A-3**.

623 AOL: Flux reference (P1.6.18.3)

Reference for flux below the frequency limit. Larger value gives more torque, but increases losses. See **Page A-3**.

625 AOL: Zero speed current (P1.6.18.1)

At very low frequencies, this parameter defines the constant current reference to the motor. See **Page A-3**.

626 CL: Acceleration compensation (P1.6.17.5)

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

627 CL: Magnetizing current at start (P1.6.17.7)

628 CL: Magnetizing time at start (P1.6.17.8)

Sets the rise time of magnetizing current.

631 Identification (P1.6.16)

632 AOL: V/Hz boost (P1.6.18.5)

Boost voltage at Frequency Limit to increase flux and torque. Used if ID600 = 5 or 6. See **Page A-3**.

633 CL: Start-up torque, forward (P1.6.17.12)

Sets the start-up torque for forward direction if selected with ID621.

634 CL: Start-up torque, reverse (P1.6.17.13)

Sets the start-up torque for reverse direction if selected with ID621.

635 AOL: M5 Frequency limit (P1.6.18.4)

Corner frequency for transition to standard V/Hz control. The value is given in % of motor nominal frequency. See **Page A-3**.

636 Minimum frequency for Open Loop torque control (P1.10.8)

Defines the frequency limit below which the drive operates in the frequency control mode.

Because of the nominal slip of the motor, the internal torque calculation is inaccurate at low speeds where we recommend using the frequency control mode.

637 Speed controller P gain, Open Loop (P1.6.13)

Defines the P gain for the speed controlled in Open Loop control mode.

638 Speed controller I gain, Open Loop (P1.6.14)

Defines the I gain for the speed controlled in Open Loop control mode.

639 Torque controller P gain (P1.10.9)

Defines the P gain of the torque controller.

640 Torque controller I gain (P1.10.10)

Defines the I gain of the torque controller.

641 Torque reference selection (P1.10.4)

Defines the source for torque reference.

0 Not used
1 Analog input 1
2 Analog input 2
3 Analog input 3
4 Analog input 4
5 Analog input 1 (joystick)
6 Analog input 2 (joystick)
7 From keypad, parameter R2.4
8 Fieldbus

642 Torque reference scaling, maximum value (P1.10.5)

643 Torque reference scaling, minimum value (P1.10.6)

Scale the custom minimum and maximum levels for analog inputs within -300.0 to 300.0%.

644 Torque speed limit (P1.10.7)

With this parameter the maximum frequency for the torque control can be selected.

0 Maximum frequency, ID102
1 Selected frequency reference
2 Preset speed 7, ID130

700 Response to the 4 mA reference fault (P1.7.1)

0 No response
1 Warning
2 Warning, the frequency from 10 seconds back is set as reference
3 Warning, the Preset Frequency (ID728) is set as reference
4 Fault, stop mode after fault according to ID506
5 Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated if the 4 – 20 mA reference signal is used and the signal falls below 3.5 mA for 5 seconds or below 0.5 mA for 0.5 seconds. The information can also be programmed into digital output DO1 or relay outputs RO1 and RO2.

701 Response to external fault (P1.7.3)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated from the external fault signal in the programmable digital inputs DIN3. The information can also be programmed into digital output DO1 and into relay outputs RO1 and RO2.

702 Output phase supervision (P1.7.6)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

Output phase supervision of the motor ensures that the motor phases have approximately equal currents.

703 Ground fault protection (P1.7.7)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

Ground fault protection ensures that the sum of the motor phase currents is zero. The overcurrent protection is always present and protects the drive from ground faults with high currents.

704 Motor thermal protection (P1.7.8)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

If tripping is selected the drive will stop and activate the fault stage. Deactivating this protection, i.e. setting parameter to **0**, will reset the thermal stage of the motor to 0%. See **Page A-4**.

705 Motor thermal protection: Motor ambient temp. factor (P1.7.9)

The factor can be set between -100.0% – 100.0%. See **Page A-4**.

706 Motor thermal protection: Motor cooling factor at zero speed (P1.7.10)

The current can be set between 0 – 150.0% x I_{nMotor}. This parameter sets the value for thermal current at zero frequency. See **Figure 3-29**.

The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or even higher).

Note: The value is set as a percentage of the motor nameplate data, ID113 (nominal current of the motor), not the drive's nominal output current. The motor's nominal current is the current that the motor can withstand in direct on-line use without being overheated.

If you change the parameter Nominal current of motor, this parameter is automatically restored to the default value.

Setting this parameter does not affect the maximum output current of the drive which is determined by ID107 alone. See **Page A-4**.

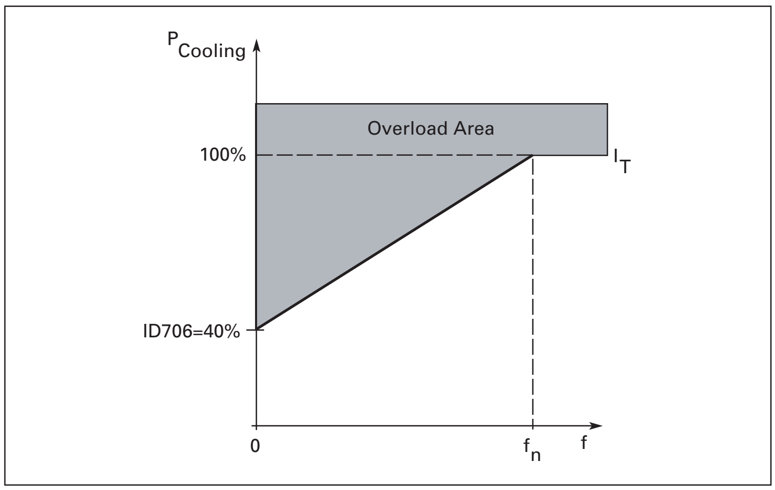


Figure 3-29: Motor Thermal Current I_T Curve

707 Motor thermal protection: Time constant (P1.7.11)

This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor, the larger the motor, the longer the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

The motor thermal time is specific to the motor design and it varies between different motor manufacturers.

If the motor's t6-time (t6 is the time in seconds the motor can safely operate at six times the rated current) is known (given by the motor manufacturer) the time constant parameter can be set based on it. As a rule of thumb, the motor thermal time constant in minutes is equal to 2 x t6. If the drive is in stop stage, the time constant is internally increased to three times the set parameter value. The cooling in the stop stage is based on convection and the time constant is increased. See **Figure 3-30.**

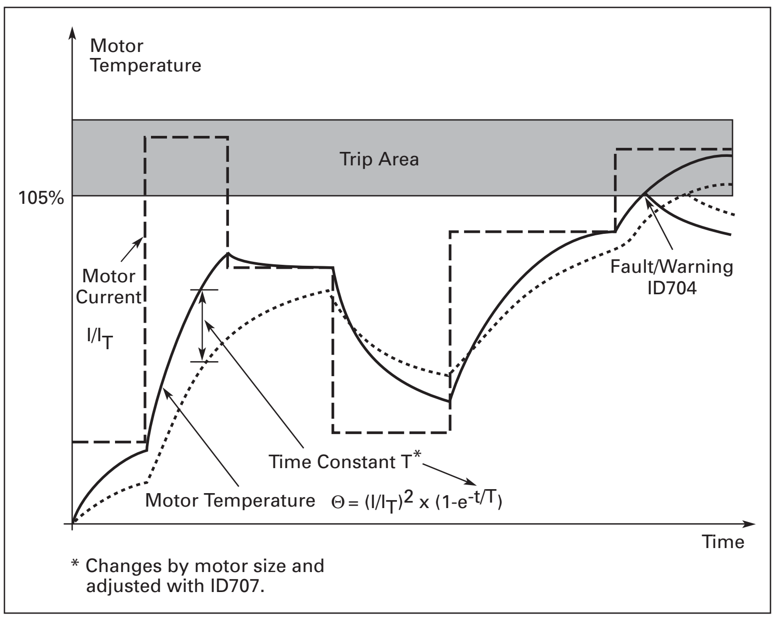


Figure 3-30: Motor Temperature Calculation

708 Motor thermal protection: Motor duty cycle (P1.7.12)

Defines how much of the nominal motor load is applied.
The value can be set to 0% – 100%. See **Page A-4**.

709 Stall protection (P1.7.13)

- **0** No response
- **1** Warning
- **2** Fault, stop mode after fault according to ID506
- **3** Fault, stop mode after fault always by coasting

Setting the parameter to **0** will deactivate the protection and reset the stall time counter. See **Page A-4**.

