ACCel500
OPEN LOOP CRANE
APPLICATION SOFTWARE

Part Number 695135.V10

Cleveland, Ohio

October 17, 2008

AVTRON INDUSTRIAL AUTOMATION, INC.
Cleveland, Ohio

ACCEL500
OPEN LOOP CRANE SOFTWARE
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AVTRON ACCEL500
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SECTION I

INTRODUCTION AND GENERAL INFORMATION

The ACCel500 Open Loop Crane software is used for control of bridge, trolley and open loop hoist sections. The software is designed to go into the AC Microdrive (ACM) family of ACCel500 AF drives.

Following is a list of the major software features.

Communications options:

- Ethernet (Modbus)
- Devicenet
- Profibus DP
- Modbus

Reference location options:

- Fixed value
- Joystick
- Infinite variable

Speed reference features:

- Up to four fixed speeds
- Fwd/Rev slow downs
- Load float
- Extended speed range
- Fast stop rates

Crane features:

- End stop inputs
- Brake set and release logic
- Extended speed range
- Running and over weight counters

Additional Crane Protection features:

- Fwd/Rev end stop inputs
- Brake feedback
- Contactor feedback
- Run off
- Overspeed / Tach loss
- Auto reset
- Watchdog
- Under load
- Stall

Firmware Options enabled:

- Identification (Motor and torque loop tuning)
- Motor control
  - Volt/Hertz
  - Open loop vector
- Extended speed range to 320 Hz
- Fault FIFO
- Signal analyzer with trigger

IMPORTANT:

Configuration information in this manual is provided to assist users in designing their own operational/functional schemes. It is deemed to be correct, however, if any errors or omissions exist, Avtron and/or Avtron representatives will not be liable to provide "warranty" on-site support. If one is designing his own configuration, or using one of the examples, it is highly recommended to test the operation prior to putting the drive into production.

SECTION II

SELECTING THE CONTROL MODE

The drive can be commanded to run from three distinct locations:

- Remote (from I/O or communications)
- Local drive keypad
- Computer diagnostic software

Most crane functions only work in the Remote mode. Local and computer modes are used for check out and troubleshooting.

The drive out of the box is defaulted to the remote mode. When the mode is changed, it is stored even through power failure (retentive).

Crane features while not in Local mode:

- Forward / Reverse End Stops still active
- Slow down is active but slows speed in both directions
- Extended speed range disabled.

2-1 REMOTE OPERATION

To transfer to remote operation, set *Remote Control* parameter in the keypad menu to 1. The display should have the message "Bus/Comm" displayed.

Control Place = 0 in this mode.

2-2 LOCAL DRIVE KEYPAD

To transfer to local operation, set *Remote Control* parameter in the keypad menu to 0. The display should have the message "Keypad" displayed.

The **start/stop** buttons will now work and the drive will run at the entered keypad reference setpoint.

Set the keypad control parameters Keypad Speed Direction and Keypad Speed Reference using menu M3 (Keypad Control).

If keypad communications goes down while in the local mode, the drive will fault (Keypad Comm).

Control Place = 1 in this mode.

2-3 PC CONTROL (COMPUTER DIAGNOSTIC SOFTWARE ADDaptACC)

The drive must be off before the PC Control check box from the diagnostic software is checked to go into computer control. If the box is checked while running, control will not be transferred until the run is removed and the box is re-checked.

If computer communications goes down while in PC control, the drive will fault (Keypad Comm). When the fault is reset, control will revert to the previous control mode (local or remote).

Once in computer control, the drive can be started/stopped by the control buttons from ADDaptACC.

Control Place = 2 in this mode.

SECTION III

KEYPAD AND PARAMETER DESCRIPTIONS

3-1 ACCel500 KEYPAD OPERATION

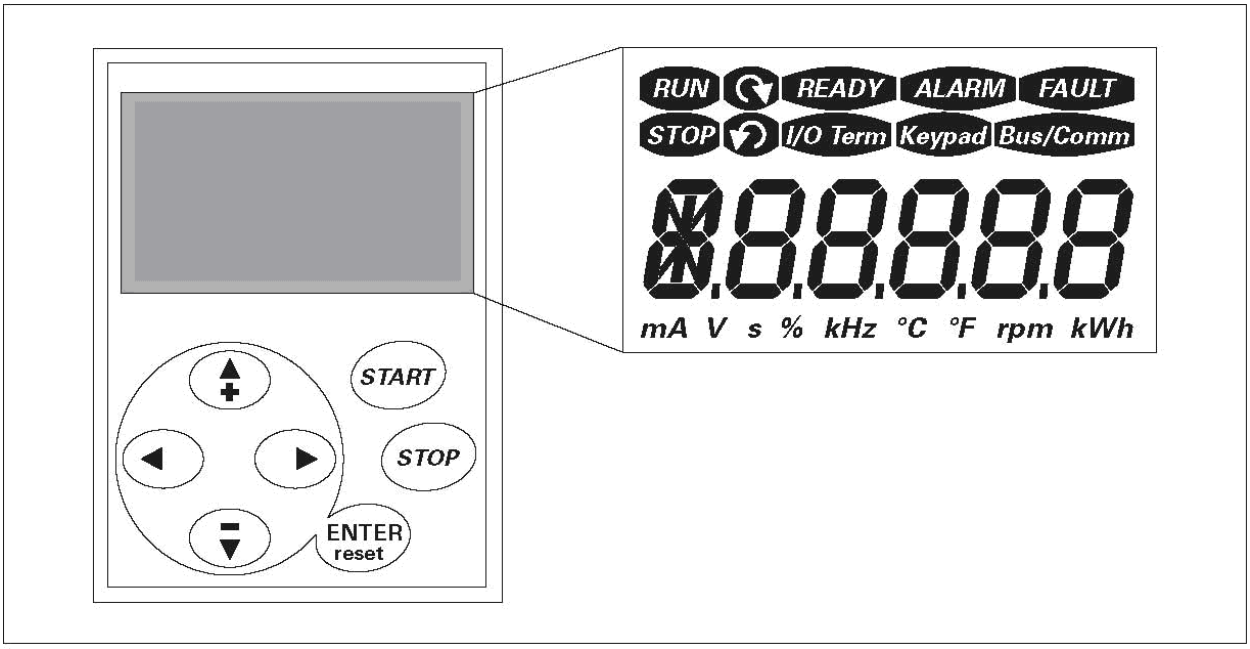


Figure 3-1. Keypad and Display

TABLE 3-1. NAVIGATION BUTTONS

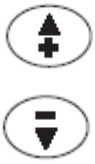
Button	Description
	**ENTER reset** There are two operations integrated in this button. The button operates mainly as RESET button except in the parameter edit mode. The button operation is shortly described below. The ENTER button serves for: 1. confirmation of selections 2. fault history reset (2 – 3 seconds) RESET is used to reset active faults. **Note:** The motor may start immediately after resetting the faults
	**Up and Down Arrows** • move either up or down a menu list to select the desired menu item. • edit values
	**Left Arrow** • Move backward in menu. • Move cursor left (in parameter menu). • Exit edit mode. • Press for 2 to 3 seconds to return to main menu.
	**Right Arrow** • Move forward in menu. • Move cursor right (in parameter menu). • Enter edit mode.
	**START** This button operates as the START button for normal operation when “Keypad” is selected as the active control.
	**STOP** This button has two integrated operations. The button operates as STOP button during normal (local) operation … • motor STOP from the keypad Note that if the STOP button is depressed for 3 seconds, a Stop Fault will occur in any control mode.

TABLE 3-2. LCD STATUS INDICATORS

Indicator	Description
RUN	**Run** Indicates that the ACCel500 is running and controlling the load. Blinks when a stop command has been given but the ACCel500 is still ramping down.
	Indicates the direction of motor rotation.
STOP	**Stop** Indicates that the ACCel500 is stopped and not controlling the load.
READY	**Ready** Indicates that the ACCel500 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 Term** I/O terminals are selected as the control place, i.e., START/STOP commands or reference values etc. are given through the I/O terminals.
Keypad	**Keypad** Control keypad is selected as the control place, i.e., the motor can be started or stopped, or its reference values, etc., altered from the keypad.
Bus/comm	**Bus/Comm** The drive is controlled through a fieldbus.

3-2 MENU NAVIGATION

The data on the control keypad are arranged in menus and submenus. The menus are used for the display and editing of measurement and control signals, parameter settings, reference values, and fault displays.

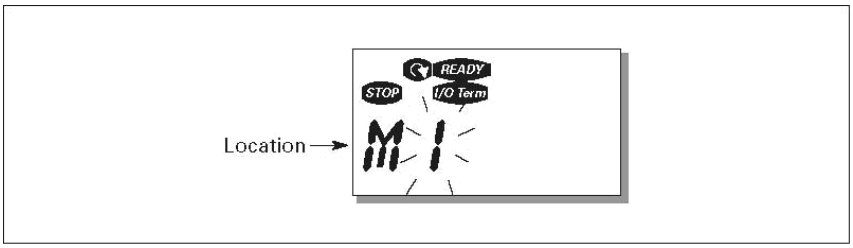


Figure 3-2. Keypad Display Data

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

The control keypad navigation chart is shown in Figure 3-3. Please note that menu M1 is located in the lower left corner. From there you will be able to navigate your way up to the desired menu using the menu and browser buttons.

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

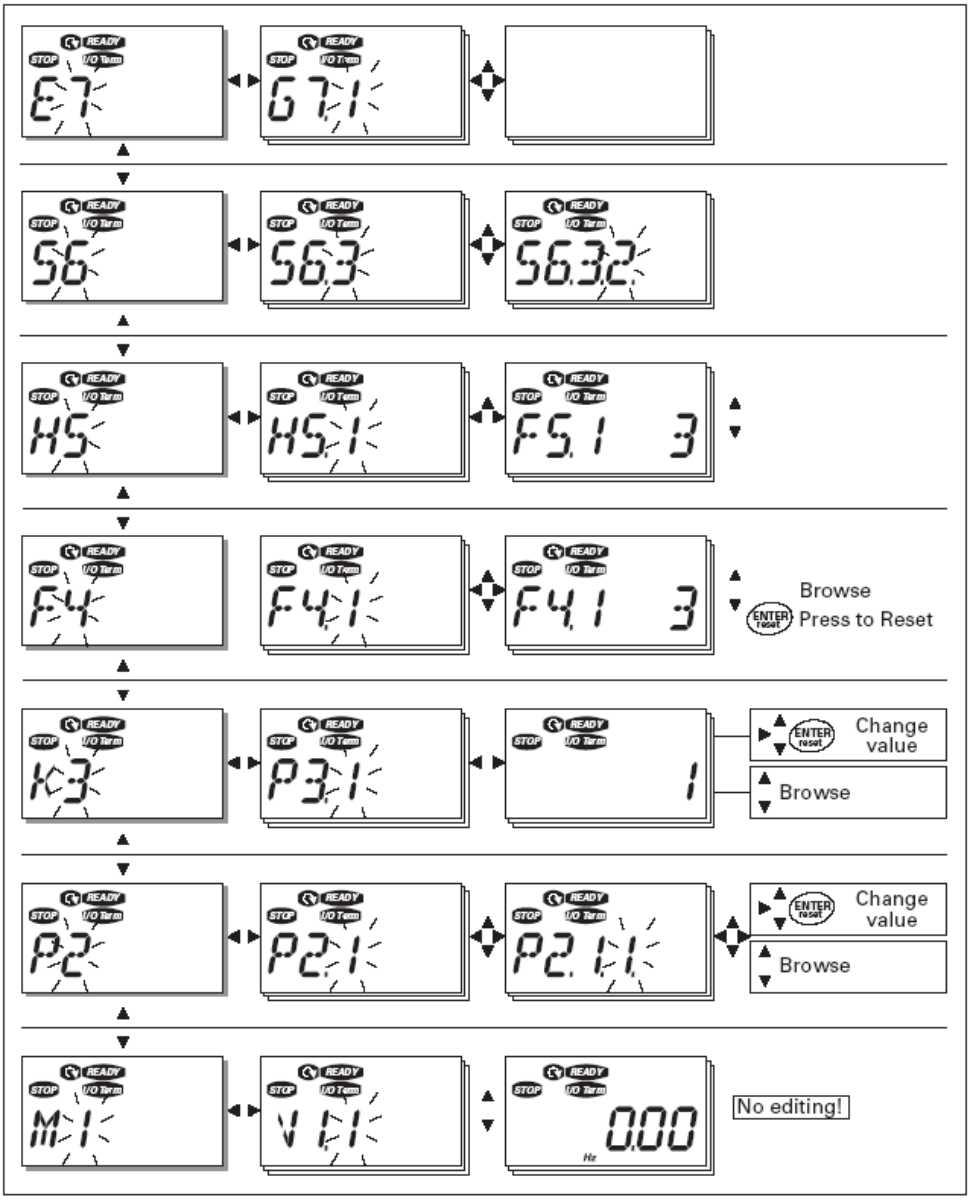


Figure 3-3. Keypad Navigation Chart

3-2.1 MAIN MENU

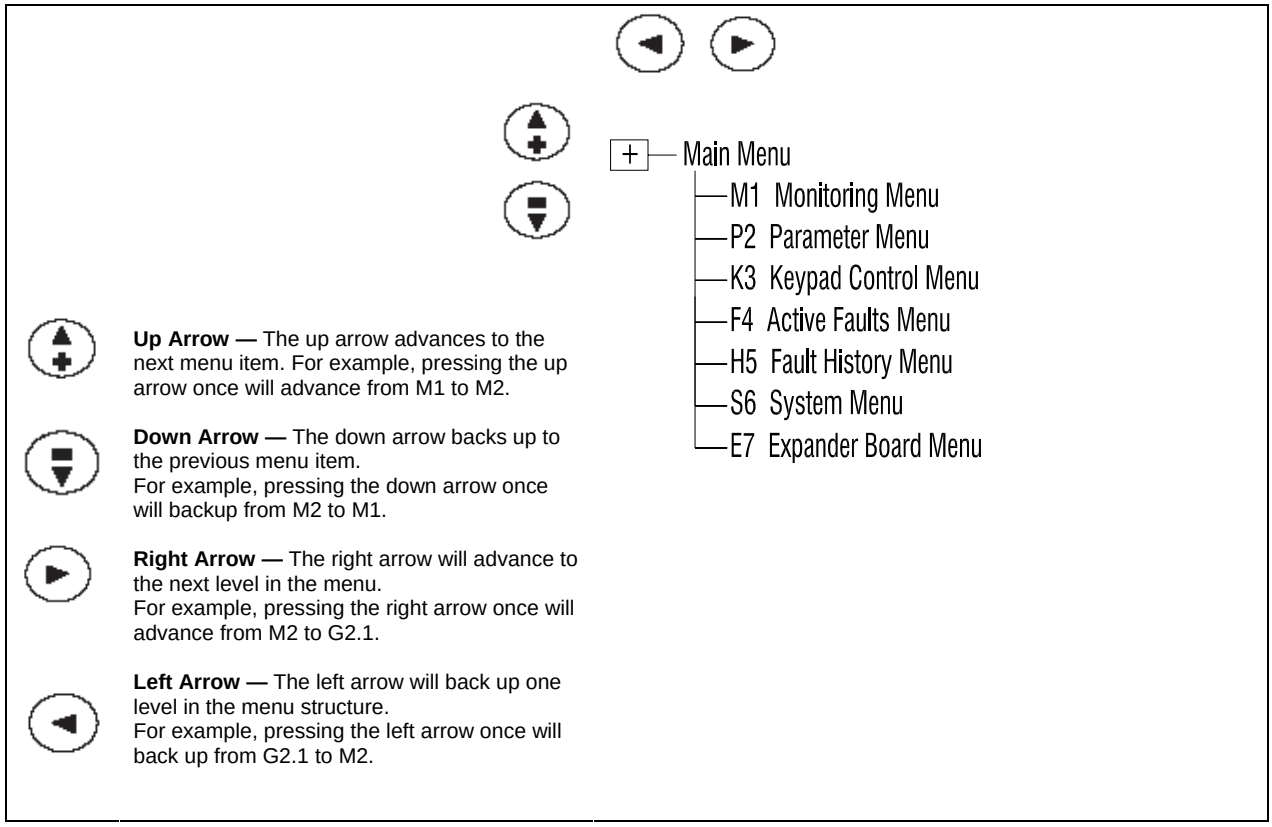


Figure 3-4. Main Menu Navigation

3-2.2 MONITOR MENU (M1)

You can enter the Monitoring menu from the Main menu by pressing the Right Arrow button when the location indication M1 is visible on the display. Figure 3-5 shows how to browse through the monitored values.