710 Stall current limit (P1.7.14)

The current can be set between Motor Current Min. and Motor Current Max. For a stall stage to occur, the current must have exceeded this limit. See **Figure 3-31.** The software does not allow entering a greater value than Motor Current Max. If ID113, nominal motor current is changed, this parameter is automatically restored to the default value (I_L). See **Page A-4.**

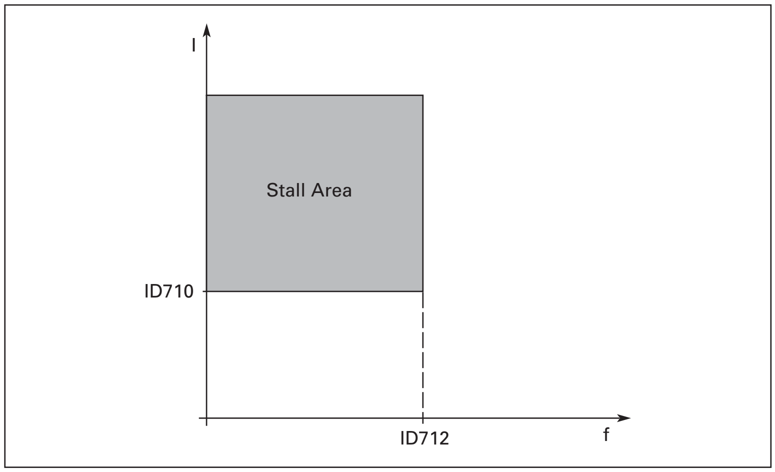


Figure 3-31: Stall Characteristics Settings

711 Stall time (P1.7.15)

This time can be set between 1.0 and 120.0s.

This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter. If the stall time counter value goes above this limit, the protection will cause a trip (see ID709). See **Page A-4.**

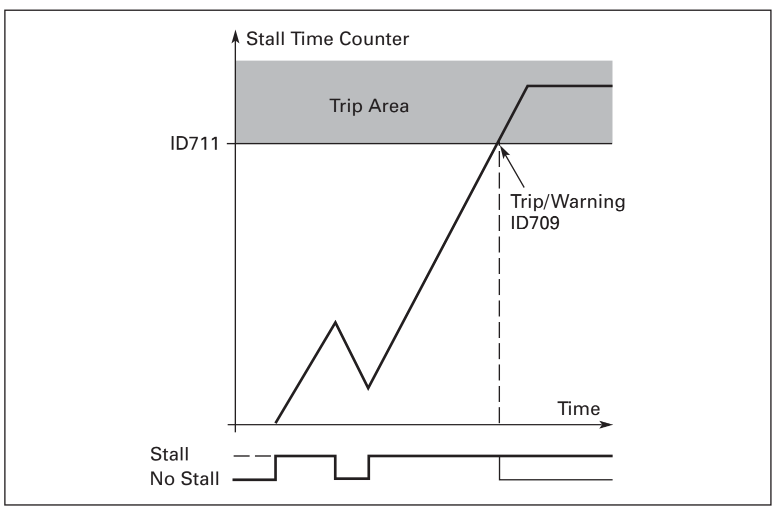


Figure 3-32: Stall Time Count

712 Stall frequency limit (P1.7.16)

The frequency can be set between 1 – f_{mAx} (ID102).

For a stall state to occur, the output frequency must have remained below this limit. See **Page A-4**.

713 Underload protection (P1.7.17)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

If tripping is set active the drive will stop and activate the fault stage. Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero. See **Page A-5**.

714 Underload protection, field weakening area load (P1.7.18)

The torque limit can be set between 10.0 – 150.0 % x T_{nMotor}.

This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point. See **Figure 3-33**.

If you change ID113, nominal motor current, this parameter is automatically restored to the default value. See **Page A-5.**

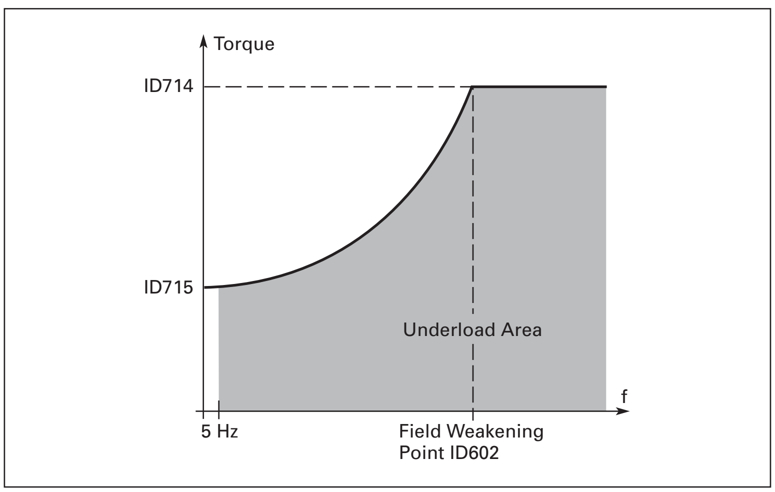


Figure 3-33: Setting of Minimum Load

715 Underload protection, zero frequency load (P1.7.19)

The torque limit can be set between 5.0 – 150.0 % x T_{nMotor}.

This parameter gives value for the minimum torque allowed with zero frequency. See **Figure 3-33**.

If you change the value of ID113, nominal motor current, this parameter is automatically restored to the default value. See **Page A-5**.

716 Underload time (P1.7.20)

This time can be set between 2.0 and 600.0s.

This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to ID713. If the drive is stopped the underload counter is reset to zero. See **Figure 3-34** and **Page A-5**.

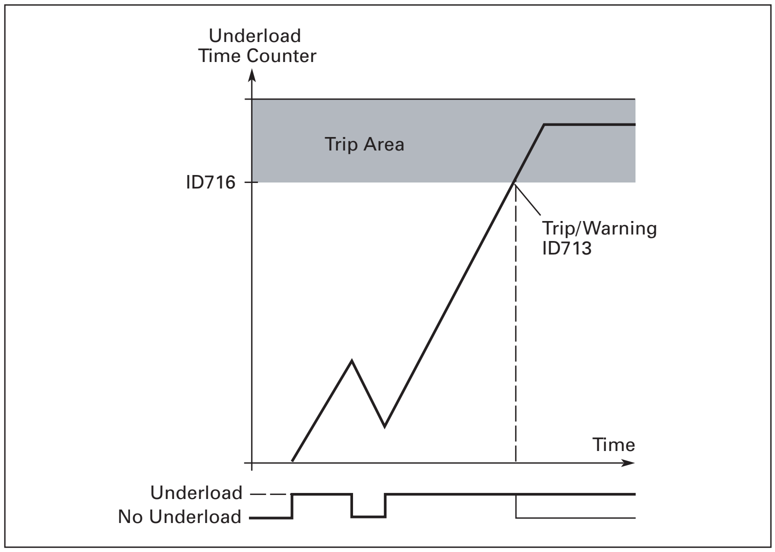


Figure 3-34: Underload Time Counter Function

717 Automatic restart: Wait time (P1.8.1)

Defines the time before the drive tries to automatically restart the motor after the fault has disappeared.

718 Automatic restart: Trial time (P1.8.2)

The Automatic restart function restarts the drive when the faults selected with ID720 to ID725 have cleared and the waiting time has elapsed.

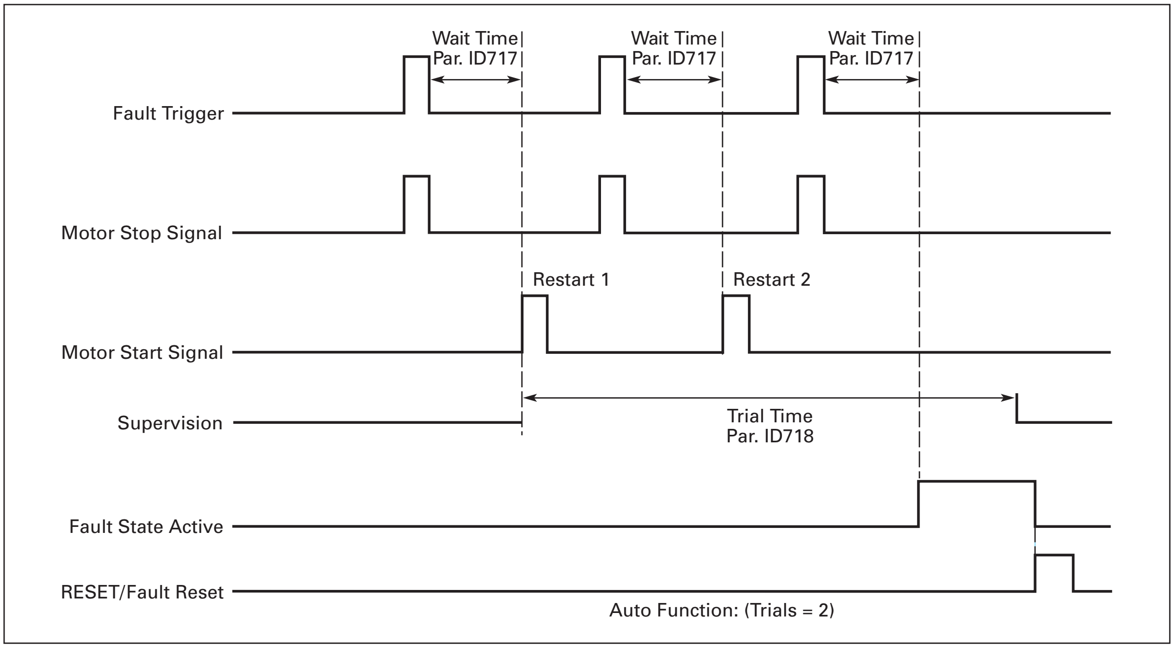


Figure 3-35: Example of Automatic Restarts with Two Restarts

ID720 to ID725 determine the maximum number of automatic restarts during the trial time set by ID718. The time count starts from the first automatic restart. If the number of faults occurring during the trial time exceeds the values of ID720 to ID725, the fault state becomes active. Otherwise, the fault is cleared after the trial time has elapsed and the next fault starts the trial time count again.