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

This menu is for signal checking. The values cannot be changed. To change values of the parameters, see section 3.2.3, Parameter Menu.

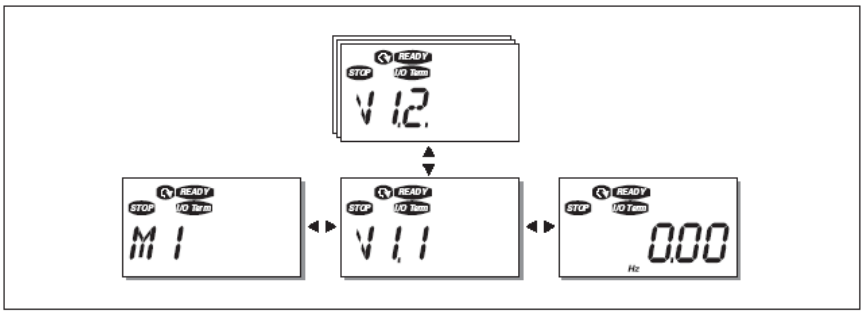


Figure 3-5. Accessing the Monitor Menu

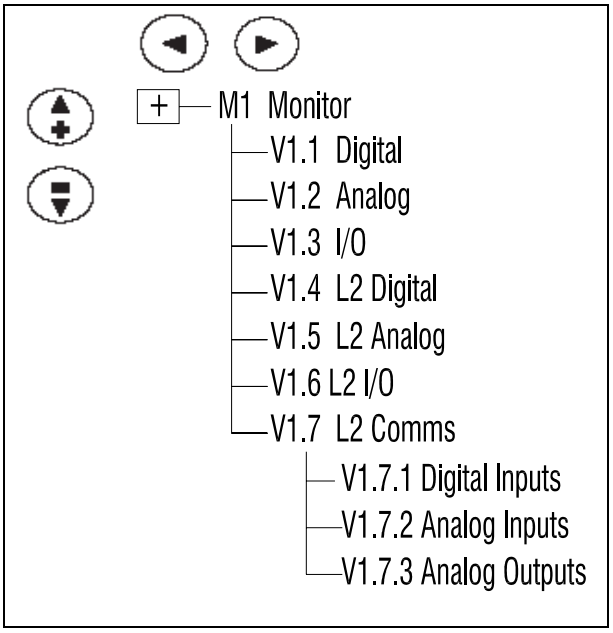


Figure 3-6. Monitor Menu Structure Example

3-2.3 PARAMETER MENU (P2)

Parameter values can be edited by entering the Parameter Menu (see Figure 3-7) from the Main Menu when the location indication P2 is visible on the display. The value editing procedure is presented in Figure 3-8.

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

- Set the desired value with the Browser buttons and confirm the change with the ENTER button. Consequently, the blinking stops and the new value is visible in the value field.

- Press the Right Arrow button once more. Now you will be able to edit the value digit by digit. This may come in handy, when a relatively greater or smaller value than that on the display is desired. Confirm the change with the ENTER button.

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

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

The parameter values can also be locked using the function in menu S6. You can return to the Main Menu any time by pressing the Left Arrow button for 1 to 2 seconds. You will find the complete parameter lists and descriptions in Appendix B.

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

Once in the last parameter of a parameter group, you can move directly to the first parameter of that group by pressing UP arrow button. See the diagram for parameter value change procedure in Figure 3-8.

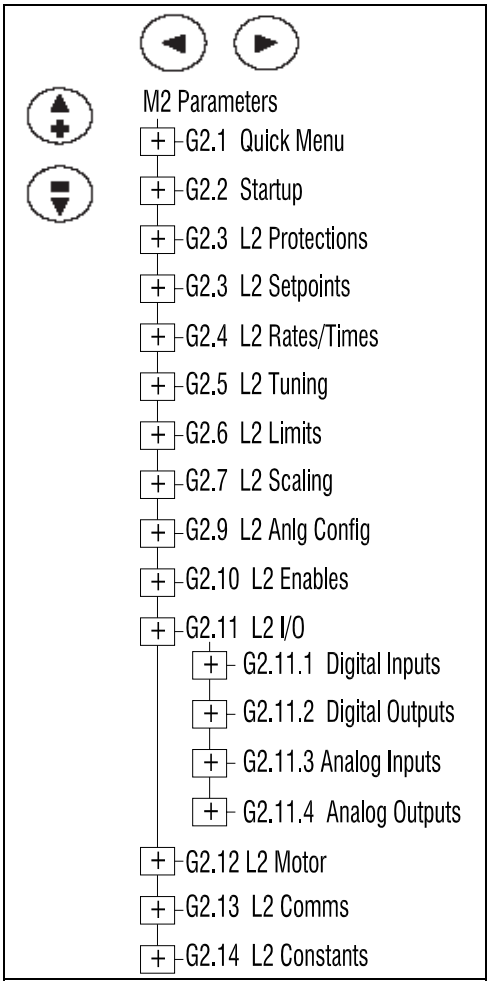


Figure 3-7. Parameter Menu

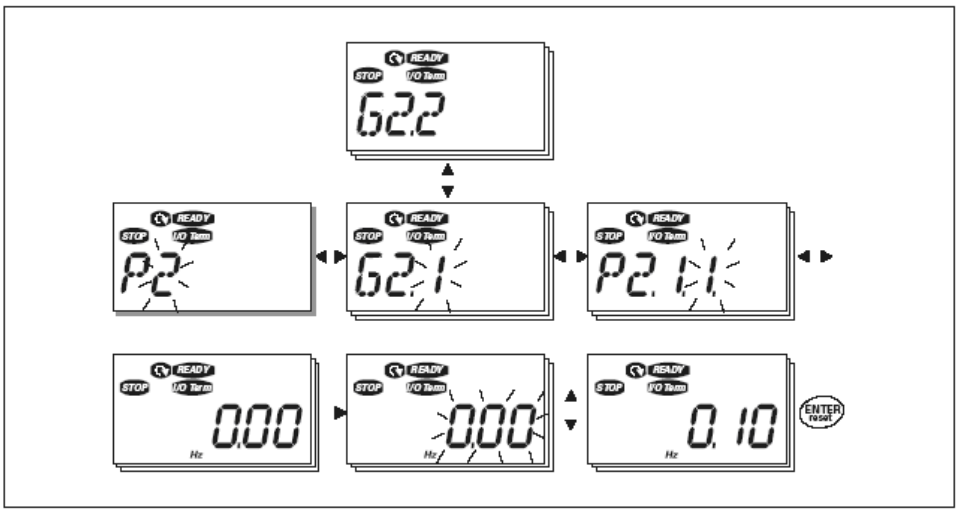


Figure 3-8. Parameter Value Change Procedure

3-2.4 KEYPAD CONTROL MENU (K3)

In the Keypad Control Menu, you can choose the control place, edit the frequency reference, and change the direction of the motor. You can enter the submenu level by pressing the Right Arrow button. See Figure 3-9.

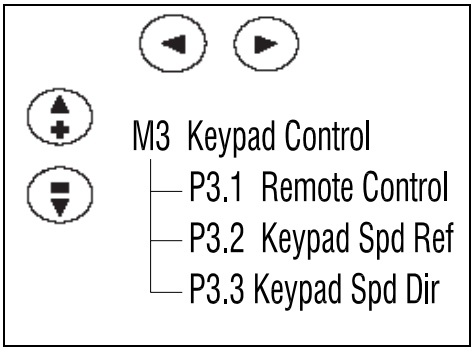


Figure 3-9. Keypad Control Menu

P3.1 Remote Control Changes between I/O terminal control and keypad control

P3.2 Keypad_Spd_ref Range: 0.00 to 60.00
Units: Hertz (Hz)

P3.3 Keypad Spd Dir Range: Forward, Reverse

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.

3-2.5 ACTIVE FAULTS MENU (F4)

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

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

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

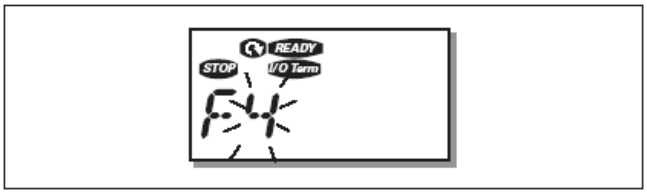


Figure 3-10. Normal State, No Faults

Fault Types

The drive has two types of faults. These types differ from each other on the basis of the subsequent behavior of the drive. Fault codes are listed in Section 10.

A (Alarm) This type of fault is a sign of an unusual operating condition. It does not cause the drive to stop, nor does it require any special actions. The "A fault" remains in the display for about 30 seconds.

F (Fault) An "F fault" makes the drive stop. Actions need to be taken to restart the drive.

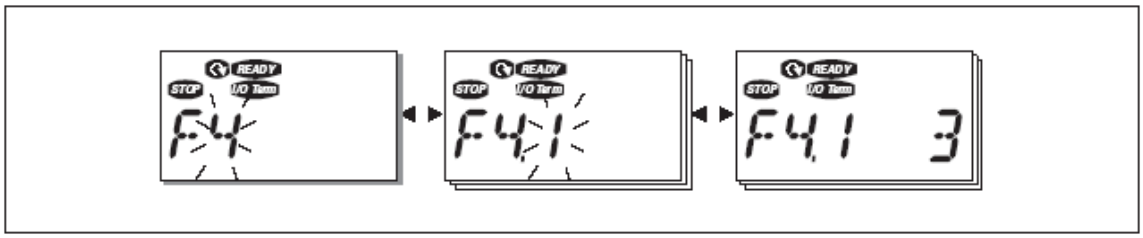


Figure 3-11. Active Fault Display Example

3-2.6 FAULT HISTORY MENU (H5)

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

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

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

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

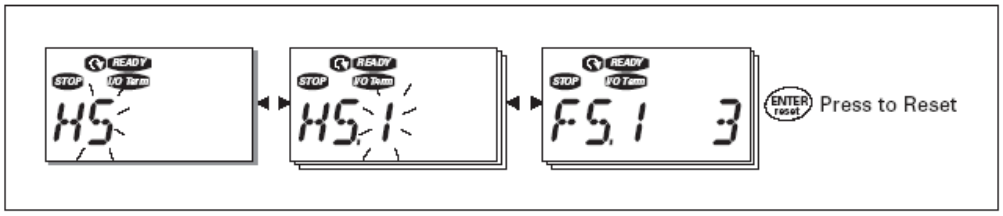


Figure 3-12. Fault History Display Example

3-2.7 SYSTEM MENU (S6)

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

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

System Menu Parameters

Copy Parameter Options (S6.3)

This allows the store or load of two separate parameter sets. Loading of the factory defaults are also sleected here.

S6.3.1 Parameter Sets	0 = Select 1 = Store set 1 2 = Load set 1 3 = Store set 2 4 = Load set 3 5 = Load defaults 6 = Fault 7 = Wait 8 = OK

Security Parameter Options (S6.5)

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

P6.5.2 Parameter Lock Range: ChangeEnable, ChangeDisabl Default: ChangeDisabl

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.

This function does not prevent unauthorized editing of parameter values.

Keypad Settings (S6.6)

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

P5.6.1 Default page Default: 0

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.

P5.6.3 Range: 0 – 65535 Default: 30
Timeout time Units: Seconds
The Timeout Time setting defines the time after which the keypad display returns to the Default Page. If the Default Page value is 0, the Timeout Time setting has no effect.

Hardware Settings (S6.7)

The Hardware Settings submenu (S6.7) provides parameters for setting information on Internal brake resistor connection, Fan control, Keypad acknowledge timeout and Keypad retries.

P6.7.2 Range: Continuous, Temperature Default: Continuous
Fan Control This function sets the control method of the ACCel500 drive'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 _eatsink temperature reaches 60°C. The fan receives a stop command when the _eatsink 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".

The fan runs continuously, regardless of this setting, when the ACCel500 drive is in RUN state.

P6.7.3 Range: 200 – 5,000 Default: 200
HMI ACK Keypad Units: ms
timeout This function allows the user to change the timeout of the Keypad acknowledgement time.

If the ACCel500 drive 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 ACCel500 drive 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 ACCel500 drive 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 ACCELDRIVE.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 ACCel500 drive monitoring.

P6.7.4 Range: 1 – 10 Default: 5
HMI retry With this parameter, you can set the number of times the drive will try to receive an acknowledgement when it has not been received within the acknowledgement time (Keypad Acknowledge Timeout) or if the received acknowledgement is faulty.

System Information (S6.8)

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

S6.8.1
Total Counters

In the Total Counters page you will find information related to the ACCel500 operating times, i.e., the total numbers of MWh, operating days, and operating hours. See Table 3-6.

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

The Power On time counters, days and hours, operate whenever power is applied to the ACCel500 drive.

TABLE 3-6. TOTAL COUNTERS

Number	Name	Description
C6.8.1.1	MWh counter	Megawatt hours total operation time counter
C6.8.1.2	On Day counter	Number of days the ACCel500 drive has been supplied with power
C6.8.1.3	PWOn hour count.	Number of hours the ACCel500 drive has been supplied with power

S6.8.2
Trip counters

The Trip Counters are counters whose values can be reset to zero. The resettable counters are shown in Table 3-7.

TABLE 3-7. 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 ACCel500 drive has been run since the last reset
T5.8.2.4	Power On hour counter	Number of hours the ACCel500 drive 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.

S6.8.3
Software

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

TABLE 3-8. SOFTWARE INFORMATION

Number	Name	Description
I6.8.3.1	Software package	695135
I6.8.3.2	System Sw version	1556
I6.8.3.3	Firmware interf.	1.24
I6.8.3.4	System load	Laod percentage

S6.8.4 Applications

The Application information page includes information on not only the application currently in use but also all other applications loaded into the ACCel500. The information available is shown in Table 3-9. Note that the "x" in the table refers to the sequential number of the application in the list.

TABLE 3-9. APPLICATIONS INFORMATION

Number	Content
A6.8.4.x	Not visible from keypad
D6.8.4.x.1	Application ID
D6.8.4.x.2	Version
D6.8.4.x.3	Firmware interface

S6.8.5 Hardware

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

TABLE 3-10. HARDWARE INFORMATION

Number	Content
I6.8.5.2	Nominal voltage of the unit
I6.8.5.3	Brake chopper

S6.8.6 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 3-11. 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 3-11. EXPANDER BOARD INFORMATION

Number	Content
E6.8.6.x	Slot "x" board identification
E6.8.6.x.1	Operating state
E6.8.6.x.2	Software version

Analog in mode (S6.9)

This menu shows the actual filtered current in amps.

TABLE 3-12. POWER MONITOR INFORMATION

Number	Content
C6.9.1	Analog input 1 0 = Voltage 1 - Current
C6.9.2	Analog input 2 0 = Voltage 1 - Current

Fieldbus (S6.10)

This menu shows the actual filtered current in amps.

TABLE 3-12. POWER MONITOR INFORMATION

Number	Content
C6.10.1	Communication status
C6.10.2	Field bus protocol. 0 = Not used. 1 = Modbus
C6.10.3	Slave address 1 – 255
C6.10.4	Baud rate 0 = 300 baud 1 = 600 baud 2 = 1200 baud 3 = 2400 baud 4 = 4800 0baud 5 = 9600 baud 6 = 19200 baud 7 = 38400 baud 8 = 57600 baud
C6.10.5	Stop bits 0 = 1 1 = 2
C6.10.6	Parity 0 = None 1 = Odd 2 = Even
C6.10.7	Timeout 0 = Not used 1 + number of seconds.

3-2.8 EXPANDER BOARD MENU (E7)

The Expander Board Menu makes it possible for the user:

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

Each option board has its own set of parameters.

3-2.9 EDITING A NUMERIC VALUE

Use the following procedure to edit numeric parameter values.

1. To edit a parameter, navigate to show that parameter and its value.

2. Press the right arrow button to enter the edit mode. In edit mode, the parameter value will flash.

3. Pressing the up or down arrow keys to change the parameter value.

   If you press the right arrow a second time, the leftmost digit of the parameter value will flash. You can then use the up or down arrow keys to change the value of the flashing digit.

   Press the right arrow again to select the next digit, and repeat the process to change the rest of the digits in the parameter value.

4. When you are finished, you must press the **enter** button to confirm the parameter change. **The new value will not be saved unless the enter button is pushed.**

3-2.10 KEYPAD REMOVAL WHILE DRIVE IS RUNNING

If the keypad is removed while the drive is running, a Keypad Comm fault (52) will result. The drive will also be placed in remote control mode. Clear the Keypad Comm fault by pressing the **reset** button. To restore local keypad control, press the **loc/rem** button.

3-2.11 STOP FAULT

The Keypad **stop** button will fault the drive and operate as a coast stop if held for three seconds, regardless which mode is active.

SECTION IV

I/O PARAMETER DESCRIPTIONS

4-1 ANALOG INPUTS

Parameters	**Type**	**Default**
AIN1 Gain and AIN2 Gain	CAL	1.00
AIN1 Off and AIN2 Off	CAL	0.0
AIN1 Tc and AIN2 Tc	CAL	0.1 seconds
AI1 Type and AI2 Type	APB	
AIN1and AIN2	APB	

Description

Two analog inputs are available in this software. The two analog inputs are located on the main board. When Stepless (Joystick) type is selected by the startup wizard the first analog input is defaulted for the speed command.

The Type of board is read from the I/O slot and can be viewed as *AI1 Type-AI2 Type* as follows:

Mode	AI 1 – 4	Pre-scaling
0 = Unknown	0 – 10,000	0 – 10,000
1 = 0-20 ma	0 – 10,000	0 – 10,000
2 = 4-20 ma	2,500 – 10,000	0 – 10,000
3 = 0-10 V	0 – 10,000	0 – 10,000
4 = 2-10 V	2,500 – 10,000	0 – 10,000
5 = +/-10 V	0 – 10,000	-10,000 – 10,000

Scaling for the first analog input is done as follows:

Value 1 = (Pre_Scaling x *AIN1 Gain* / 100) + *AIN1 Off*

AI1 Tc is a low pass filter on the input, entered in seconds.

AIN1 is the value after scaling and filtering.

The analog inputs can be configured to the following parameters.

Parameters	**Analog In 1**	**Analog In2**
Joyst Inp	*Joyst Sel* = 2	*Joyst Sel* = 3
MotorCurrentLimit	*Cur Lim Sel* = 2	*Cur Lim Sel* = 3

* Note the first analog input can be configured for digital in 4 if needed.

4-2 ANALOG OUTPUTS

Parameters	**Type**	**Default**
AOUT1 Config and AOUT2Config	ACFG	Mtr Fil IA Motor Speed
AOUT1 Zero and *AOUT2 Zero*	CAL	0.0
AOUT1 Cal and *AOUT2 Cal*	CAL	1.00
AOUT1 TC and *AOUT2 TC*	CAL	0.10 seconds
AOUT1 Val to *AOUT2 Val*	APB	0
AOUT2 Slot ID	ACFG	

Description

Two analog outputs are available in this software. The first analog output is available on the main board. The second one requires additional I/O board to take advantage of it.

AOut1 Config and *AOUT2 Config* selects which signal to output as follows:
0 = *Mtr Fi IA*
1 = *Motor Speed*
2 = *Motor Power*
3 = *Motor Torque*
4 = *Freq Ramp Out*

The slot ID configures the location of the analog output. First digit of the ID is the slot location: Slot A-E = 1-5. Second digit is the order of the output on the board; 0 = first analog output. The first analog output is hard set to the default input board output.

After scaling, the value can be viewed as *AOUTx_Val* with a range of 0-10,000; +/-10,000 for ±10 volt boards.

The Type of board must be known for the scaling factor:

0 = Unknown
1 = 0-20 mA = 0-10,000 value
2 = 4-20 mA = 2,500 -10,000 value
3 = 0-10 V = 0-10,000 value
4 = 2-10 V = 2,500 -10,000 value
5 = +/-10 V = 0-10,000 value

Scaling for the fist analog output is done as follows:

Value 1 = (*AOUT1 ID* value + *AOUT1 Zero*) x *AOUT1 Cal* / 100

Note: 10,000 is the board's full output.

AOUTx Tc is a low-pass filter on the output entered in seconds.

4-3 DIGITAL INPUTS

Parameters	**Type**	**Default**
DIN 1 to *DIN 9*	DPB	
Input Word	APB	
Ref Mode	CAL	0 = No action

Description

Nine digital inputs are available in this software. Three digital inputs are available on the main board. *DIN 4* is mapped to the first analog input. The last five require option board B9 installed.

When the first analog input is goes above 5 volts *DIN 4* will go high. The digital inputs are packed into *Input Word* which is used to select functions defined later. *Input Word* is packed as follows:

Bit 0 = 0
Bit 1 = 1
Bit 2 = *DIN 1*
Bit 3 = *DIN 2*
Bit 4 = *DIN 3*
Bit 5 = *DIN 4*
Bit 6 = *DIN 5*
Bit 7 = *DIN 6*
Bit 8 = *DIN 7*
Bit 9 = *DIN 8*
Bit 10 = *DIN 9*
Bit 11 = *FB DIN 1*
Bit 12 = *FB DIN 2*
Bit 13 = *FB DIN 3*
Bit 14 = *FB DIN 4*
Bit 15 = *FB DIN 5*

The *Ref Mode* pre-defines the digital inputs based on the reference mode selected and if the option board is present in slot D as follows: If *Ref Mode* = 0 then any combination of I/O and field bus inputs can be used.

Ref Mode with No option board

Digital Input	1= 3 Step	2 = 4 Step	3 = 2 Step Inf Var.	4 =Stepless
DIN 1	Raise	Raise	Raise	Raise
DIN 2	Lower	Lower	Lower	Lower
DIN 3	2nd Speed	2nd Speed	Accelerate	
DIN 4	3rd Speed	3rd Speed		

Ref Mode with Option board B9

Digital Input	1 = 3 Step	2 = 4 Step	3 = 2 Step Inf Var.	4 = Stepless
DIN 5	Raise	Raise	Raise	Raise
DIN 6	Lower	Lower	Lower	Lower
DIN 7	2nd Speed	2nd Speed	Accelerate	
DIN 8	3rd Speed	3rd Speed		
DIN 9		4th Speed		

4-4 DIGITAL OUTPUTS

Parameters	Type	Default
DOUT1 Config and DOUT2 Config	BCFG	2 = *MC Fault*, 7 = *Rel Brakes*

Description

Two digital outputs are set up in the software. The first is available on the main board. The other require the option B9 board.

DOUT1 Config and DOUT2 Config determines what bit is sent to the output as follows:

0 = *MC Run*
1 = *MC Ready*
2 = *MC Fault*
3 = *MC AtSpeed*
4 = *At Zero Spd*
5 = *MC Out*
6 = *MC Reverse*
7 = *Rel Brakes*
8 = *EndSt Perm*
9 = *Slow Down Cmd*
10 = *Ramp Hold*
11 = *Abv Base Spd*
15 = *Watchdog Out*

SECTION V

LOGIC SEQUENCE

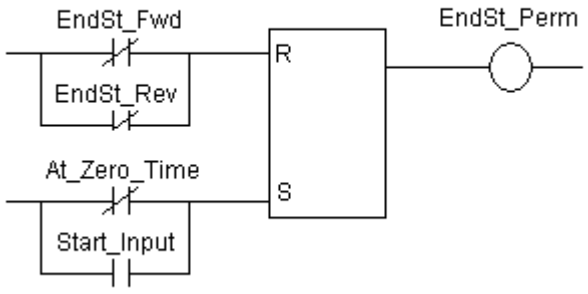
5-1 MISCELLANEOUS LOGIC

Zero Bit - Set to FALSE. ID number for this bit is 1002.

One Bit - Set to TRUE. ID number for this bit is 1001.

5-2 REMOTE OPERATION

5-2.1 *EndSt Perm*

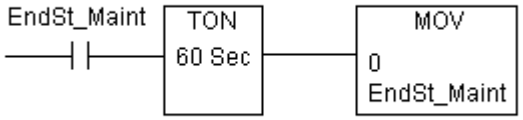


EndSt Perm goes high if either of the end stop inputs goes low. It will stay high until the drive has stopped and no run is commanded.

This is used to initially coast the drive and apply the brakes. After stopping, the logic will allow the section to back out of the condition.

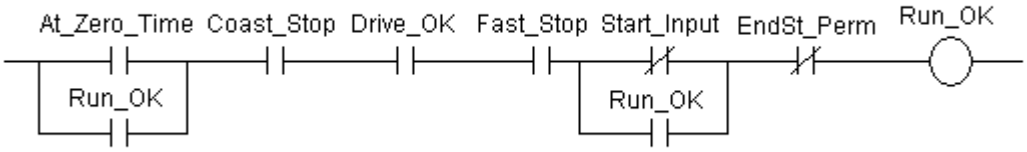
To use end stop functionality, set *EndSt Fwd* and *EndSt Rev* to digital inputs that are normally high. Default for the end stops are set to a constant 1.

5-2.2 *EndSt Maint*



EndSt Maint allows the drive to go beyond the end stops to test the ultimate limits. A sixty second timer is programmed to disable this feature. If a longer time is required to get to the ultimate limit, this may have to be set again.

5-2.3 *Run OK*



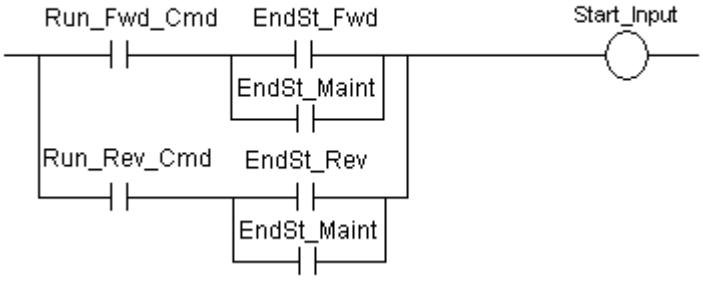
The *Run OK* bit is used to stop the drive in any control mode. The drive will go to a coast stop and the brakes applied.

For the Crane software, the drive run inputs must be turned off along with the motor at zero speed before *Run OK* can be reset.

Coast Stop and *Fast Stop* are defaulted to *One Bit*.

EndSt Perm is derived from the forward and reverse limit switch inputs that are defaulted to TRUE.

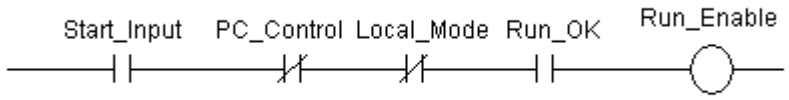
5-2.4 *Start Input*



Normally *Start Input* is high when either *Run Fwd Cmd* or *Run Rev Cmd* is active.

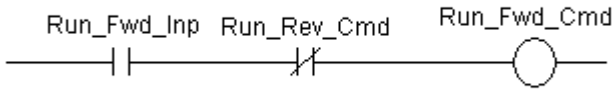
If the section is in one of the travel end stops, only the opposite travel is allowed to be selected. A maintenance selection is available to bypass the end stops and to test the ultimate limit. This selection is only active for 60 seconds after being set.

5-2.5 *Run Enable*



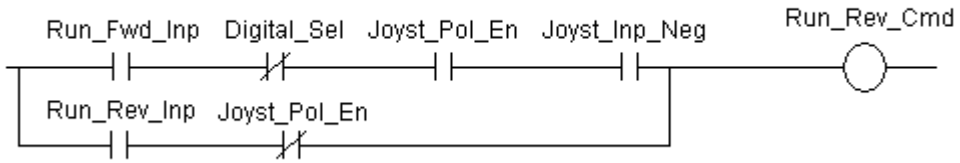
Run Enable is enabled when the drive is OK, is in remote mode, and a run is commanded.

5-2.6 *Run Fwd Cmd*



Run Fwd Inp is defaulted to the first digital input of the main board or the option board B9, if present.

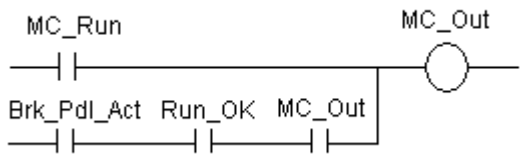
5-2.7 *Run Rev Cmd*



Run Rev Inp is defaulted to the second digital input and provides the run command.