If a single fault remains during the trial time, a fault state is true.

719 Automatic restart: Start function (P1.8.3)

The Start function for automatic restart is selected with this parameter. The parameter defines the start mode:

0 Start with ramp
1 Flying start
2 Start according to ID505

720 Automatic restart: Number of tries after undervoltage fault trip (P1.8.4)

This parameter determines how many automatic restarts can be made during the trial time set by ID718 after an undervoltage trip.

0 No automatic restart
>0 Number of automatic restarts after undervoltage fault. The fault is reset and the drive is started automatically after the DC link voltage has returned to the normal level.

721 Automatic restart: Number of tries after overvoltage trip (P1.8.5)

This parameter determines how many automatic restarts can be made during the trial time set by ID718 after an overvoltage trip.

0	No automatic restart after overvoltage fault trip
>0	Number of automatic restarts after overvoltage fault trip. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.

722 Automatic restart: Number of tries after overcurrent trip (P1.8.6)

This parameter determines how many automatic restarts can be made during the trial time set by ID718.

Note: An IGBT temperature fault also included as part of this fault.

0	No automatic restart after overcurrent fault trip
>0	Number of automatic restarts after an overcurrent trip, saturation trip or IGBT temperature fault.

723 Automatic restart: Number of tries after reference trip (P1.8.7)

This parameter determines how many automatic restarts can be made during the trial time set by ID718.

0	No automatic restart after reference fault trip
>0	Number of automatic restarts after the analog current signal (4 – 20 mA) has returned to the normal level (≥ 4 mA)

725 Automatic restart: Number of tries after external fault trip (P1.8.9)

This parameter determines how many automatic restarts can be made during the trial time set by ID718.

0	No automatic restart after External fault trip
>0	Number of automatic restarts after External fault trip

726 Automatic restart: Number of tries after motor temperature fault trip (P1.8.8)

This parameter determines how many automatic restarts can be made during the trial time set by ID718.

0	No automatic restart after Motor temperature fault trip
>0	Number of automatic restarts after the motor temperature has returned to its normal level

727 Response to undervoltage fault (P1.7.5)

0	Fault stored
1	No history

728 4 mA reference fault: preset frequency reference (P1.7.2)

If the value of parameter ID700 is set to 3 and the 4 mA fault occurs, then the frequency reference to the motor is the value of this parameter.

730 Input phase supervision (P1.7.4)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

The input phase supervision ensures that the input phases of the drive have approximately equal currents.

732 Response to thermistor fault (P1.7.21)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

Setting the parameter to **0** will deactivate the protection.

733 Response to fieldbus fault (P1.7.22)

This sets the response mode for the fieldbus fault when a fieldbus board is used. For more information, see the respective Fieldbus Board Manual.

See ID732.

734 Response to slot fault (P1.7.23)

This sets the response mode for a board slot fault caused by a missing or failed board.

See ID732.

738 Automatic restart: Number of tries after underload fault trip (P1.8.10)

This parameter determines how many automatic restarts can be made during the trial time set by ID718.

0 No automatic restart after an Underload fault trip
>0 Number of automatic restarts after an Underload fault trip

739 Number of PT100 inputs in use (P1.7.24)

If a PT100 input board is installed in the drive, this sets the number of PT100 inputs in use. See the *9000X Option Board User Manual*.

Note: If the selected value is greater than the actual number of PT100 inputs being used, the display will read 200°C. If the input is short-circuited the displayed value is -30°C.

740 Response to PT100 fault (P1.7.25)

0 No response
1 Warning
2 Fault, stop mode after fault according to ID506
3 Fault, stop mode after fault always by coasting

741 PT100 warning limit (P1.7.26)

Selects the limit at which the PT100 warning will be activated.

742 PT100 fault limit (P1.7.27)

Selects the limit at which the PT100 fault (F56) will be activated.

850 Fieldbus reference minimum scaling (P1.9.1)

851 Fieldbus reference maximum scaling (P1.9.2)

Use these two parameters to scale the fieldbus reference signal. Setting value limits: 0 ≤ ID850 ≤ ID851 ≤ ID102. If ID851 = 0, custom scaling is not used and the minimum and maximum frequencies are used for scaling. The scaling functions as illustrated in **Figure 3-6**. See **Page A-5.**

Note: Using this custom scaling function also affects the scaling of the actual value.

852 to 859 Fieldbus data out selections 1 to 8 (P1.9.3 to P1.9.10)

Using these parameters, you can observe any monitored item or parameter from the fieldbus. Enter the ID number of the item you wish to observe for its value. See **Page A-5.**

Some typical values:

Table 3-11: Typical Monitored Items

Item	Description	Item	Description
1	Output frequency	15	Digital inputs 1,2,3 status
2	Motor speed	16	Digital inputs 4,5,6 status
3	Motor current	17	Digital and relay output status
4	Motor torque	25	Frequency reference
5	Motor power	26	Analog output current
6	Motor voltage	27	AI3
7	DC link voltage	28	AI4
8	Unit temperature	31	AO1 (expander board)
9	Motor temperature	32	AO2 (expander board)
13	AI1	37	Active fault 1
14	AI2	—	—

Keypad Control Parameters

Unlike the parameters listed above, these parameters are located in the **M2** menu of the control keypad. The reference parameters do not have an ID number.

114 STOP button activated (P2.3)

To make the STOP button a "hotspot" which always stops the drive regardless of the selected control place, set the value of this parameter to **1**.

See also ID125.

123 Keypad direction (P2.2)

0 Forward: The rotation of the motor is forward, when the keypad is the active control place.

1 Reverse: The rotation of the motor is reversed, when the keypad is the active control place.

For more information, see **Page 2-17**.

R2.1 Keypad reference (R2.2)

The frequency reference can be adjusted from the keypad with this parameter.

The output frequency can be copied as the keypad reference by pushing the STOP button for 3 seconds when you are on any of the pages of menu **M2**. For more information, see **Page 2-17**.

R2.4 Torque reference (R2.5)

Defines the torque reference from 0.0 to 100.0%.

Appendix A — Additional Information

In this chapter you will find additional information on special parameter groups. Such groups are:

- Parameters of External Brake Control with Additional Limits (see below)
- Closed Loop Parameters (see **Page A-3**)
- Advanced Open Loop Parameters (see **Page A-3**)
- Parameters of Motor Thermal Protection (see **Page A-4**)
- Parameters of Stall Protection (see **Page A-4**)
- Parameters of Underload Protection (see **Page A-5**)
- Fieldbus Control Parameters (see **Page A-5**)

External Brake Control with Additional Limits

ID315, ID316, ID346 to ID349, ID352, ID353

The external brake used for additional braking can be controlled through ID315, ID316, ID346 to ID349 and ID352/ID353. Selecting On/Off Control for the brake, defining the frequency or torque limit(s) the brake should react to and defining the Brake-On/-Off delays will allow an effective brake control. See **Figure A-1**.

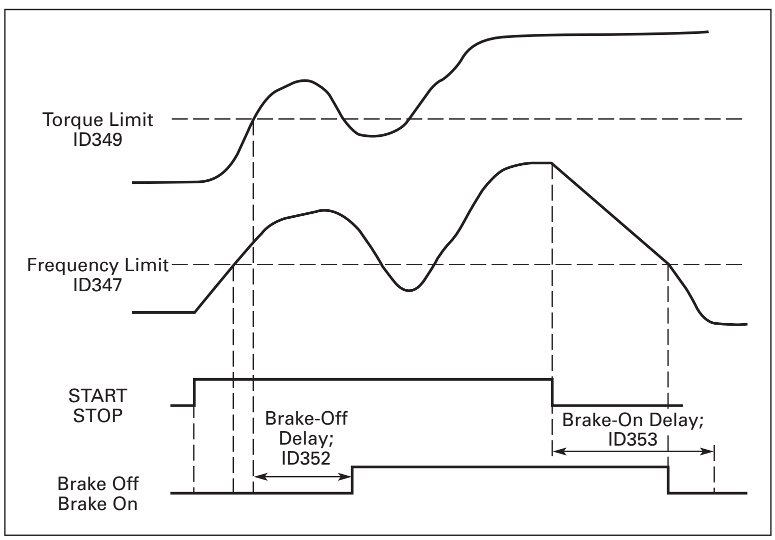


Figure A-1: Brake Control with Additional Limits

In **Figure A-1**, the brake control is set to react to both the torque supervision limit (ID349) and frequency supervision limit (ID347). Additionally, the same frequency limit is used for both brake-off and brake-on control by giving ID346 the value **4.** Use of two different frequency limits is also possible. Then ID315 and ID346 must be given the value **3.**

Brake-off: In order for the brake to release, three conditions must be fulfilled: 1) the drive must be in Run state, 2) the torque must be over the set limit (if used) and 3) the output frequency must be over the set limit (if used).

Brake-on: Stop command activates the brake delay count and the brake is closed when the output frequency falls below the set limit (ID315 or ID346). As a precaution, the brake closes when the brake-on delay expires, at the latest.

Note: A fault or stop state will close the brake immediately without a delay.

See **Figure A-2**.

Note: It is strongly advisable that the brake-on delay be set longer than the ramp time in order to avoid damaging of the brake.

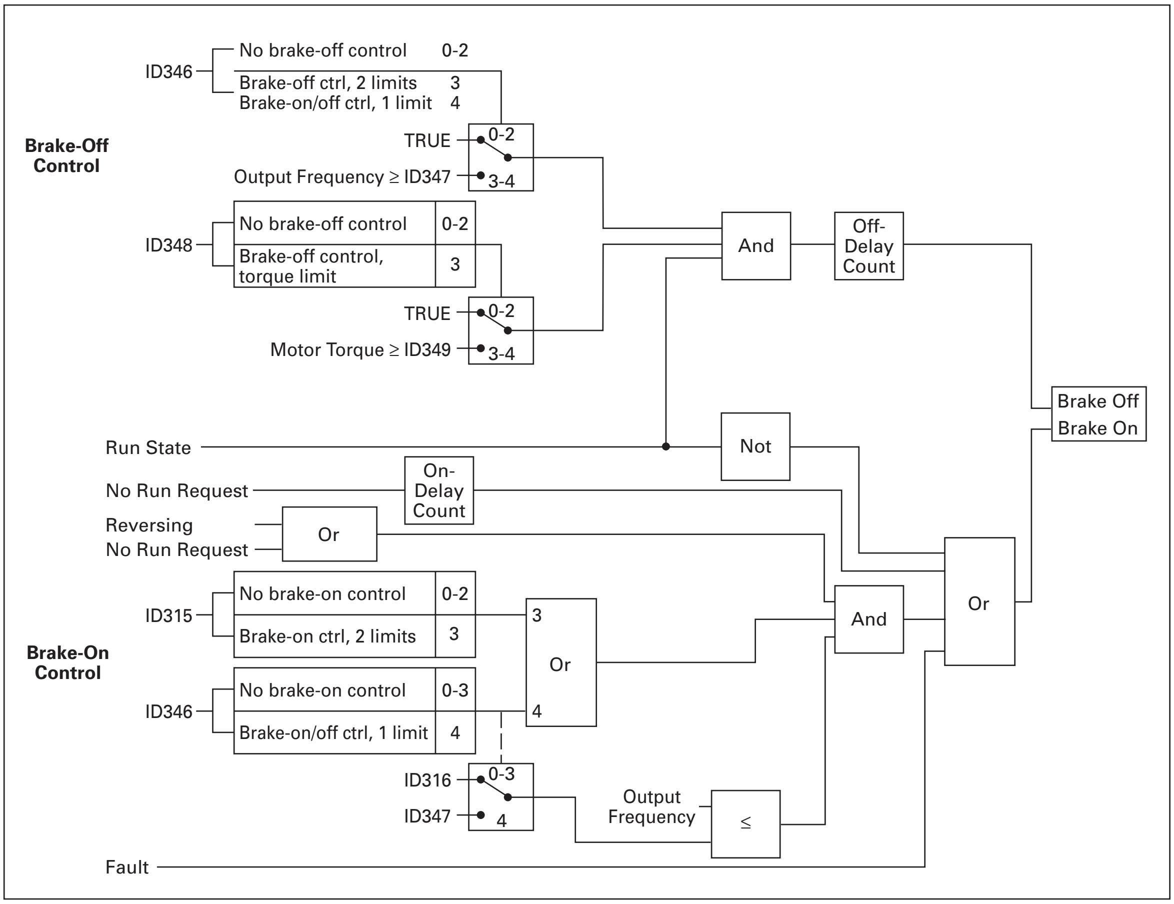


Figure A-2: Brake Control Logic

Closed Loop Parameters

ID612 to ID621

Select the Closed Loop control mode by setting value **3** or **4** for ID600.

Closed loop control mode (see **Page 3-36**) is used when enhanced performance near zero speed and better static speed accuracy with higher speeds are needed. Closed loop control mode is based on "rotor flux oriented current vector control". With this controlling principle, the phase currents are divided into a torque-producing current portion and a magnetizing current portion. Thus, the squirrel cage induction machine can be controlled in a fashion of a separately excited DC motor.

Note: These parameters can be used with SVXP drive only.

Example: Motor Control Mode = 3 (Closed loop speed control)

This is the usual operation mode when fast response times, high accuracy or controlled run at zero frequencies are needed. Encoder board should be connected to slot C of the control unit. Set the encoder P/R-parameter (P7.3.1.1). Run in open loop and check the encoder speed and direction (V7.3.2.2). Change the direction parameter (P7.3.1.2) or switch the phases of motor cables if necessary. Do not run if encoder speed is wrong. Program the no-load current to ID612 and set ID619 (Slip Adjust) to get the voltage slightly above the linear V/Hz-curve with the motor frequency at about 66% of the nominal motor frequency. The Motor Nominal Speed parameter (ID112) is critical. The Current Limit parameter (ID107) controls the available torque linearly in relation to motor nominal current.

Advanced Open Loop Parameters

ID622 to ID625, ID632, ID635

Select the Advanced Open Loop control mode by setting value **5** or **6** for parameter ID600.

The Advanced Open Loop control mode finds similar implementations as the Closed Loop control mode above. However, the control accuracy of the Closed Loop control mode is higher than that of the Advanced Open Loop control mode.

Example: Motor Control Mode = 5 Frequency control (Advanced open loop) and
6 Speed control (Advanced open loop)

The motor is running at current vector control at low frequencies. At frequencies above the frequency limit, the motor is in frequency control. The default current value is 120% at zero frequency. Use linear V/Hz-curve (ID108). 120% starting torque should now be possible. Sometimes increasing the frequency limit (ID635) will improve the run. The Frequency limit is the critical point. Increase the zero frequency point to get enough current at frequency limit.

Parameters of Motor Thermal Protection

ID704 to ID708

General

The motor thermal protection protects the motor from overheating. The Cutler-Hammer drive is capable of supplying higher than nominal current to the motor. If the load requires this high current, there is a risk that the motor will be thermally overloaded. This is the case, especially at low frequencies. At low frequencies, the cooling effect of the motor is reduced as well as its capacity. If the motor is equipped with an external fan, the load reduction at low speeds is small.

The motor thermal protection is based on a calculated model, and it uses the output current of the drive to determine the load on the motor.

The motor thermal protection can be adjusted with parameters. The thermal current I_T specifies the load current above which the motor is overloaded. This current limit is a function of the output frequency.

The thermal stage of the motor can be monitored on the control keypad display. See **Page 2-25.**

CAUTION

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

Parameters of Stall Protection

ID709 to ID712

General

The motor stall protection protects the motor from short time overload situations, such as one caused by a stalled shaft. The reaction time of the stall protection can be set shorter than that of motor thermal protection. The stall state is defined with two parameters, ID710 (Stall current) and ID712 (Stall frequency limit). If the current is higher than the set limit and output frequency is lower than the set limit, the stall state is true. There is actually no real indication of the shaft rotation. Stall protection is a type of overcurrent protection.

Parameters of Underload Protection

ID713 to ID716

General

The purpose of the motor underload protection is to ensure that there is load on the motor when the drive is running. If the motor loses its load, there might be a problem in the process, e.g., a broken belt or a dry pump.

Motor underload protection can be adjusted by setting the underload curve with parameters ID714 (Field weakening area load) and ID715 (Zero frequency load), see below. The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5 Hz (underload time counter is stopped).

The torque values for setting the underload curve are set in percentage, which refers to the nominal torque of the motor. The motor's nameplate data. parameter motor nominal current and the drive's nominal current I_H are used to find the scaling ratio for the internal torque value. If other than nominal motor is used with the drive, the accuracy of the torque calculation decreases.

Fieldbus Control Parameters

ID850 to ID859

The Fieldbus control parameters are used when the frequency or the speed reference comes from the fieldbus (Modbus, Profibus, DeviceNet, etc.). With the Fieldbus Data Out Selection 1 – 8, you can monitor values from the fieldbus.

Appendix B — 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 B-1** contains all the fault codes.