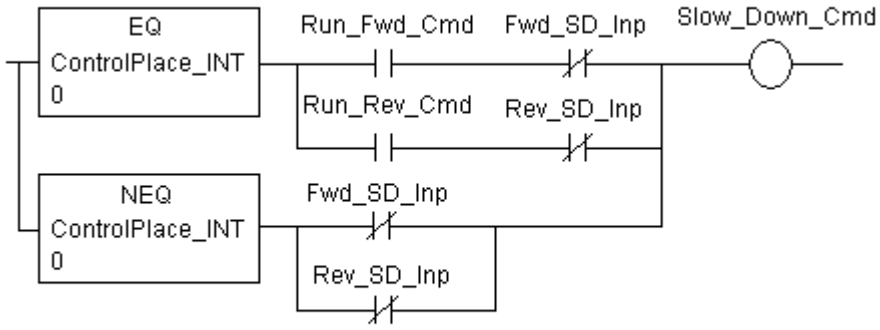
If the direction command is desired by joystick polarity, set *Joyst Pol En* parameter.

5-2.8 *MC Out*



MC Out is used to control the motor contactor if available after the inverter. *MC Run* commands the contactor to open or close. *Brk Pdl Act* allows the contactor to remain closed as long as the brake pedal is active. The drive is in coast state with brakes released during this mode.

5-2.9 *Slow Down Cmd*



Two separate slow down inputs are available. For safety reasons, these inputs must be normally high and go low during slow down region.

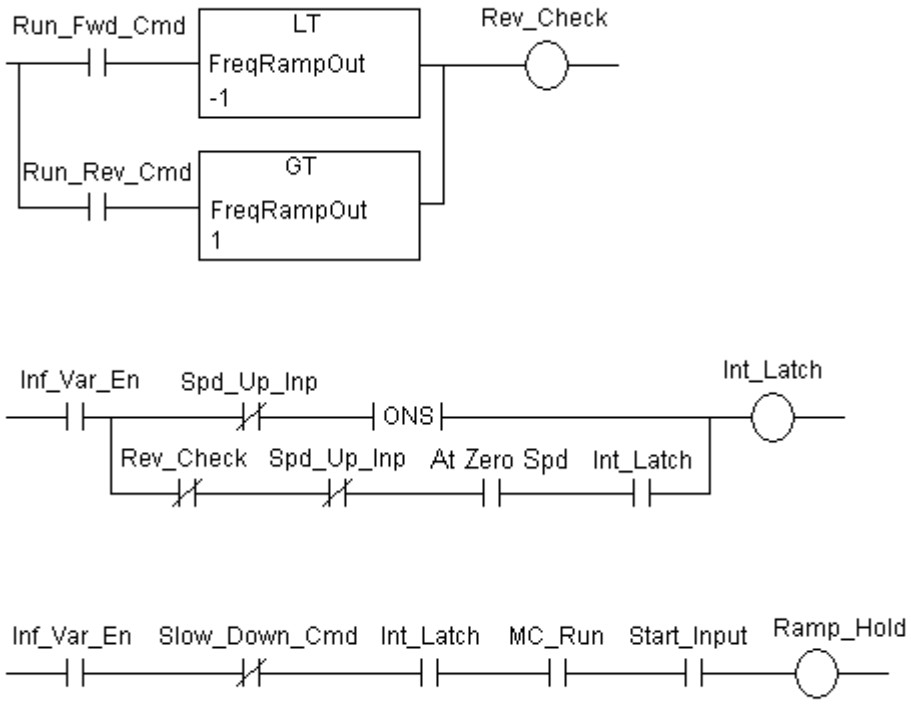
The slow down inputs are defaulted to TRUE and must be configured to a digital input to activate this feature. If the crane only has one slow down input for both directions, set both *Fwd SD Inp* and *Rev SD Inp* to the same digital input.

The slow down function operates differently depending if the drive is in remote mode operation or not.

In remote mode, the slow down input is only active in the selected drive direction. This allows full speed coming out of a slow down region.

In local or computer mode, the drive will be in slow down if either input goes low as polarity of the reference is unknown.

5-2.10 INFINITE VARIABLE SPEED LOGIC



Infinite variable speed control is implemented by having the drive run between zero speed, the first fixed speed, and the second fixed speed. *Run Fwd Cmd* or *Run Rev Cmd* ramps the drive to the first selected fix speed setpoint. When *Spd Up Inp* is selected, the drive will start to ramp to the second fix speed, which should be set to maximum speed desired. Removing *Spd Up Inp* will set *Ramp Hold* to stop at the desired speed.

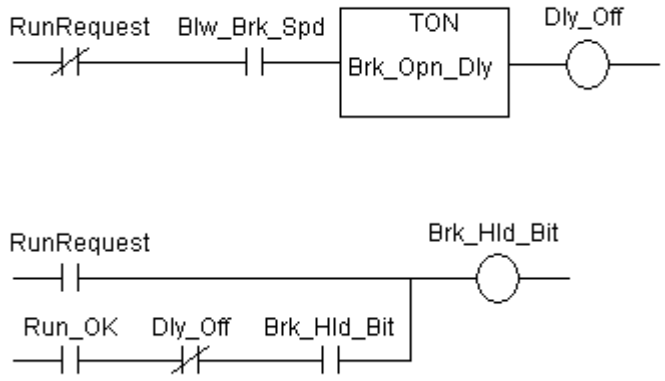
During a fault, opposite direction commanded or removal of run will reset the *Ramp Hold*.

During opposite direction command, the drive will not allow the speed to be held until the opposite direction is actually achieved.

To hold a speed lower than the first fix speed, command the direction and then toggle *Spd Up Inp* at the desired low speed.

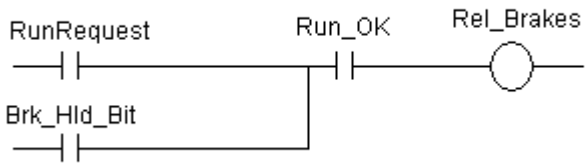
To enable the infinite variable function, *Spd Up Inp* must be configured to a digital input and *Digital Sel* must be set.

5-2.11 *Brk Hld Bit*



Brk Hld Bit is used to keep the brakes from setting until the runs are removed and drive ramps to zero speed. An optional *Brk Opn Dly* delay the brakes from setting after zero speed is achieved.

5-2.12 BRAKES



Rel Brakes bit is used to control an external motor brake contactor. To use this function, it must be configured to a digital output of the drive.

Brk Hld Bit keeps the brakes released until the drive run is removed and the drive is at zero speed.

If an external brake is also available, this will keep the brakes from setting when active.

5-2.13 RAMP DELAYS

Rel Ramp Delay will hold the speed ramp at zero until it times out on a start command. This value is in ms. This is used to allow contactors and brakes to energize before ramping up the speed.

5-3 LOCAL DRIVE KEYPAD

5-3.1 LOCAL RUN MODE

The drive can be put into the local mode by setting *Remote Control* parameter to 0.

Pressing the Start button on the keypad when in the local mode will initiate a drive Run as long as *MC Ready* is high and the drive is not faulted (*MC Fault* is low)

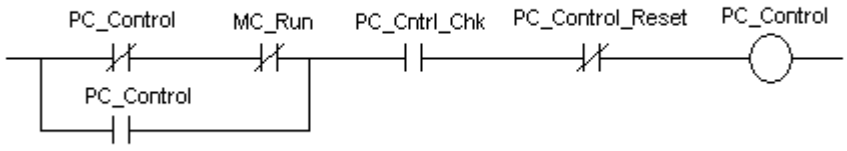
Pressing the Stop Button on the keypad will initiate a local stop. This does not stop the drive in remote or PC control. See button Stop fault in next section.

5-3.2 BUTTON STOP FAULT

In any mode, if the Stop button is pressed for 4 seconds, a button stop fault will occur.

5-4 ADDaptACC SOFTWARE CONTROL

5-4.1 *PC Control*



PC Control is enabled by the ADDaptACC diagnostic software package. It will transfer into this mode only if the drive is not running. The drive will transfer out of *PC Control* if communications are lost to the computer.

5-4.2 *SC Start*

SC_Start is the run command from the ADDaptACC program. It will be enable if in *PC Control* and *MC Ready* is high and no drive faults are present (*MC Fault* is low)

5-4.3 *SC Comm Fault*

SC Comm Fault will fault out the drive and take the section out of *PC Control* mode.

5-5 RUN INTERFACE TO FIRMWARE

5-5.1 *RunRequest*

RunRequest enables the drive's firmware to start ramping and enables the inner torque loops. *RunRequest* will go high on any of the three control modes: Remote, Local or diagnostic computer.

5-5.2 COAST STOP

The drive will coast stop under the following conditions:

- Not in *PC Control* and *Coast Stop* goes low.
- In *PC Control* and the user presses the coast stop button in Addapt ACC.
- Drive faults out and the response is setup for coast stop.

SECTION VI

REFERENCING AND OUTER CONTROL LOOP

6-1 SPEED REFERENCE

6-1.1 JOYSTICK REFERENCE SELECTION

Parameters	**Type**	**Default**
Joyst Sel	ACFG	*Analog In 1*
Joyst Inp Neg	DPB	
Slow Down Cmd	DPB	
SD Mlt Stpt	CAL	0.5
Anlg Ref2	APB	%
Digital Sel	BCFG	*One Bit*

Description:

To enable joystick reference:

- Set *Digital Sel* = 1002 = *Zero bit*.
- Configure *Joyst Sel* to the analog input or communication point for the reference.

Or set *Ref Mode* = 4.

Slow Down Cmd is high when a slow down condition is present. See Chapter 4 for the slow down logic. When in this condition, the Joystick reference is multiplied by *SD Mlt Stpt*, which is defaulted to 0.50 to cut the speed in half.

Anlg Ref2 is the reference after going through an absolute value function and checking for slow down.

6-1.2 DIGITAL REFERENCE SELECTION

Parameters	**Type**	**Default**
Run Fwd Se	BCFG	2 = *DIN 1*
Run Rev Sel	BCFG	3 = *DIN 2*
Run Cmd Inp	DPB	
Spd2 Sel	BCFG	4 = *DIN 3*
Spd3 Sel	BCFG	0
Spd4 Sel	BCFG	0
Speed 1	CAL	20.00%
Speed 2	CAL	40.00%
Speed 3	CAL	60.00%
Speed 4	CAL	80.00%
Slow Down Cmd	DPB	
SD Speed	CAL	20.00
Digital Sel	BCFG	1

Description:

Digital Sel is defaulted to 1 which allows for step speed referencesw.

The first two digital inputs are defaulted to run forwad and reverse at the lowest speed step (*Speed 1*).

To enable additional speed steps, configure *Spd2 Sel – Spd4 Sel* to digital inputs or communication inputs for the different steps. The Speeds are then entered into *Speed 1 – 4* in percent of maximum speed. The same speed steps are used for forward or reverse.

Slow Down Cmd is high when a slow down condition is present. See Chapter 4 for the slow down logic. When in this condition, the speed reference switches to *SD Speed*.

For infinite variable speed operation, set *Spd Up Sel* input to the same as *Spd2 Sel*. Also set *Speed 2* to 100%.

The *Ref Mode* parameer sets the digital inputs and speeds to predefined values based on the reference mode selected as follows: After setting, the speed can be modified, but the inputs can not.

Parameter	**1 = 3 Step**	**2 = 4 Step**	**3 = 2 Step Inf Var**	**Stepless**
Digital Sel	1	1	1	0
Speed 1	10.00%	10.00%	10.00%	
Speed 2	50.00%	33.00%	100.00%	
Speed 3	100.00%	66.00%		
Speed 4		100.00%		
Spd2 Sel	4 = DIN 3/ 8 = DIN 7	4 = DIN 3/ 8 = DIN 7	4 = DIN 3/ 8 = DIN 7	
Spd3 Sel	5 = DIN 4/ 9 = DIN 8	5 = DIN 4/ 9 = DIN 8	0	
Spd4 Sel	0	0/ 10 = DIN 9	0	
Inf Var En	0	0	1	0
Spd Up Inp	0	0	4 = DIN 3/ 8 = DIN 7	0
Joyst Resp	0 (Dis Fault)	0 (Dis Fault)	0 (Dis Fault)	2 (En Fault)

Note: The digital inputs change depending if the option B9 board is present.

6-1.3 REFERENCE LOCATION AND LIMIT

Parameters	**Type**	**Default**
Control Place	APB	
Keypad Spd Ref	APB	
SC Spd Ref	APB	
Slow Down Cmd	DPB	
SD Speed	CAL	20.00%
Max Speed Per	CAL	100.00%
Abs Per Spd	APB	

Description:

Control Place determines where the speed reference is derived from. Normally, it is set equal to zero to allow remote control. For startup or troubleshooting, this can be set to keypad or computer.

Several speed limits are used. Normal operation uses *Max Speed Per,* which is set to 100.00%.

Slow Down Cmd is high when a slow down condition is present. See Chapter 4 for the slow down logic. When in this condition, the speed is limited by *SD Speed*.

The final speed reference can be viewed by *Abs Per Spd*.

6-1.4 REVERSE COMMAND AND CONVERSION

Parameters	**Type**	**Default**
Run Rev Cmd	DPB	
Control Place	APB	
Keypad Spd Dir	DPB	
SC Reverse	DPB	
Reverse	DPB	
Abs Per Spd	APB	
LS to Freq	CAL	0.60
LS Scl Div	CAL	1000
Freq_Stpt	APB	

Description:

Reverse command is dependant on *Control Place* as follows:

- Remote Control – See chapter 4 for *Run Rev Cmd* logic. Reverse can be set up to be from a digital input or from a negative joystick polarity.
- Panel Control - *Panel Reverse* command. This is changed via the keypad.
- Computer Control - Reverse comes from a check box on the control pad screen from ADDaptACC (*SC Reverse*)

The speed reference is converted from percent to motor hertz by the scaling factors *LS to Freq* and *LS Scl Div*. Default scaling sets 100.00% speed equal to 60.00 Hz on the motor.

6-1.5 REFERENCE ENABLE

Parameters	**Type**	**Default**
Rel Brakes	DPB	
Brk Aux Sel	BCFG	0
Rel Rmp Dly	CAL	0.1 ms.
Rel Brakes	DPB	

Description:

The speed reference is held at zero until the brakes have been released.

Rel Rmp Dly is used to delay the ramp to wait to make sure the brakes have released.

Brk Aux Sel is used to tell the drive when the brakes have opened. *Brk Aux Sel* should be set to the digital input wired to the brakes opened limit switch, if available.