Table B-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 rated limits: • too short a deceleration time • high overvoltage spikes in supply	Set the deceleration time longer. Add a brake chopper or brake resistor.
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 cables and motor.
7	Saturation trip	Various causes: • component failure • brake resistor short circuit or overload	Cannot be reset from the keypad. Switch off power. DO NOT RE-CONNECT POWER! Contact Eaton. If this fault appears simultaneously with Fault 1, check motor cables and motor.
9	Undervoltage ①	DC-link voltage is under the rated voltage limits. • most probable cause is 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.
10	Input line supervision ①	Input line phase is missing.	Check supply voltage and cable.
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 14°F (-10°C)	

① Programmable.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
14	Drive overtemperature	• Heatsink temperature is over 158°F (70°C). Overtemperature warning is issued when the heatsink temperature exceeds 149°F (65°C). • Circuit board temperature is over 185°F (85°C). Overtemperature warning is issued when the board temperature exceeds 158°F (70°C).	Check that rated values for I_{th} are not exceeded. Check the ambient temperature. Make sure that the switching frequency is not too high in relation to ambient temperature and motor load. Circulation of air in the drive is blocked. The cooling fans are defective.
15	Motor stalled ①	Motor stall protection has tripped.	Check motor.
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.	
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.)
31	IGBT temperature (hardware)	IGBT Inverter Bridge overtemperature protection has detected too high a short-term overload current.	Check loading. Check motor size.
41	IGBT temperature	IGBT Inverter Bridge overtemperature protection has detected too high a short-term overload current.	Check loading. Check motor size.
50	Analog input selection 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, signal source and wiring.
51	External fault	Digital input failed.	Check source of trigger.
52	Keypad communication fault	There is no connection between the control keypad and the drive.	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	Defective option board or slot.	Check that the board is properly installed and seated in slot. If the installation is correct, contact your Cutler-Hammer distributor.
56	PT100 board temperature fault	Temperature limit values set for the PT100 board parameters have been exceeded.	Determine the cause of the high temperature.

① Programmable.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
80	Torque prove fault	Motor could not produce the required torque under parameter setting when drive starts up.	Check motor, connections and linkage when starting for proper operation. Check brakes to make sure they are adjusted properly. Adjust P1.11.2, P1.11.3, P1.11.4.
81	Forward and reverse fault	Both the DIN1 forward and DIN2 reverse inputs are simultaneously closed. Note: Both inputs must be opened before the fault can be cleared.	Check wiring and switch operation. Adjust P1.7.28.
82	Brake prove fault on start	Closed loop system only. Motor revolutions exceed parameter setting when drive starts up. When this fault occurs, the drive will only operate in lower direction at the minimum speed. Reset by powering down and then back up 10 seconds after the drive totally discharges.	Check brake when stopping for proper operation. Adjust P1.11.9, P1.11.10.
83	Upper limit fault	Upper limit switch is tripped.	Reset limit switch.
84	Feedback fault	Encoder exceeds feedback tolerance parameter.	Adjust P.1.11.14.
85	Brake prove fault on stop	Closed loop system only. Motor revolutions exceed parameter setting when drive comes to a stop. When this fault occurs, the drive will only operate in lower direction at the minimum speed. Reset by powering down and then back up 10 seconds after the drive totally discharges.	Check brake when stopping for proper operation. Adjust P1.11.5, P1.11.9, P1.11.10.
86	No encoder board	Encoder board not detected for closed loop operation.	Check wiring to an external board, check whether an internal board is properly seated.
87	Runtime fault	The brake output has not set the brake in the time required.	Check the set brake output relay. Adjust P.1.11.17, P1.11.18.
88	Smart runtime fault	Brake output did not change state after run signal removed within the calculated time limit plus the tolerance.	Check the set brake output relay. Adjust P1.11.17, P1.11.19.
89	Invalid password	Password entered is not correct.	Enter correct password.
90	Validation code	An incorrect validation code is entered in parameter P1.11.29.	After repowering the drive, enter the correct validation code obtained from Eaton's drive division.

① Programmable.

Appendix C — Option Boards Used for Crane Applications

The option boards listed in this appendix are the typical boards used for crane applications. Additional boards are available to expand the drive capabilities for more demanding crane applications. User Manual MN04003001E provides more information on all the option boards available for the 9000X drives.

Board Slot Guides and Allowed Slots

You cannot plug an option board into any slot. Option card information shows which slots are allowed for each option board used. For reasons of safety, slots A and B have guides to prevent the use of incorrect boards, as shown in **Figure C-1**. If an incorrect board is plugged into slots C, D or E, the board will not work, but there is no danger to personnel or for equipment damage.

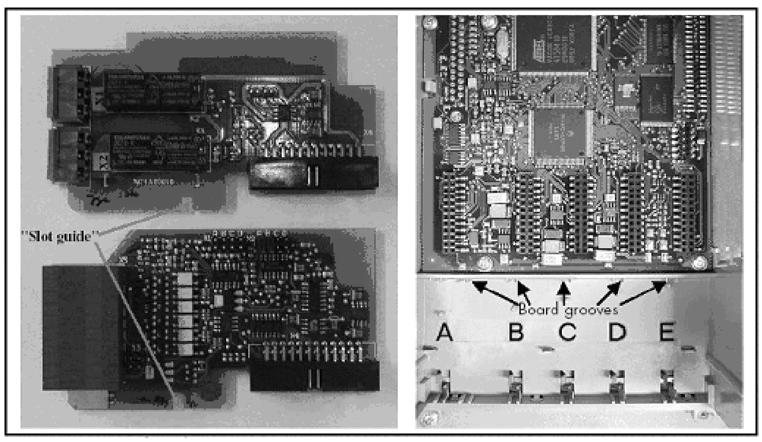


Figure C-1: Board Slot Guide to Prevent Plugging In of Incorrect Boards

Defining Functions to Inputs and Outputs

Several of the option boards for the 9000X Series Drive provide flexibility in that a particular I/O feature can be programmed to operate as one of multiple function choices. These function choices appear as parameters in the drive application menu. The operator chooses which function the particular parameter will become.

To connect a specific input or output to a certain function (parameter) an *address code* is assigned to the parameter. The code is formed from the control board *slot identification number*, into which the option board is plugged, and the respective *input/output number*. (See **Figure C-1**.)

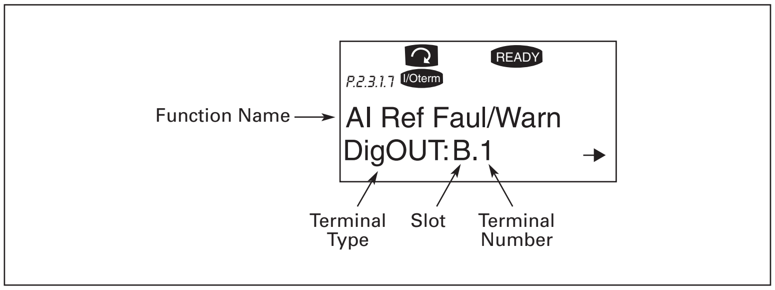


Figure C-2: Example of Function/Parameter Address Code

Option Board A9

OPTA9

Description: Basic I/O board similar to the OPTA1 except that the I/O terminals are larger for Size 14 wires using M3 screws.

Allowed slots: A
Type ID: 16697
Terminals: Two terminal blocks; Screw terminals (M3) (see **Figure C-4**)
Keying: Terminals #1 and #12
Jumpers: 4; X1, X2, X3 and X6 (see **Figure C-5**)
Board parameters: Yes (see **Table C-2**)