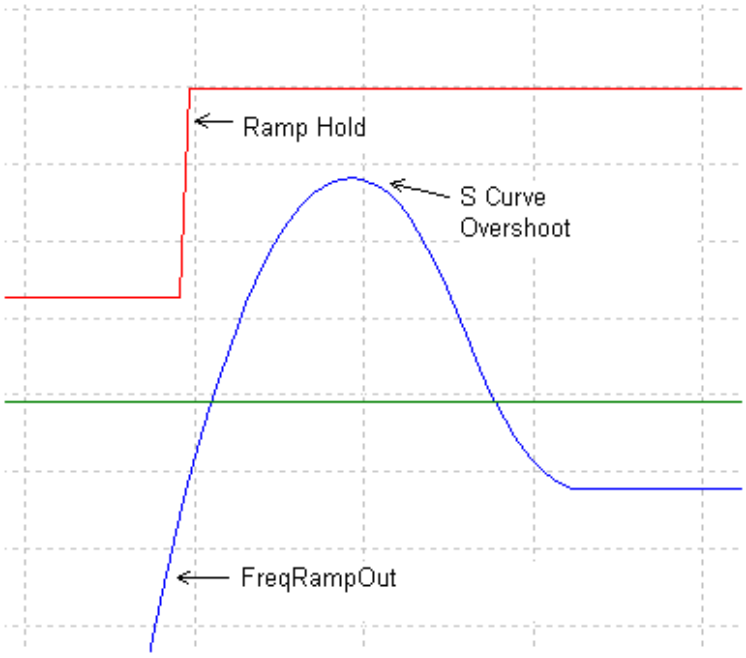
6-1.6 RAMP HOLD

Parameters	**Type**	**Default**
Ramp_Hold	DPB	
Freq Ramp Out	APB	
FreqReference	APB	

Description:

Ramp Hold is used for infinite variable speed reference. See chapter 4 logic. This takes the output of the ramped speed reference *Freq Ramp Out* and makes this the reference value. Note: this will hold the reference in all modes except when the run is removed.

Note that if S-curve ramping is enabled, the speed will overshoot by the S-curve value, then it will ramp back to the correct value. See the example below:



The output *FreqRef* is then passed to the firmware, which is detailed in the following sections.

6-1.7 FAST RAMP TIMES

Parameters	**Type**	**Default**
Fast Stop Sel	BCFG	1
EndSt Perm	DPB	
Fast Stop Tim	CAL	0.1
Accel Time 1	APB	
Decel Time 1	APB	
Smoot h Ratio 2	CAL	0.1

Description:

When either *Fast Stop* goes low or the drive is in an end stop condition *EndSt Perm* high, the second set of acceleration and deceleration rates are used. Both of the rates are set to *Fast Stop Tim.*

Enter the fastest time to stop from full speed into *Fast Stop Tim*. Default is the fastest time allowed (1 second).

RampTimeSelect is the final time sent to the firmware.

Smooth Ratio 2 is the S-curve during Fast stop and should be left at default.

6-1.8 RAMP TIMES

Parameters	**Type**	**Default**
Accel Time 1	CAL	5.0 seconds
Decel Time 1	CAL	5.0 seconds
Smooth Ratio	CAL	0.1

Description:

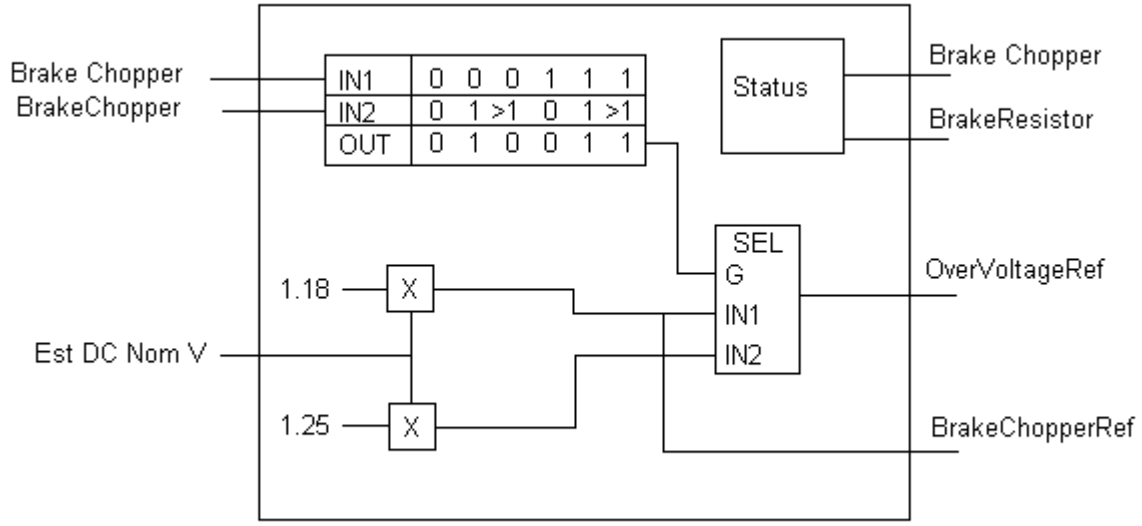
The normal ramp times are *Accel Time 1* and *Decel Time 1*. These times are scaled to the amount of seconds it takes to get from zero to *Freq Max*.

Smooth Ratio is used to create a rounding to the ramp rate. The units are in seconds to get to from zero to the ramp rate. Note that if *Smooth Ratio* = 2.0, then it will take 2 seconds to get to the ramp rate. It does not matter if the rate is 1 Hz/s or 10 Hz/s.

6-2 PI LIMITERS

There are two open loop PI limiters. When enabled the limiters modify the speed reference to avoid the drive from tripping out.

6-2.1 OPEN LOOP OVERVOLTAGE LIMITER



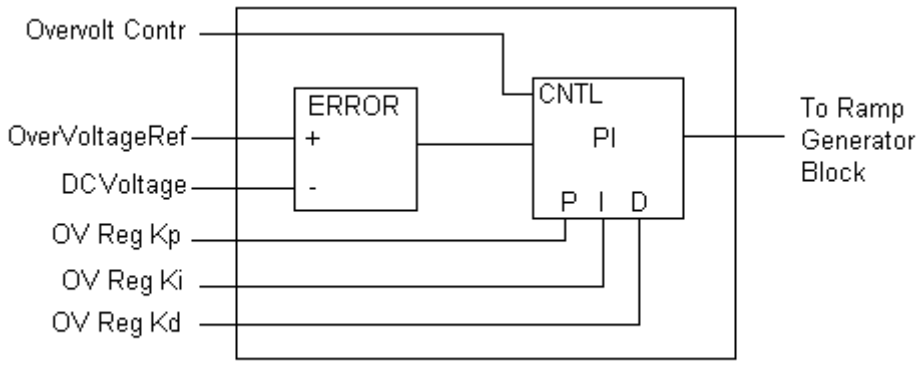
Parameters	**Type**	**Default**
Brake Chopper	APB	
BrakeChopper	CAL	0
Est DC Nom V	APB	
BrakeResistor	APB	

Description:

The Overvoltage reference is either set to 1.18 or 1.25 times the *Est DC Nom V*, depending on whether there is a DC chopper and if there is a resistor present.

Brake Chopper is set to 0 if the drive is not equipped with an internal brake Chopper. Otherwise, it is set equal to 1.

BrakeResistor is set to 0 if no resister is detected when tested. Otherwise, it is set equal to 1.



Parameters	**Type**	**Default**
Overvolt Contrl	CAL	0
DCVoltage	APB	
OV Reg Kp	CAL	By frame size
OV Reg Kd	CAL	By frame size
OV Reg Ki	CAL	By frame size

Description:

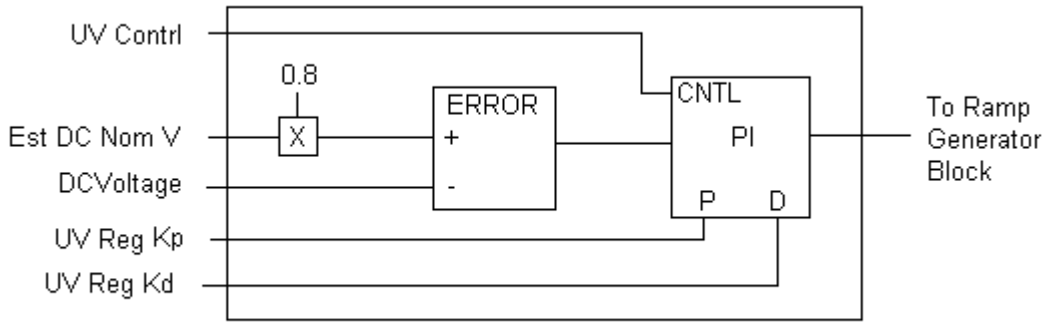
The Overvoltage limiter can be used to avoid the DC Bus from tripping out. This modifies the speed reference to try and keep the Bus voltage down.

Overvolt Contrl is used to enable this PI limiter.

The over voltage reference is either 1.18 or 1.25 times the nominal bus voltage, depending on if there is a brake chopper circuit and resistor present.

The three gains *OV Reg Kp, OV Reg Ki*, and *OV Reg Kd* are factory set and can not be modified.

6-2.2 OPEN LOOP UNDERVOLTAGE LIMITER



Parameters	**Type**	**Default**
UV Contrl	CAL	disable
DCVoltage	APB	
UV Reg Kp	CAL	By frame size
UV Reg Kd	CAL	By frame size
Est DC Nom V	APB	

Description:

The Undervoltage limiter can be used to avoid the DC Bus from tripping out. This modifies the speed reference to try and keep the Bus voltage up.

Undervolt Contrl can be used to enable or disable this function. It is defaulted to disable.

The setpoint is 0.8 x *Est DC Nom V.*

The two gains *UV Reg Kp* and *UV Reg Kd* have different default values based on frame size and are factory set.

SECTION VII

MOTOR CONTROL MODE

7-1 OPEN LOOP CONTROL

Options for Open loop control is set by *Motor Ctrl Mode.*

0 = Frequency control (Volts/Hertz)
1 = Open loop speed control (Open loop vector speed control)

Each mode has its own regulator scheme. In each open loop mode there are three stabilizers: Torque, DC-Link, and Flux. Each of these are factory-set, but are explained for reference.

7-1.1 TORQUE STABILIZER

The Torque stabilizer is used to dampen possible oscillations in the estimated torque calculations. This loop comes into affect above 3 hertz and is factory tuned. The reference to the controller is the derivative of the estimated torque value. The stabilizer control is a proportional-only controller with a variable gain. The gain is changed linearly between zero and field weaken frequency. The zero and field weaken gain points are be TorqStabGain and TorqStabGainFWP.

TorqStabGainHwDtcFWP is an additional gain with dead time compensation above the field weaken point.

The output of the regulator is also limited by TorqStabLimit. The output of the controller goes through a damping block to reduce spikes from the derivative input based on parameter TorqStabDamp.

The torque stabilizer is factory set and the parameters are not editable.

TorqStabGain = 100 gain
TorqStabGainFWP = 50 gain
TorqStabGainHwDtcFWP = 50
TorqStabLimit. = 150 Hz/FreqScale
TorqStabDamp = 900

7-1.2 DC-LINK STABILIZER

The DC-link Stabilizer operates similar to the Torque stabilizer and also operates above 3 hertz. The reference to the controller is the derivative of the DC-link voltage. The proportional gain is variable by estimated motor torque. As the torque increases from 10% to 50%, the controller gain decreases from VoltStabGain to zero gain.

VoltStabGainHwDtc is an additional gain with dead time compensation.

The output of this stabilizer is limited by VoltStabLimit. The output of the controller goes through a damping block to reduce spikes from the derivative input based on parameter VoltStabDamp.

The Voltage stabilizer is factory set and the parameters are not editable.

VoltStabGain = 100 gain
VoltStabGainHwDtc = 50 gain
VoltStabLimit = 150 Hz/FreqScale
VoltStabDamp = 900

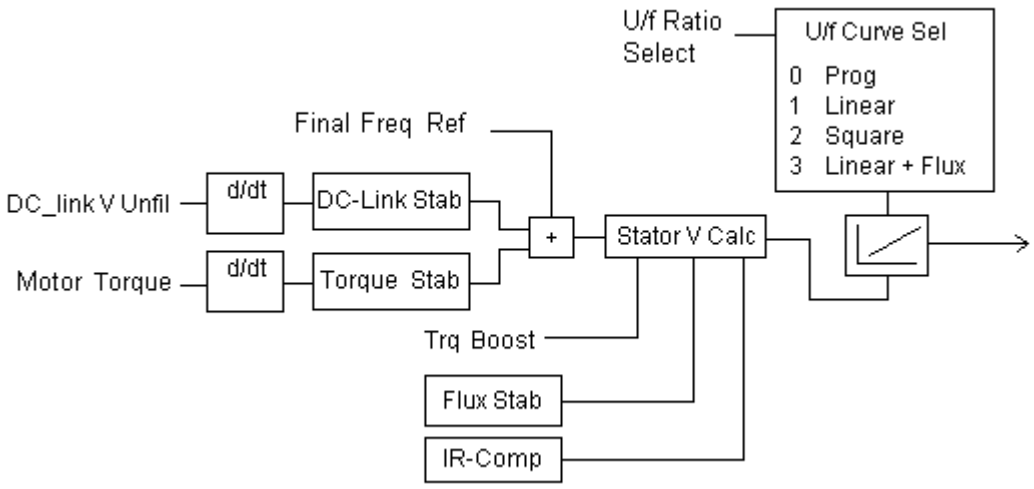
7-1.3 FLUX STABILIZER

The Flux stabilizer purpose is to stabilize the magnetizing current. The error to the controller is from the difference between filtered and unfiltered magnetizing current. The filtered signal has a time constant of ldsFiltCoeff (in ms). The Flux stabilizer is a proportional-only controller with a gain of ldsStabGAinRef.

The Flux stabilizer is factory set and the parameters are not editable.

ldsFiltCoeff = 64 ms
ldsStabGAinRef = 500 gain

7-1.4 OPEN LOOP FREQUENCY REFERENCE (*Motor Ctrl Mode* = 0)



Parameters	**Type**	**Default**
Motor Ctrl Mode	CAL	0 = Open Loop Frequency mode
DC_link V Unfil	APB	
Motor Torque	APB	
Freq out	APB	
U/f Optimization	CAL	0
Meas Rs V Drop	CAL	0
U/F Ratio Select	CAL	0 = Linear
Zero Freq Voltg	CAL	0
Voltage at FWP	CAL	100.00
U/F Mid Voltg	CAL	100.00

If *Motor Ctrl Mode* = 0, then *Freq out* becomes the drives motor frequency reference in volts per hertz mode.

The torque and DC-link voltage stabilizer output is added straight to the frequency reference. Both of these stabilizers are zero mean additions to the output frequency. The torque stabilizer is to dampen possible oscillations in the estimated torque calculations and DC-link stabilizer is to dampen changes in the DC bus voltage.

The Stator Voltage calculation block takes the output of *Freq out* modified by the stabilizers and calculates the correct stator voltage. Inputs to this calculation are the torque boost and IR compensation.

- Torque boost is enabled by setting *U/F Optimization* = 1. The torque boost is to compensate for the voltage drop due to stator resistance.

The IR compensation scaling is broken up into two values, depending if the drive is in motoring or in generation mode. The IR compensation value then goes through a low-pass filter with a time constant which is hard coded to 8 ms.

The output voltage is then determined by going through one of three volts per hertz curves. Selection of a curve is done with the *U/F Ratio Select* parameter.

- *U/F Ratio Select* = 0 = Linear curve – As the name implies, this performs a linear curve between the *Zero Freq Voltg* and *Voltage at FWP*. *Zero Freq Voltg* is entered in percent of nominal voltage and is the starting voltage for the drive.

  Voltage at FWP is entered in percent of nominal voltage and is the ending voltage when the field weakening frequency has been reached.

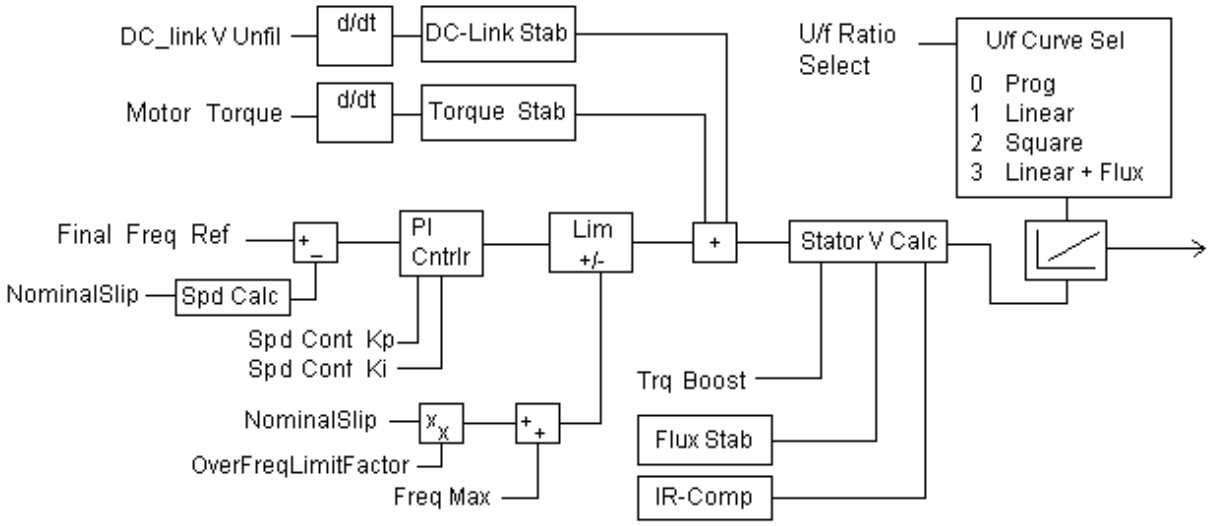
- *U/F Ratio Select* = 1 = Squared – The same parameters as linear curve are used except, instead of a linear interpolation between the two points, a squared curve is used.

- *U/F Ratio Select* = 2 = Programmable – This is automatically selected if the drive has completed its identification with run and built the frequency-to-voltage curve. Three voltage, frequency points are found and used to define the curve. The points are:

  Zero Freq Voltge
  U/f Mid Freq
  U/f Mid Voltg
  Voltage at FWP

- *UFRatio* = 3 = Linear with Flux optimization – Uses the linear curve with voltage being drooped during constant operation. The advantage if this modification is to reduce motor losses. The disadvantage is a lag in the torque loop.

7-1.5 OPEN LOOP SPEED CONTROL (*Motor Ctrl Mode* = 1)



Parameters	**Type**	**Default**
Motor Ctrl Mode	CAL	0 = Open Loop Frequency mode
Freq out	APB	
Spd Cont Kp	CAL	3000 Gain
Spd Cont Ki	CAL	300 Gain
Freq Max	CAL	60 Hz

If *Motor Ctrl Mode*= 1, then *Freq out* becomes the drive's open loop speed reference.

The motor speed feedback is calculated from the motor voltage and the estimated slip value (NominalSlip).

The error is then passed to a Speed PI regulator. The proportional gain is set by *Spd Cont Kp* and the integral gain is set by *Spd Cont Ki*.

The output of the PI regulator is limited to *Freq Max* plus the value of NominalSlip x OverFreqLimitFactor. OverFreqLimitFactor is factory-set for 300 and allows the motor to get to its rated speed.

After the frequency limiter, the reference goes through the same stabilizers and volts per hertz curve as the open loop frequency reference. See the section prior to setup of these control sections.

SECTION VIII

MISCELLANEOUS CONTROL BLOCKS

This section deals with all the control blocks and firmware parameters that do not fit into any other category.

8-1 SPEED COMPARITORS

Parameters	Type	Default
Motor Speed	APB	*RPM*
Spd Cmp Fil TC	CAL	0.2 seconds
Max RPM	APB	*RPM*
Ovr Spd Stp	CAL	110%
Zero Detect	CAL	2 %
Spd Hyst	CAL	1 %
Spd Decimal	CAL	2
Base Spd RPM	CAL	1800 RPM
Brk Hld Spd	CAL	50 RPM
Blw Brk Spd	DPB	
Abv_Base_Spd	DPB	

Motor Speed is scaled in motor RPM.

Motor Speed is passed through a low pass filter with a time constant of *Spd Cmp Fil TC* before it goes to the speed comparators.

Max RPM is calculated using the motor poles and the entered *FreqMax*.

The zero speed setpoint is defined by *Zero Detect* which is defaulted to 2.00%. *At Zer Spd* bit will go high when the percentage of *Motor Speed* falls below this value minus the hysteresis value *Spd Hyst*.

The over speed setpoiont is defined by *Ovr Spd Stp*, which is defaulted to 110.00%. *Over Speed* bit will go high when the percentage of *Motor Speed* goes above this value plus the hysteresis value *Spd Hyst*.

Spd Decimal is defaulted to 2. Modify this if the compare block setpoint decimal place needs to be moved due to integer limitations.

The other two comparitors are used in other portions of the drive logic.

- *Abv Base Spd* can be used to switch to lower ramp rates.
- *Blw Brk Spd* is used to hold the brakes open on a ramp sto

SECTION IX

COMMUNICATIONS

9-1 MODBUS INTERFACE

The ACCel500 AF Drive has a built-in Modbus RTU bus interface. The signal level of the interface is in accordance with the RS-485 standard.

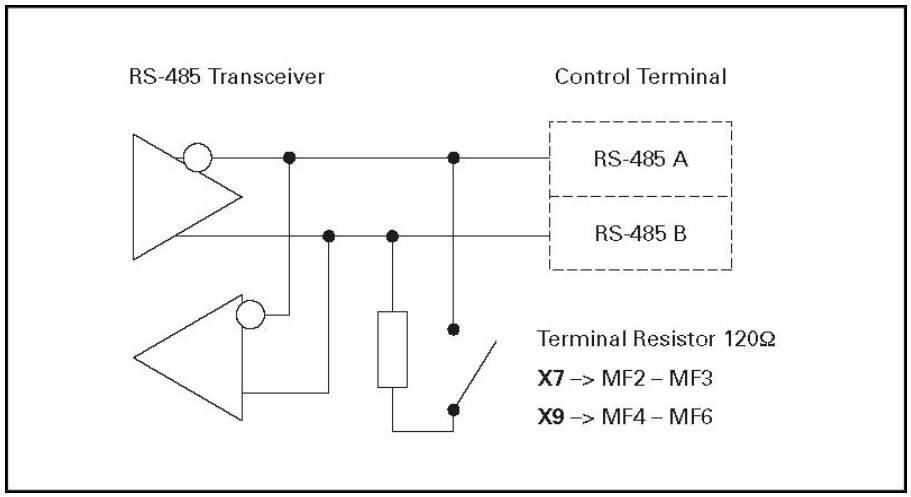


Figure 9-1. Modbus Interface

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

Modbus RTU Protocol

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

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

TABLE 9-1. MODBUS COMMANDS SUPPORTED BY FUNCTION CODE

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

Termination Resistor

The RS-485 bus is terminated with 120Ω termination resistors in both ends. The ACCel500 AF Drive has a built-in termination resistor which is switched off as a default.

Modbus Address Area

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

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

Modbus Process Data

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

TABLE 9-2. OUTPUT PROCESS DATA

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

TABLE 9.3 INPUT PROCESS DATA

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

TABLE 9-4. STATUS WORD

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

TABLE 9-5. GENERAL STATUS WORD

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
WD	—	—	—	ABV BASE	RMP HLD	SLW DWN	END ST	—	REL BRK	REV	MC OUT	AT SPD	PLT	RDY	RUN

TABLE 9-6. ACTUAL SPEED

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

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

TABLE 9-7. CONTROL WORD

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

In THE ACCEL500 AF DRIVE applications, the three first bits of the control word are used to control the drive. However, you can customize the content of the control word for your own applications because the control word is sent to the drive as such.

TABLE 9-8. SPEED REFERENCE

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

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

TABLE 9-9. BIT DEFINITIONS

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

Fieldbus Parameters

RS-485 Communication Status (I6.10.1)
With this function you can check the status of the RS-485 bus. If the bus is not in use, this value is 0.

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

Fieldbus Protocol (P6.10.2)

With this function you can select the fieldbus communications protocol.

0 = Not used
1 = Modbus protocol

Slave Address (P6.10.3)

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

Baud Rate (P6.10.4)

Selects the baud rate used with the Modbus communication.
0 = 300 baud
1 = 600 baud
2 = 1200 baud
3 = 2400 baud
4 = 4800 baud
5 = 9600 baud
6 = 19200 baud
7 = 38400 baud
8 = 57600 baud

Stop Bits (P6.10.5)

Sets number of stop bits used in Modbus communication.

0 = 1 stop bit
1 = 2 stop bits

Parity Type (P6.10.6)

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

0 = None
1 = Odd
2 = Even

Communication Time-out (P6.10.7)

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

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

9-2 READ AND WRITE STANDARD ID NUMBERS

Above and beyond the field bus bits outlined above the following are available offering more flexibility in the communication.

Write integer to the drive:

ID	Parameter Name
1611	*A_FB_AIN1*
1612	*A_FB_AIN2*
1613	*A_FB_AIN3*
1614	*A_FB_AIN4*
1615	*A_FB_AIN5*
1616	*A_FB_AIN6*

Joystick reference and motor current limit can be configured to any of these inputs.

Write bits to the drive:

1621 *FB Fix Cntrl Wrd* is used to write bits to the drive.

FB DIN1 = Bit selected by *FB DIN1 Sel*
FB DIN2 = Bit selected by *FB DIN2 Sel*
FB DIN3 = Bit selected by *FB DIN3 Sel*
FB DIN4 = Bit selected by *FB DIN4 Sel*
FB DIN5 = Bit selected by *FB DIN5 Sel*

Any digital selection that can be configured to physical I/O can also be configured to these five bits.

Read integer from the drive:

ID	Parameter Name	Configuration Parameter
1622	*FB Data Out 1*	*FB AOUT1*
1623	*FB Data Out 2*	*FB AOUT2*
1624	*FB Data Out 3*	*FB AOUT3*
1625	*FB Data Out 4*	*FB AOUT4*
1626	*FB Data Out 5*	*FB AOUT5*
1627	*FB Data Out 6*	*FB AOUT6*

Each of the above can be selected from the following list of values:

0 = *Freq Rmp Out*
1 = *Motor Speed*
2 = *Motor Current*
3 = *Motor Torque*
4 = *Motor Power*
5 = *Motor volts*
6 = *DC volts*
7 = *Active Fault*
8 = *Freq Ref*
9 = *Drive Temp*
10 = *Motor Calc Temp*
11 = 0
12 = 0
13 = *Input Status Word*
14 = *FB General Status Word*
15 = 0

Input Status word

0 – 9 = *DIN1 – DIN9*

9-3 FAULTS

A) Slot Fault – Occurs when a slot indicates a problem. This bit can go to a fault block that can be configured for a drive warning or a fault by parameter *FBComm.FaultResp*.

B) Watchdog Bit - Logic is built into the drive to allow for an external device to toggle a bit to create a communication watchdog.

Configure *Watchdog In* to the field bus input bit that the PLC is going to toggle. The drive in turn will move the state of this to WatchdogOut (ID:1003) which can be read by the PLC from its address or from the FBGeneralStatsWord bit 15.

Com WD Trip will go high after the bit stops toggling for *WD Com Dly* amount of time in milliseconds.

WD Init Dly Tim is used to delay the watchdog fault after power up of the drive. Default is 10 seconds.

Set *WD Flt Response* for the action the drive will take on a communication failure.

SECTION X

FAULT CODES

Drive faults can be derived from either hard coded firmware faults or from the application Fault block.

The firmware faults have no options associated with them. They will fault the drive with a coast stop and record the event in the FIFOs.

The application Fault block allows different options such as drive action, Stop type, recording, and ability to reset the fault. See the Fault block in the function block library for in depth description of the Fault block. Fault block triggers can come from either the firmware or from the application program.

10-1 FAULT ACTIONS

Fault action is decided by the FMode input of the Fault block. There are three options available.

0 = Disabled
1 = Warning – No drive action but the information is stored in the Fault FIFO
2 = Fault – Drive performs a stop.

10-2 STOP ACTION

The type of drive stop command is decided with the Stop input of the Fault block. There are three options available.

0 = Coast stop – Highest priority if multiple faults occur
1 = Normal stop mode
2 = Ramp stop.

10-3 FAULT RESET

A fault can be reset by several methods.

- The input configured to *E_Fault Reset* will reset all active faults.
- Reset/Enter button from the keypad
- Enable *Auto Reset* and after the drive stops and *Auto Res Tim* seconds it will automatically reset.

10-4 RECORDING

There are two fault FIFOs: active fault FIFO, which records 10 faults, and history table FIFO that records 5 faults/warnings.

The Hist input of the Fault block determines how it is recorded into the FIFO. There are 4 options available:

0 = Fault always will be stored.
1 = If a fault occurs several times, each event will be logged unless they occur within the time frame defined by the Wait input. The wait input is set in 10 ms increments.
2 = Fault will be recorded if different than the previous fault recorded.
3 = Not recorded.