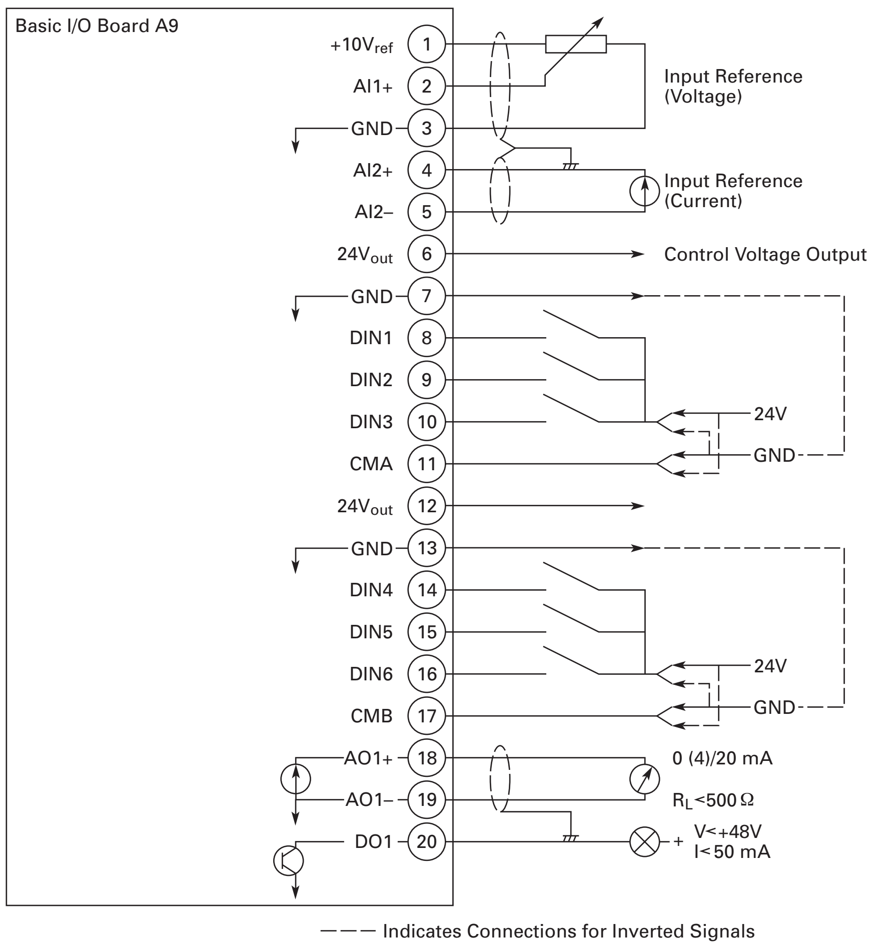


Figure C-3: Option Board A9 Wiring Diagram

Table C-1: Option Board A9 Terminal Descriptions

Terminal		Signal (Keypad Parameter Reference)	Description and Parameter Reference
1	$+10V_{ref}$	Reference voltage	Maximum current 10 mA
2	AI1+	Analog input, voltage (An.IN:**A.1**)	Default: 0 – +10V (R_i = 200 kΩ); (-10V to +10V joystick control) 0 – 20 mA (R_i = 250Ω) Select V or mA with jumper block X1 (**Figure C-5**) Resolution 0.1%; Accuracy ±1%
3	GND	Analog input common	Differential input if not connected to ground allows ±20V differential mode voltage to GND
4	AI2+	Analog input (An.IN:**A.2**)	Default: 0 – 20 mA (R_i = 250Ω) 0 – +10V (R_i = 200 kΩ); (-10V to +10V joystick control) Select V or mA with jumper block X2 (**Figure C-5**) Resolution 0.1%; Accuracy ±1%
5	GND/ AI2-	Analog input common	Differential input if not connected to ground; allows ±20V differential mode voltage to GND
6	$24V_{out}$	24V control voltage (bi-directional)	±15%, 250 mA (all boards total); 150 mA (max. current from single board); short circuit protected; Can be used as external power backup for the control (and fieldbus); Galvanically connected to terminal #12
7	GND	I/O ground	Ground for reference and controls; Galvanically connected to terminals #13, 19
8	DIN1	Digital input 1 (Dig.IN:**A.1**)	R_i = min. 5 kΩ
9	DIN2	Digital input 2 (Dig.IN:**A.2**)	R_i = min. 5 kΩ
10	DIN3	Digital input 3 (Dig.IN:**A.3**)	R_i = min. 5 kΩ
11	CMA	Digital input common A for DIN1, DIN2 and DIN3	Must be connected to GND or 24V of I/O terminal or to external 24V or GND. Default connect to GND. Select with jumper block X3. (**Figure C-5**)
12	$24V_{out}$	24V control voltage (bi-directional)	Same as terminal #6; Galvanically connected to terminal #6
13	GND	I/O ground	Same as terminal #7; Galvanically connected to terminals #7 & 19
14	DIN4	Digital input 4 (Dig.IN:**A.4**)	R_i = min. 5 kΩ
15	DIN5	Digital input 5 (Dig.IN:**A.5**)	R_i = min. 5 kΩ
16	DIN6	Digital input 6 (Dig.IN:**A.6**)	R_i = min. 5 kΩ
17	CMB	Digital input common B for DIN4, DIN5 and DIN6	Must be connected to GND or 24V of I/O terminal or external 24V or GND. Default connect to GND. Select with jumper block X3. (**Figure C-5**)
18	A01+	Analog signal (+output) (An.OUT:**A.1**)	Output signal range: Current: 0(4) – 20 mA, R_L max. 500Ω or Voltage: 0 – 10V, R_L >1 kΩ – default Selection with jumper block X6. (**Figure C-5**) Resolution: 0.1% (10 bits); Accuracy ±2%
19	A01-	Analog output common	Galvanically connected to terminals #7, 13
20	DO1	Digital output 1 (Dig.OUT:**A.1**)	Open collector, maximum current = 50 mA, maximum voltage = 48V DC

Table C-2: Option Board A9 Parameters

Number	Parameter	Min.	Max.	Default	Note
1	AI1 mode	1	5	3	1 = 0 – 20 mA 2 = 4 – 20 mA 3 = 0 – 10V 4 = 2 – 10V 5 = -10 – +10V
2	AI2 mode	1	5	1	1 = 0 – 20 mA 2 = 4 – 20 mA 3 = 0 – 10V 4 = 2 – 10V 5 = -10 – +10V
3	AO1 mode	1	4	1	1 = 0 – 20 mA 2 = 4 – 20 mA 3 = 0 – 10V 4 = 2 – 10V

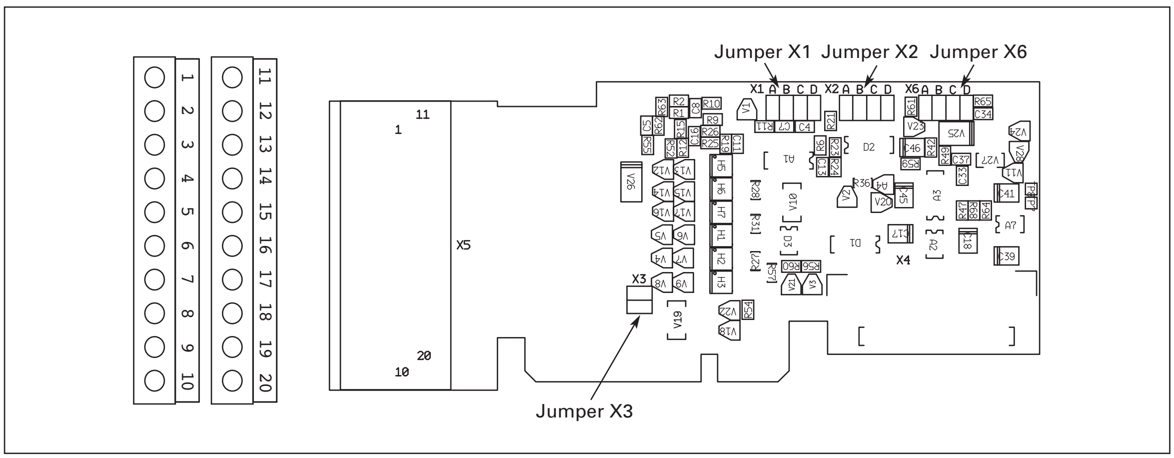


Figure C-4: Option Board A9 Terminal Locations

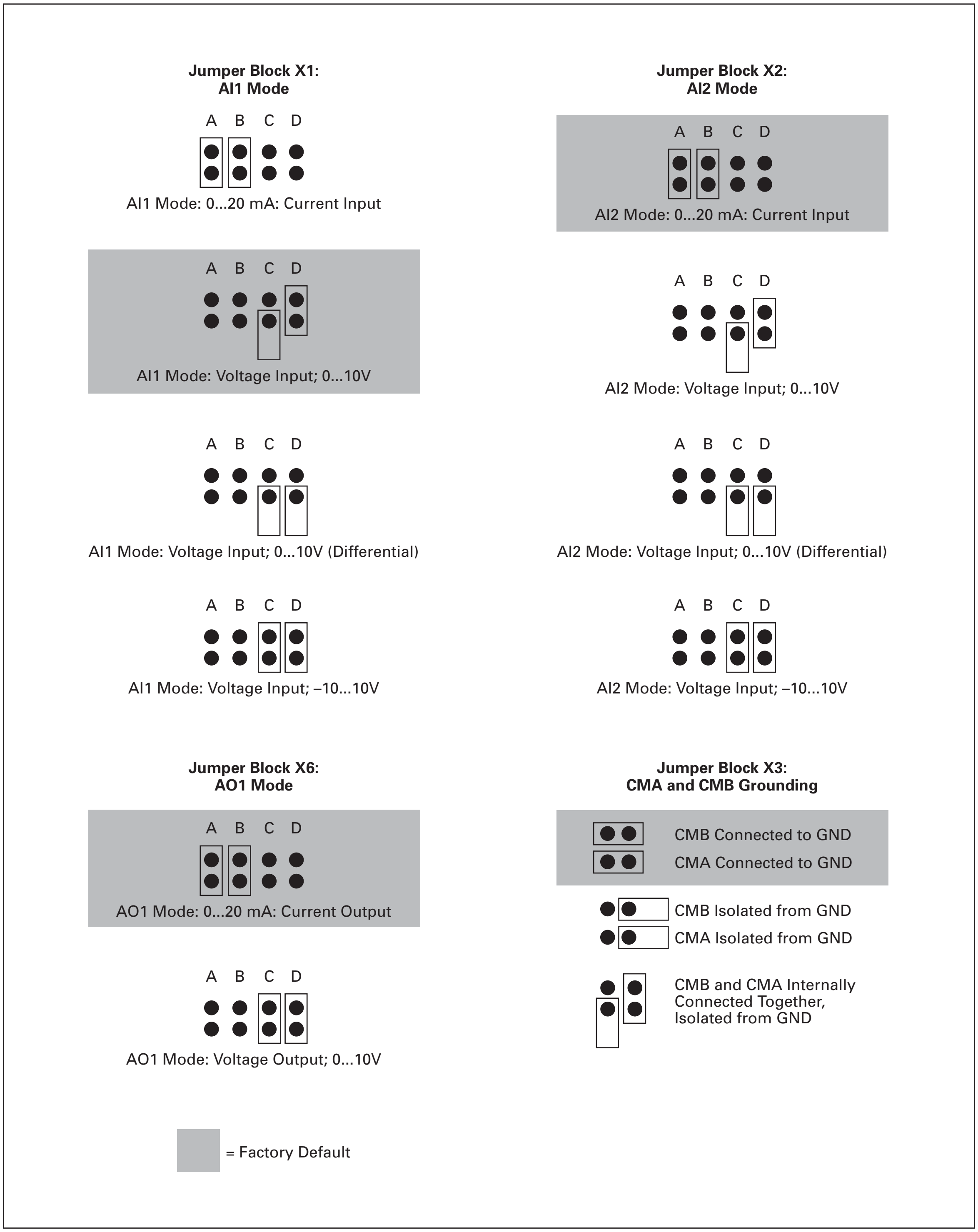


Figure C-5: Option Board A9 Jumper Locations and Settings

Option Board A2

OPTA2

Description: Standard relay board with two relay outputs
Allowed slots: B
Type ID: 16690
Terminals: Two terminal blocks; Screw terminals (M3) (see **Figure C-7**)
Keying: None
Jumpers: None
Board parameters: None

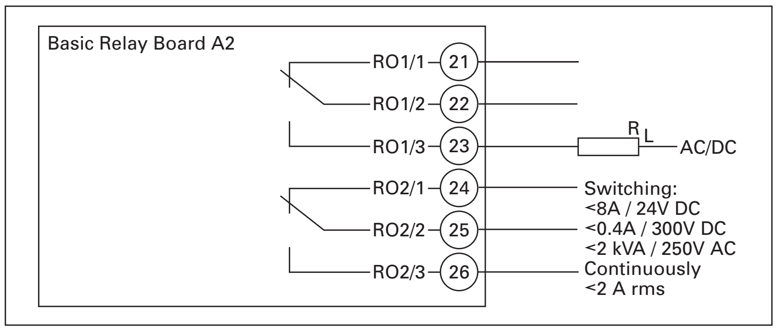


Figure C-6: Option Board A2 Wiring Diagram

Table C-3: Option Board A2 Terminal Descriptions

Terminal	Signal	Keypad Parameter Reference	Technical Information
21	RO1/1 Normally Closed (NC)	DigOUT:**B.1**	Switching capacity: 24V DC/8A 250V AC/8A 125V DC/0.4A Min. switching load: 5V/10 mA Continuous capacity: < 2A rms
22	RO1/2 Common		
23	RO1/3 Normally Open (NO)		
24	RO2/1 Normally Closed (NC)	DigOUT:**B.2**	Switching capacity: 24V DC/8A 250V AC/8A 125V DC/0.4A Min. switching load: 5V/10 mA Continuous capacity: < 2A rms
25	RO2/2 Common		
26	RO2/3 Normally Open (NO)		

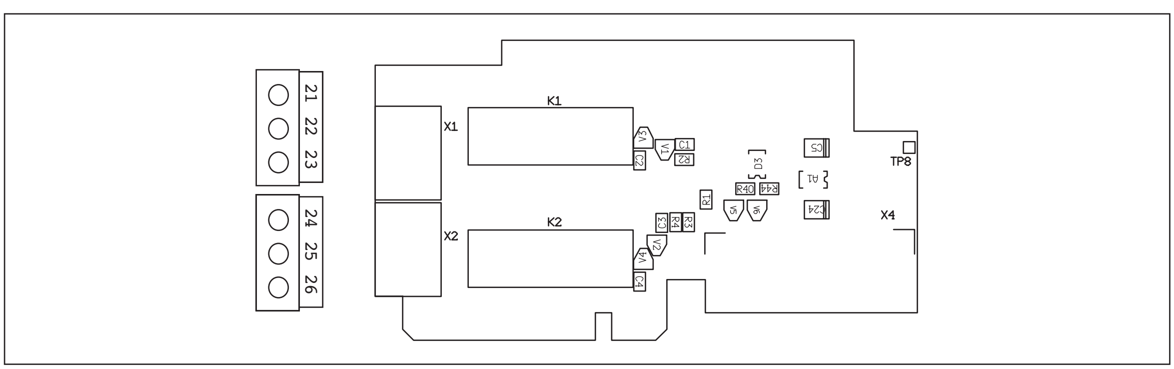


Figure C-7: Option Board A2 Terminal Locations

Option Board A4

OPTA4

Description: Encoder input board with a programmable control voltage for the encoder.

This board is for TTL type encoders (TTL, TTL(R)) providing input signal levels that meet the RS-422 interface standard. Encoder inputs A, B and Z are *not* galvanically isolated. This board also includes the qualifier input ENC1Q (meant to trace the Z-pulse in certain situations) and a special/fast digital input DIC4 (used to trace very short pulses). These two inputs are used in special applications.

TTL type encoders do not have an internal regulator and must use a supply voltage of +5V±5%, whereas the TTL(R) type encoders have an internal regulator and can have a supply voltage of +15V±10% (depending on the encoder manufacturer).

Allowed slots: C
Type ID: 16692
Terminals: One terminal block; Screw terminals (M2.6) (see **Figure C-9**)
Keying: Terminal #3
Jumpers: 1; X4 (see **Figure C-8**)
Board parameters: Yes (see **Table C-6**)

Table C-4: Option Board A4 Terminal Descriptions

Terminal		Description and Parameter Reference
1	DIC1A+	Pulse input A
2	DIC1A-	
3	DIC2B+	Pulse input B; phase shift of 90 degrees as compared to pulse input A
4	DIC2B-	
5	DIC3Z+	Pulse input Z; one pulse per revolution
6	DIC3Z-	
7	ENC1Q	Reserved for future use
8	DIC4	Reserved for future use
9	GND	Ground for control and inputs ENC1Q and DIC4
10	+5V/+15V/ +24V	Control voltage (auxiliary voltage) output to encoder; Output voltage selectable with jumper X4

Table C-5: Option Board A4 Technical Data

Function	Technical Information
Encoder control voltage, +5V/+15V/+24V	Control voltage selectable with jumper X4
Encoder input connections Inputs A+, A-, B+, B-, Z+, Z-	Maximum input frequency ≤ 300 kHz Inputs A, B and Z are differential Encoder inputs are RS-422 interface compatible Maximum load per encoder input $I_{low} = I_{high} \approx 25$ mA
Qualifier input ENC1Q	Maximum input frequency ≤ 10 kHz Minimum pulse length 50 μS Digital input 24V; R_i >5 kΩ Digital input is single ended, connected to GND
Fast digital input DIC1	

Jumper Selections

There is one jumper block on the OPTA4 board. Jumper block **X4** is used to program the control (auxiliary) voltage. **Figure C-8** shows the jumper selections and the default position.