10-5 DRIVE FAULTS

Fault Code	Fault Text	Possible Cause	Solution
1	Overcurrent	Over 400% nominal current detected. - Sudden increase in load. - Needs tuning - Shorted motor / cables - Unsuitable or bad motor	- Check section for binding or excessive loads. - Check motor tuning - Check motor leads and motor shorts - Replace drive - Replace motor
2	Overvoltage	DC bus has exceeded its upper limit. - Braking resister not working properly - Deceleration too rapidly - Unstable or utility voltage spikes.	- Check brake resister and chopper unit - Check deceleration rates - Verify proper incoming voltage
3	Earth Fault	Sum of motor current do not equal zero. - Motor cable or motor short to ground. - Bad current sensing	- Check motor cables for shorts to ground - Check motor for short to ground. - Replace drive inverter.
6	Emergency Stop	Input board not found or not seated properly.	- Reseat I/O boards. - Replace I/O boards.
7	Saturation	Very high overload - Cable / motor short - Defective component	- Cannot be reset must cycle power. - If occurs with Fault #1 then check motor and motor cables.
8	System Fault	Additional information will be stored in FIFOs. - Component Failure	- Replace processor board.
9	Undervoltage	DC bus has dropped below its lower limit. - Supply voltage too low - Converter fault - Excessive loading	- Check incoming voltage level - Check for Convert fault - Check motor loading - Replace converter
11	Output Phase	No current detected in one of the output motor leads. - Bad motor lead or motor. - Bad current sensor	- Check motor cables for an open phase. - Check motor for open winding - Replace Drive inverter
12	Brk Chopper Supr	Brake Chopper operation failure. - Bad resister - Chopper failure	- Check and replace braking resistor - Replace brake chopper components
13	Undertemp	Heat sink temperature under -10°C. - Ambient temperature too low. - Thermister failure	- Heat drive enclosure - Replace drive power components.
14	Overtemp	Heatsink over 90° C. - Ambient temperature too high. - Drive cooling not adequate - Bad temperature sensor	- Lower drive enclosure ambient temperature. - verify fan operation
15	Motor Stall	Motor stall protection tripped. - Motor is binding - Not enough motor torque available. - Stall protection set too tight.	- Check to make sure motor is not binding. - Retune to get proper magnetizing current. - Check stall protection for proper setup. - Verify motor is getting current. -Replace motor - Replace inverter

Fault Code	Fault Text	Possible Cause	Solution
16	Mot.Overtemp	Motor over heating detected by temperature model.	- Check for excessive motor loading - Check motor cooling - Check motor current to verify proper tuning.
17	MotorUnderld	Motor underload protection trip.	- Check process for load. - Check shafts and couplings - Check Under load parameters for proper setting.
22/23	Chksum Flt	EEProm has checksum fault.	- Verify parameters are set properly - Replace microprocessor board.
24	Changed data warning	Changes may have occurred during power interurruption	- Check parameters against saved file - re-download parameters - Replace microprocessor board.
25	Micro Watchdog	Microprocessor timed out.	- Redownload the system and application software. - Replace microprocessor board.
31	IGBT Temp	IGBT temperature exceeded its limit.	- Check ambient temperature - Check drive fan - Check for excessive build up of material on heat sink - Observe operation for high drive loading.
32	Fan cooling	Detection of a fan failure	- Check fan fuses on larger dirves - Replace fan - Replace fan controller
37	Device Change	Option board changed.	- Enter correct parameters for new option board. - Check I/O board seating - Replace option board.
38	Device Added	Option board or different drive size changed.	- Enter correct parameters for new hardware. - Check I/O board seating. - Check microprocessor board connection. - Replace drive
39	Device Removed	Option board or drive removed from microprocessor.	- Check I/O board seating - Check microprocessor board connection. Replace drive.
40	Device Unknown	Unknown option board added to the drive.	- Check I/O board seating - Replace I/O board
41	IGBT Temp	Same as fault 31	Same as fault 31
50	Anlg In Flt	Analog input is below its low limit.	- Check signal source - Check connections - Verify correct option board and jumpers. - Replace option board
52	Keypad Comm	Connection between keypad and drive is broken.	- Verify keypad cable connections or proper seating of keypad - Replace keypad - Replace microprocessor board.
53	FBCommunicat	Field bus fault fro D_FB_Fault bit. Bit is set when board failure is noted	- Check fieldbus board seating. - Replace fieldbus board
54	Slot Communic	Communication to a smart I/O option board is lost	- Check board seating in slots C-E. - Replace option boards - Replace microprocessor board
57	Identification	Identification is completed	- Verify Identification parameter is set to a value other than 0.

Fault Code	Fault Text	Possible Cause	Solution
60	Com Watchdog	Communication watchdog bit is not toggling	- Verify communications is working. - Verify watchdog bit is being toggled by host device.
61	User Fault 1	PB_User_Flt_1 is configured to a value that is High.	- Check configuration for function.
62	User Fault 2	PB_User_Flt_2 is configured to a value that is High.	- Check configuration for function.
65	Overspeed Flt	Drive tripped out on overspeed.	- Check for sudden loss of load. - verify proper speed feedback device and scaling. - Check overspeed setup
71	Brake Open	Brake has been commanded open and the aux brake contact has not been sensed.	- Check brake logic - Check brake aux logic - Check brake - Check configuration - Check digital input
76	Run Off Flt	Brakes have not set soon enough after runs removed	- Check for overload. - Check encoder feedback - Check motor tuning - Check motor
77	Dir Fault	Both directions selected at same time	- Check operator controls - Check configuration
78	Joystick Flt	Joystick reference without a run	- Check joystick calibration - Replace input board
80	Loc Stop Flt	Keypad stop button pressed for two seconds.	- Replace keypad.

10-6 DRIVE FAULT OPTIONS

Fault Code	Fault Text	Fault Mode	Stop Mode
1	Overcurrent	Fault	Coast Stop
2	Overvoltage	Fault	Coast Stop
3	Earth Fault	*Earth Fault*	*Earth Fault*
6	Emergency Stop	Fault	Coast Stop
7	Saturation	Fault	Coast Stop
8	System Fault	Fault	Coast Stop
9	Undervoltage	Fault	Normal Stop
11	Output Phase	*Phase Supv F*	*Phase Supv F*
12	Brk Chopper Supr	Fault	Coast Stop
13	Undertemp	Fault	Coast Stop
14	Overtemp	Fault	Coast Stop
15	Motor Stall	*Stall Protection*	*Stall Protection*
16	Mot.Overtemp	*Therm Prot F*	*Therm Prot F*
17	MotorUnderld	*ULoad Protect F*	*ULoad Protect F*
22/23	Chksum Flt	Fault	Coast Stop
24	Changed data warning	Fault	Coast Stop
25	Micro Watchdog	Fault	Coast Stop
31	IGBT Temp	Fault	Coast Stop
32	Fan Colling	Fault	Coast Stop
37	Device Change	Fault	Coast Stop

Fault Code	Fault Text	Fault Mode	Stop Mode
38	Device Added	Fault	Coast Stop
39	Device Removed	Fault	Coast Stop
40	Device Unknown	Fault	Coast Stop
41	IGBT Temp	Fault	Coast Stop
50	Anlg In Flt	Fault	Coast Stop
52	Keypad Comm	Fault	Normal Stop
53	FBCommunicat	*FBComm.FaultResp*	*FBComm.FaultResp*
54	Slot Communic	*SPI Flt Resp*	*SPI Flt Resp*
57	Identification	Warning	Coast Stop
60	Com Watchdog	*WD Flt Response*	*WD Flt Response*
61	User Fault 1	Fault	Coast Stop
62	User Fault 2	Fault	Coast Stop
65	Overspeed Flt	*Overspeed Resp*	*Overspeed Resp*
71	Brake Open	*Brk Opn Resp*	*Brk Opn Resp*
76	Run Off Flt	*Run Off Resp*	*Run Off Resp*
77	Dir Fault	*Dir Flt Resp*	*Dir Flt Resp*
78	Joystick Flt	*Joyst Resp*	*Joyst Resp*
80	Loc Stop Flt	Fault	Coast Stop

10-7 CRANE-SPECIFIC FAULTS SETUP

10-7.1 BRAKE OPEN FAULT

Parameters	**Type**	**Default**
Rel Brakes	DPB	
Brk Aux In	BCFG	1
Brk Opn FTim	CAL	200 ms.

Brake open fault is used to check the brake auxiliary contact wired to the drive to make sure it opens within *Brk Opn FTim* amount of time.

10-7.2 SPEED OFF FAULT

Parameters	**Type**	**Default**
RunRequest	DPB	
Rel Brakes	DPB	
Run Off Tim	CAL	10 seconds
Run_Off_Resp	E	Coast

The speed off fault is generated when the brakes have not set for *Run Off Tim* seconds after the runs have been removed.

Run Off Resp determines the action. Default is for the drive to fault with a coast stop.

10-7.3 BOTH DIRECTIONS FAULT

Parameters	**Type**	**Default**
Run Fwd Inp	BCFG	*DIN 1*
Run Rev Inp	BCFG	*DIN 2*
Dir_Flt_Resp	E	No Action

This fault occurs when both directions are commanded at the same time for 2 seconds.

Dir Flt Resp determines the action. Default is for the drive to ignore this condition.

10-7.4 JOYSTICK FAULT

Parameters	**Type**	**Default**
Anlg Ref	APB	
Joyst Flt St	CAL	20%
Start Input	DPB	
Joyst_Resp	E	No Action

This condition check to make sure the joystick is near zero when the runs are not active to verify the integrity of the device.

Joyst Resp determines the action. Default is for the drive to ignore this condition.

10-7.5 STALL FAULT

Parameters	**Type**	**Default**
Motor Current	APB	
Stall Flt Resp	E	0
Stall Freq Lim	CAL	25.00%
Stall Time Lim	CAL	15 seconds
Stall Current	CAL	100

Stall protection prevents motor damage by not allowing full torque with no movement. Default is to allow for stall to occur for 15 seconds which most motors can deliver without over heating.

Stall Resp determines the action. Default is for the drive to ignore this condition.

SECTION XI

QUICK STARTUP

The drive has two functions to help the user get started. The first is the *Ref Mode*, which will assist in setup of the digital inputs and speeds. The second is the identification routine, which will find the motor characteristics.

****

W A R N I N G

Crane software is highly specialized. This procedure does not set up for a hoist operation or set up all protections and limits. Protections must be set properly for safe crane operation. Review manual thoroughly or consult factory for setup.

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11-1 REF MODE

See Digtal input section of this manual for the setting of the digital inputs. If *Ref Mode* is enabled (not set to 0) the digtal inputs are hard set and can not be changed. If a different configuration is required *Ref Mode* needs to be set to zero and each input must be configured as desired.

The digital speeds are set *by Ref Mode* also per section 6.1 of the manual. Unlike the digital inputs these are set only upon the first time *Ref Mode* was set allowing the user to modify them as needed.

11-2 IDENTIFICATION

The Motor Identification program is used to scale motor parameters that are not listed on the nameplate. The parameters listed in the startup wizard must be entered.

The Identification parameter (*Self Tune Motor*) is located in the parameters\startup menu of the drive. Three options are available.

0 = No Action
1 = ID No Run

After selecting the action desired, the user has 20 seconds to activate a drive Run before the parameter switches back to 0 = No Action.

At any time during the Identification process, the stop button can be pressed to abort.

After identification is complete, the drive will turn off, and after 20 seconds, the *Self Tune Motor* parameter will go back to 0 = No Action.

The motor control mode determines what parameters are adjusted.

- *Self Tune Motor* = ID No Run
  - U/f curve, stator resistance, and torque boost are found

APPENDIX A

CONTROL BLOCK DIAGRAMS

Accel500 Crane Application Software control block diagrams are available upon request. Please contact the Avtron Customer Help Desk for assistance.

Phone: (216) 642-1230 ext. 1369

FAX: (216) 642-6037

APPENDIX B

PARAMETER LIST

MENU	NAME	ID	MIN	MAX	DEFAULT	DESCRIPTION
1	Monitor					Menu Name
1.1	Digital					Menu Name
1.1.1	MC Run	1098	0	1		
1.1.2	MC Ready	1115	0	1		
1.1.3	MC Fault	1116	0	1		Drive is in fault condition
1.1.4	MC Reverse	1086	0	1		Reverse indication
1.1.5	MC At Speed	1118	0	1		At speed
1.1.6	EndSt Perm	1135	0	1		Prevents crane movement when end stop is hit until crane comes to a stop and no command.
1.1.7	Slow Down Cmd	1149	0	1		In slow down condition.
1.1.8	Brk Hld Bit	1133	0	1		Holds in the brake until runs removed and below brake open speed.
1.1.9	Rel Brakes	1144	0	1		OK to release the brakes
1.1.10	At Zero Spd	1127	0	1		Speed feedback is near zero speed.
1.1.11	Command	0	0	20		Shows the reference commands for diagnostics
1.1.12	StopSlow	0	0	5		Stop and slow down status for diagnostics
1.2	Analog					Menu Name
1.2.1	Motor Speed	2	-100.00	100.00		Calculated motor speed in rpm//
1.2.2	DC-link Voltage	7	0	1000		Measured DC-link voltage//
1.2.3	Motor Current	3	0.00	100.00		Measured motor current//
1.2.4	Motor Torque	4	-100.0	100.0		[R] Motor torque as % value, +1000 equals +100.0 %//pos=clockwise, neg=counterclockwise
1.2.5	Motor Voltage	6	0.0	1000.0		Measured motor voltage //
1.2.6	Unit Temperature	8	-50	300		Temperature of the heat sink//
1.2.7	Run Time Cntr	1513	0	32767		Run time counter. Contineous without reset.
1.2.8	Output Frequency	1	0.00	Max_Frequency		Output frequency to the motor//
1.3	IO					Menu Name
1.3.1	DIN 1	1011	0	1		First digital input
1.3.2	DIN 2	1012	0	1		Second digital input
1.3.3	DIN 3	1013	0	1		Third digital input
1.3.4	DIN 4	1014	0	1		Fourth digital input from the first analog input.
1.3.5	DIN 5	1015	0	1		Fifth digital input need option board
1.3.6	DIN 6	1016	0	1		Sixth digital input need option board
1.3.7	DIN 7	1017	0	1		Seventh digital input need option board
1.3.8	DIN 8	1018	0	1		Eighth digital input need option board
1.3.9	DIN 9	1019	0	1		Ninth digital input need option board
1.3.10	AIN 1	1601	-327.65	327.65		First analog input
1.3.11	AIN 2	1602	-327.65	327.65		Second analog input
1.3.12	AOUT1 Val	1590	-327.67	327.67		Percent of full scale for the first analog output
1.3.13	AOUT2 Val	1591	-327.67	327.67		Percent of full scale for the second analog output
1.4	L2 Digital					Menu Name
1.4.1	Drive OK	1088	0	1		Drive not faulted.
1.4.2	Cntrl Inhib	1099	0	1		Drive is not ready to run.
1.4.3	Run OK	1091	0	1		All the interlocks are met to enable a run command.
1.4.4	Run Fwd Cmd	1147	0	1		Run forward is commanded.
1.4.5	Run Rev Cmd	1148	0	1		Run reverse has been commanded.
1.4.6	MC Out	1106	0	1		Motor contactor output bit.
1.4.7	Reverse	1128	0	1		Reverse commanded.