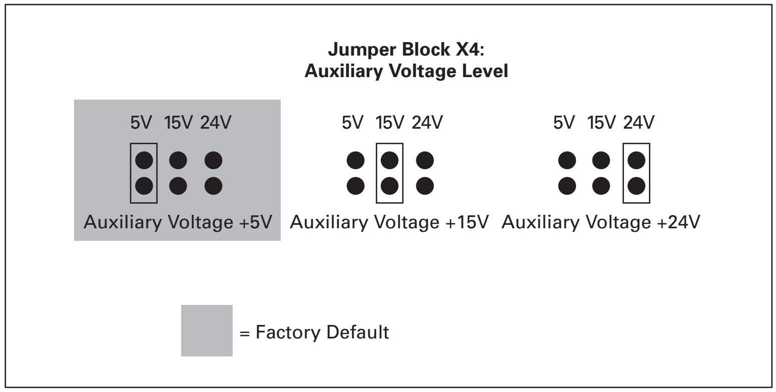


Figure C-8: Jumper Positions for Option Board A4

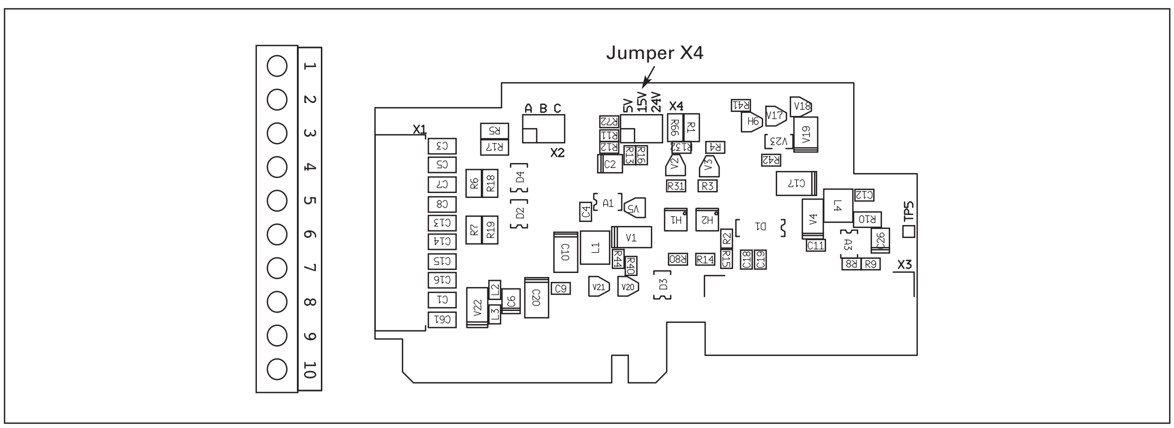


Figure C-9: Option Board A4 Terminal and Jumper Locations

Encoder Connection — Differential Inputs

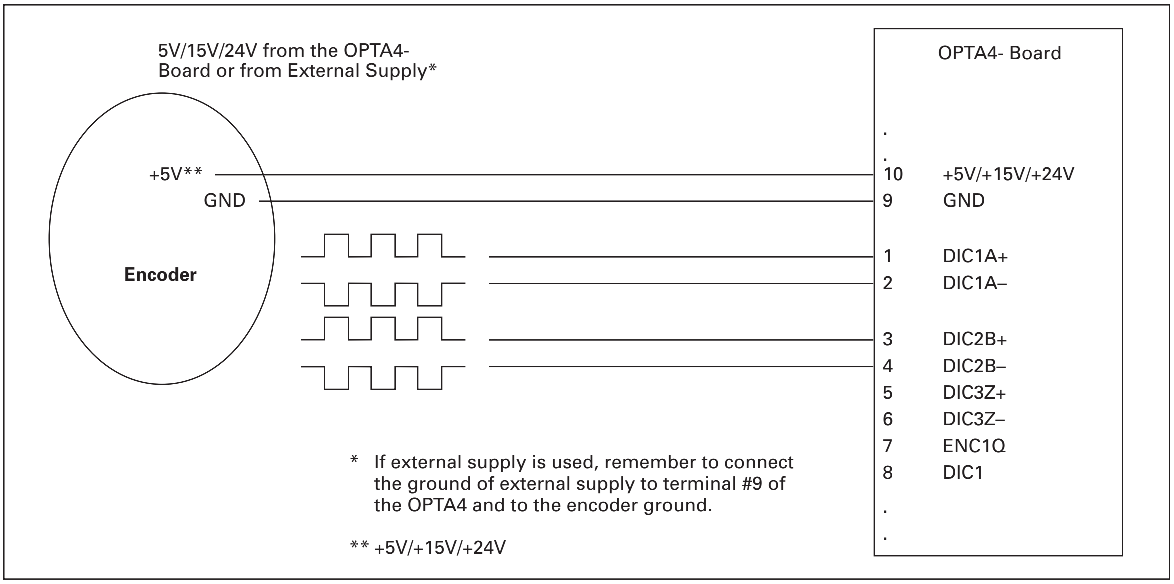


Figure C-10: Option Board A4 Encoder Connection Using Differential Inputs

Note: The encoder pulses are processed by the 9000X Series Drive as indicated in **Figure C-11.**

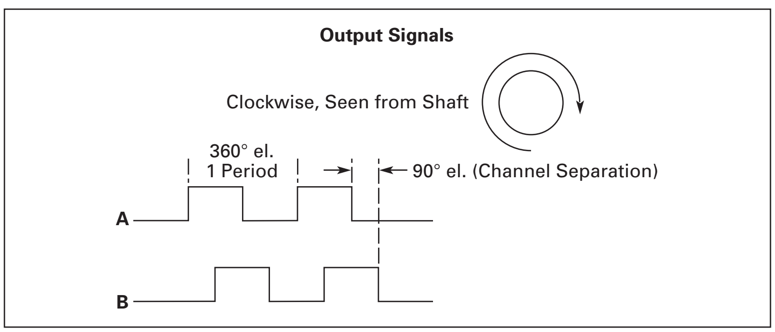


Figure C-11: Option Board A4 Encoder

Table C-6: Option Board A4 Parameters

Parameter	Minimum	Maximum	Default	Note
Pulse/revolution	1	65535	1024	
Invert direction	0	1	0	0 = Yes 1= No
Reading rate ①	0	4	1	0 = No 1 = 1 mS 2 = 5 mS 3 = 10 mS 4 = 50 mS

① Time used to calculate the actual value of speed. Use the value 1 when in Closed Loop mode.

Option Board B9

OPTB9

Description: I/O board with five 42 – 240V AC digital inputs and one relay output.
Allowed slots: B, C, D, E
Type ID: 16953
Terminals: One terminal block; Screw terminals (M2.6) (see **Figure C-13**)
Keying: None
Jumpers: None
Board parameters: None

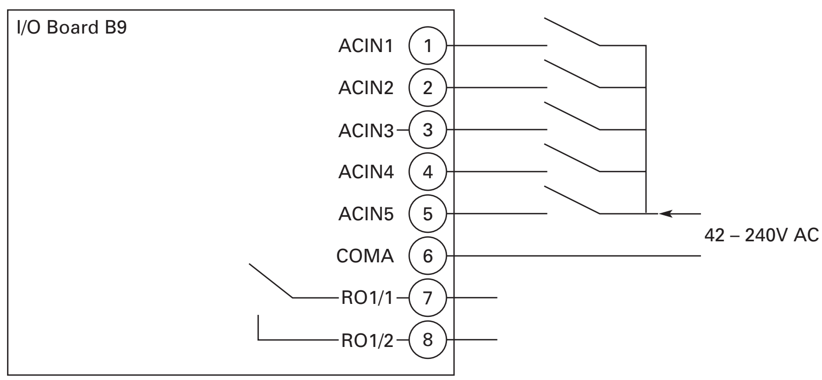


Figure C-12: Option Board B9 Wiring Diagram

Table C-7: Option Board B9 I/O Terminals

Terminal	Function	Keypad Parameter Reference	Technical Information
1	ACIN1	DigIN: **X1**	Digital input, 42 – 240V AC (threshold 35V) Control voltage: "0"<33V, "1">35V
2	ACIN2	DigIN: **X2**	Digital input, 42 – 240V AC (threshold 35V) Control voltage: "0"<33V, "1">35V
3	ACIN3	DigIN: **X3**	Digital input, 42 – 240V AC (threshold 35V) Control voltage: "0"<33V, "1">35V
4	ACIN4	DigIN: **X4**	Digital input, 42 – 240V AC (threshold 35V) Control voltage: "0"<33V, "1">35V
5	ACIN5	DigIN: **X5**	Digital input, 42 – 240V AC (threshold 35V) Control voltage: "0"<33V, "1">35V
6	COMA		Digital input X1, X2, X3, X4, X5 common
7	RO1 Common	DigOUT: **X1**	Switching capacity: 24V DC/8A 250V AC/8A 125V DC/0.4A Min. switching load: 5V/10 mA Continuous capacity: < 2A rms
8	RO1 Normally Open		

Note: This board can be installed in four different slots. The "**X**" in the Keypad Parameter Reference shall be replaced by the slot letter (B, C, D, or E) of the slot in which it is installed. See "Defining Functions to Inputs and Outputs" on **Page C-1**.

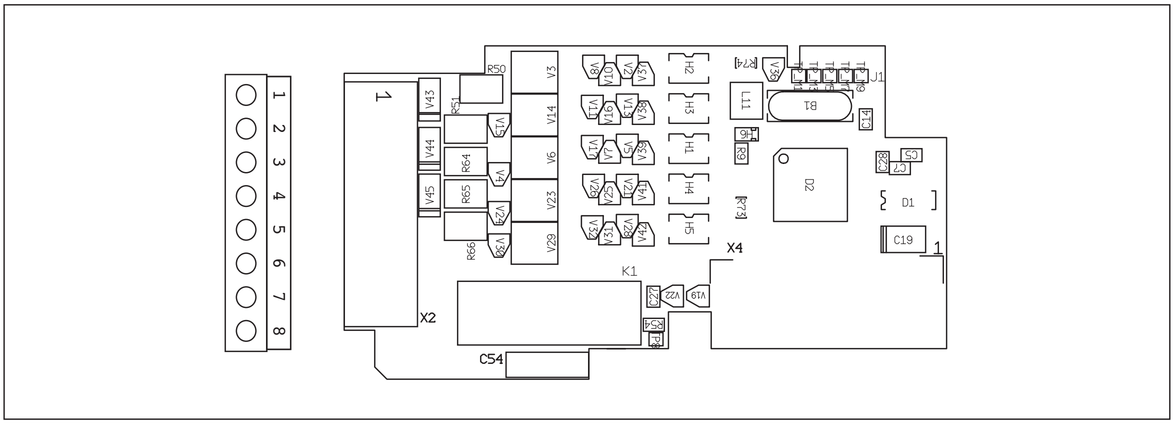


Figure C-13: Option Board B9 Terminal Locations

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Eaton Electrical Inc.
1000 Cherrington Parkway
Moon Township, PA 15108-4312
USA
tel: 1-800-525-2000
www.EatonElectrical.com

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