MENU	NAME	ID	MIN	MAX	DEFAULT	DESCRIPTION
1.4.8	Ramp Hold	1143	0	1		Ramp is held during infinite variable mode.
1.4.9	Blw Brk Spd	1131	0	1		Below the brake open speed.
1.4.10	Abv Base Spd	1129	0	1		Above base speed of the motor.
1.4.11	Run Cmd Inp	1110	0	1		Either forward or reverse run is commanded.
1.4.12	RunRequest	1090	0	1		Run request: 0=no, 1=yes
1.4.13	Watchdog Out	1003	0	1		Toggle bit for watch dog communications.
1.5	L2 Analog					Menu Name
1.5.1	Abs Mtr Spd	1501	0	32767		Absolute value of motor speed
1.5.2	Mtr Fil IA	1524	0.00	327.67		Filtered motor current in percent of the motor
1.5.3	Motor Power	5	-100.0	100.0		[R] Motor shaft power, 1000 equals 100.0 %
1.5.4	MotorTemperature	9	0.0	1000.0		Calculated Motor temperature in percent of nominal temperature (0,0 - 1000,0%)
1.5.5	Control Place	1505	0	2		Location of reference. 0 = remote, 1 = keypad, 2 = computer
1.5.6	SC Control Word	0	0	32767		SCI Control word bits B0-B15//B0 - RunRequest, 0=stop, 1=run//B1 - DirRequest, 0=clockwise, 1=counter-clockwise//B2 - FaultReset, 1=reset//B3 - GenSwitch1, application dependent //B4 - DO1, control of digital input 1, 1=active//B5 - DO2, control of d
1.5.7	Mtr Trq Unfil	1125	-300.0	300.0		Unfiltered motor torque 1000 equals 100%, pos = motor, neg = generator
1.5.8	Anlg Ref	0	-327.65	327.65		Analog speed reference
1.5.9	Abs Per Spd	1512	-320.00	320.00		Final speed reference from digital or analog source.
1.5.10	Freq Stpt	1503	-327.67	327.67		Speed reference after scaling to motor frequency and polarity.
1.5.11	FreqReference	25	0.00	Max_Frequency		Frequency reference to motor control//
1.5.12	FreqRampOut	1568	0.00	327.67		Output of ramp generator //f[Hz]=FreqRampOut/FreqScale//If FreqScale=100 then 5000 equals 50.00 Hz
1.5.13	Brake Chopper	1509	0	1		0 = no brake chopper,1 = brake chopper is installed
1.5.14	Est DC Nom V	1567	0	2000		Estimated nominal DC voltage in volts
1.5.15	BrakeResistor	1511	0	1		1 = no brake resistor,1 = brake resistor is installed
1.5.16	MtrRegStatus	1525	0	256		Status of motor limit regulators, 0=not active,1=active//B0=motoring current regulator//B1=generating current reg.//B2=motoring torque reg.//B3=generating torque reg.//B4=over voltage reg. //B5=under voltage reg.
1.5.17	SC Spd Ref	1527	-327.67	327.67		Speed reference, (0 ...32000) equals (0.00 ... 320.00) % * ???
1.5.18	Active Flt Last	37	0	2000		Last active fault code
1.5.19	Current Scale	0	0	100		Current Scale (10 or 100):// 10: I[A] = "CurrentVariable"/10// 100: I[A] = "CurrentVariable"/100//Depends on UnitSizeIndex
1.6	L2 IO					Menu Name
1.6.1	AI1 Type	0	0	5		Type of the first analog input
1.6.2	AI2 Type	0	0	5		Type of the second analog input
1.7	L2 Comms					Menu Name
1.7.1	Digital Inputs					Menu Name
1.7.1.1	FB DIN 1	1043	0	1		First digital input from the field bus. Configurable to any bit in FB Fix Cntrl Word by FB DIN1 Sel
1.7.1.2	FB DIN 2	1044	0	1		Second digital input from the field bus. Configurable to any bit in FB Fix Cntrl Word by FB DIN2 Sel
1.7.1.3	FB DIN 3	1045	0	1		Third digital input from the field bus. Configurable to any bit in FB Fix Cntrl Word by FB DIN3 Sel
1.7.1.4	FB DIN 4	1046	0	1		Fourth digital input from the field bus. Configurable to any bit in FB Fix Cntrl Word by FB DIN4 Sel
1.7.1.5	FB DIN 5	1047	0	1		Fifth digital input from the field bus. Configurable to any bit in FB Fix Cntrl Word by FB DIN5 Sel
1.7.1.6	FB Fix Cntrl Wrd	1621	0	32767		Control word,bits B0-15://B0 - RUN //B1 - DIRECTION//B2 - FaultRST//B3 - FBDIN1 //B4 - FBDIN2 //B5 - FBDIN3 //B6 - FBDIN4 //B7 - FBDIN5 //B8 - BusCtrl//B9 - BusRef//B10 – FBDIN6//B11 – FBDIN7//B12 – FBDIN8//B13 – FBDIN9//B14 – FBD
1.7.2	Analog Inputs					Menu Name
1.7.2.1	FB AIN1	1611	-327.67	327.67		First analog input from the field bus
1.7.2.2	FB AIN2	1612	-327.67	327.67		Second analog input from the field bus
1.7.2.3	FB AIN3	1613	-327.67	327.67		Third analog input from the field bus
1.7.2.4	FB AIN4	1614	-327.67	327.67		Fourth analog input from the field bus

MENU	NAME	ID	MIN	MAX	DEFAULT	DESCRIPTION
1.7.2.5	FB AIN5	1615	-327.67	327.67		Fifth analog input from the field bus
1.7.2.6	FB AIN6	1616	-327.67	327.67		Sixth analog input from the field bus
1.7.2.7	FB Spd Ref	1632	-327.67	327.67		Speed reference 0... 100,00% //Typically this value is in percent of the frequency area between the set minimum and maximum frequency.
1.7.3	Analog Outputs					Menu Name
1.7.3.1	FB Data Out 1	1622	-327.67	327.67		Application Specific process data
1.7.3.2	FB Data Out 2	1623	-327.67	327.67		Application Specific process data
1.7.3.3	FB Data Out 3	1624	-327.67	327.67		Application Specific process data
1.7.3.4	FB Data Out 4	1625	-327.67	327.67		Application Specific process data
1.7.3.5	FB Data Out 5	1626	-327.67	327.67		Application Specific process data
1.7.3.6	FB Data Out 6	1627	-327.67	327.67		Application Specific process data
1.7.3.7	FB Gen Sts Word	1631	0	32767		Status word (bits B0...B15) Binary Coded, Application Specific
1.7.3.8	Input Sts Word	1633	0	32767		Digital inputs sequential in a word
2	Parameters					Menu Name
2.1	Quick Menu					Menu Name
2.1.1	Speed 1	1313	-320.00	320.00	20.00	First digital speed. Default to 20% speed.
2.1.2	Speed 2	1314	-320.00	320.00	40.00	Second digital input speed. Default to 40% speed.
2.1.3	Speed 3	1315	-320.00	320.00	60.00	Third digital input speed. Default to 60% speed.
2.1.4	Speed 4	1316	-320.00	320.00	80.00	Fourth digital input speed. Default to 80% speed.
2.1.5	SD Speed	0	-320.00	320.00	13.12	Digital slow down speed. Default 50%
2.1.6	Rel Rmp Dly	0	0.00	327.67	0.10	Delay to release ramp until brakes can be picked up. Default is .1 seconds
2.1.7	Brk Opn Dly	0	0.00	327.67	0.00	Delay for setting the brakes after the drive is below zero speed. Default to no delay.
2.1.8	Password	0	0	32000	0	Password Entry value.
2.2	Startup					Menu Name
2.2.1	Ref Mode	0	0	4	0	Section reference type for wizard.
2.2.2	Motor Nom Voltg	110	180	690		Motor nominal voltage in Volts
2.2.3	Motor Nom Currnt	113	MotorCurrentMin	MotorCurrentMax		Motor nominal current, I[A]
2.2.4	Motor Nom Speed	112	100	20000		Motor nominal speed in rpm
2.2.5	Motor Nom Freq	111	30.00	320.00		Motor nominal frequency
2.2.6	Min Frequency	101	0.00	Max_Frequency		Min output frequency
2.2.7	Max Frequency	102	Min_Frequency	320.00		Max output frequency
2.2.8	Accel Time 1	103	0.1	3000.0		Acceleration time from Min Frequency to Max Frequency
2.2.9	Decel Time 1	104	0.1	3000.0		Deceleration time from Max Frequency to Min Frequency
2.2.10	Self Tune Motor	631	0	1		Activates Identification without run at next start. Measures RsVoltageDrop and tunes the U/f Curve.//0 = No Action//1 = Identification without run. Give start order within 20 seconds !
2.3	L2 Protections					Menu Name
2.3.1	Fault Reset Sel	0	0	15	0	Select Fault Reset bit. Default to zero bit.
2.3.2	User Flt1 Sel	0	0	15	0	First user fault. Default to zero bit.
2.3.3	User Flt2 Sel	0	0	15	0	Second user fault. Default to zero bit.
2.3.4	Overspeed Resp	0	0	3	3	Overspeed drive response. Default to fault coast stop
2.3.5	UV Fault Resp	0	0	3	3	Fault response on undervoltage. Default to Fault with Coast stop.
2.3.6	Phase Supv F	702	0	3	0	0 = No action//1 = Warning//2 = Fault, stop according to par 2.1.12//3 = Fault, stop always by coasting
2.3.7	Earth Flt Resp	0	0	3	3	Earth fault response. Default to fault with coast stop.
2.3.8	Earth fault	703	0	3		0 = No action//1 = Warning//2 = Fault, stop according to par 2.1.12//3 = Fault, stop always by coasting
2.3.9	MotAmbTempFactor	705	-100.0	100.0		Ambient temperature of the motor (-100.0... 100.0%) 0.0= nominal, 100.0= max.
2.3.10	Mot Therm 0 Spd	706	0.0	150.0		Motor cooling ability at zero speed
2.3.11	Mtr Therm TC	707	1	200		Motor Thermal Time Constant in minutes
2.3.12	Motor Duty Cycle	708	0	100		Motor Duty Cycle in %.
2.3.13	Uload Protect F	713	0	3	0	0 = No action//1 = Warning//2 = Fault, stop according to par 2.1.12//3 = Fault, stop always by coasting

MENU	NAME	ID	MIN	MAX	DEFAULT	DESCRIPTION
2.3.14	Under Ld Trq Nom	714	10.0	150.0		Underload load curve at nominal frequency
2.3.15	Under Ld Trq 0	715	5.0	150.0		Underload load curve at zero frequency
2.3.16	Under Ld State T	716	2.00	600.00		Time limit for underload supervision
2.3.17	FBComm.FaultResp	733	0	3	0	0 = No action//1 = Warning//2 = Fault, stop according to par 2.1.12//3 = Fault, stop always by coasting//4 = Warning, Preset Speed P2.7.22
2.3.18	SPI Flt Resp	734	0	3	3	Response to option card fault//0 = No action//1 = Warning//2 = Fault, stop according to par 2.1.12//3 = Fault, stop always by coasting//4=Warning, Preset speed P2.7.22
2.3.19	WD Ftl Response	0	0	3	0	Field bus watch dog timer response. Default to no action.
2.3.20	Brk Opn FTime	1268	0.00	327.67	0.20	Brake open delay to check the aux contact for a fault if enabled.
2.3.21	Run Off Resp	0	0	3	3	Faults the drive if it does not stop when commanded. Default to fault with coast stop.
2.3.22	Run Off Tim	0	0.00	327.67	2.00	Time given above the normal time the crane should have stop before a fault can occur if enabled. Dfault 2 seconds.
2.3.23	Dir Flt Resp	0	0	3	3	Both directions commanded at same time fault response. Default to fault coast stop.
2.3.24	Joyst Flt St	0	0.00	327.67	20.00	Joystick refernce above this setpoint with no run can be configured to fault the drive.
2.3.25	Joyst Resp	0	0	3	0	Enable joystick reference without a run fault. Default to no action.
2.3.26	Stall Flt Resp	709	0	3	0	0 = No action//1 = Warning//2 = Fault, stop according to par 2.1.12//3 = Fault, stop always by coasting
2.3.27	Stall Freq Lim	712	1.00	Max_Frequency		[W] Max frequency for stall protection, f[Hz] = StallFrequency/FreqScale. Init := 2500
2.3.28	Stall Time Lim	711	1.00	120.00		[W] Max time for stall in 0,01s (100 ... 12000). Init := 1500
2.3.29	Stall Current	710	MotorCurrentMin	MotorCurrentMax		[W] Current limit of motor stall protection, I[A] = StallCurrentLimit/CurrentScale//(1...65535)//if CurrentScale=10 then 100 equals 10.0 A. Init := 100
2.3.30	Auto Reset	0	0	1	0	Enables auto reset of faults after Auto Res Tim period.
2.3.31	Auto Res Tim	0	0.00	327.67	60.00	Delay to reset faults automatically in seconds if enabled by Auto Reset.
2.4	L2 Setpoints					Menu Name
2.4.1	Brk Hld Spd	1266	0	32767	50	Brake is held open until speed falls below this setpoint. Default 50 rpm.
2.4.2	Sp Cal1	1330	-327.67	327.67	0.00	Spare calibration setpoint for a analog connection input.
2.4.3	Sp Cal2	1331	-327.67	327.67	0.00	Spare calibration setpoint for a analog connection input.
2.4.4	Sp Cal3	1332	-327.67	327.67	0.00	Spare calibration setpoint for a analog connection input.
2.4.5	Sp Cal4	1333	-327.67	327.67	0.00	Spare calibration setpoint for a analog connection input.
2.4.6	Sp Cal5	1334	-327.67	327.67	0.00	Spare calibration setpoint for a analog connection input.
2.4.7	Sp Cal6	1335	-327.67	327.67	0.00	Spare calibration setpoint for a analog connection input.
2.4.8	User Password	0	0	32000	1	User password. If zero no password required for full menu.
2.5	L2 Rates/Times					Menu Name
2.5.1	Smooth Ratio	500	0.0	10.0		[W] Smooth ratio for S-curves//0 = linear ramps//100 = full acc/dec inc/dec times.
2.5.2	Fast Stop Tim	0	0.1	3000.0	2.0	Fast stop time in seconds from max speed.
2.5.3	Smooth Ratio 2	501	0.0	10.0		Smooth ratio 2 for S-curves//0 = linear ramps//100 = full acc/dec inc/dec times
2.5.4	Mtr Cur TC	0	0.00	20.00	0.50	Motor current lowpass filter for monitoring
2.5.5	Spd Cmp Fil TC	0	0.00	10.00	0.10	Speed comparitor low pass filter. Default to 0.1 seconds.
2.5.6	WD Com Dly	0	0.00	100.00	0.10	Communication Watchdog timer delay. Default 100 ms.
2.5.7	WD Init Dly Tim	0	0.00	100.00	10.00	Power up delay for the watch dog timer. Default to 10 seconds.
2.6	L2 Tuning					Menu Name
2.6.1	Speed Control Kp	0	0	32767	613	P-gain of open loop speed controller (0...32767)
2.6.2	Speed Control Ti	0	0	32767	614	I-gain of open loop speed controller (0 ... 32767)
2.7	L2 Limits					Menu Name
2.7.1	Current Limit	107	MotorCurrentMin	MotorCurrentMax		Output current limit [A] of the unit
2.7.2	Ovr Spd Stp	1258	0.00	327.67	110.00	Overspeed setpoint in percent of max speed. Default to 110%
2.7.3	Zero Detect	1259	0.00	200.00	2.00	Speed feedback comparitor At Zero Speed setpoint. Default to 2% of max speed
2.7.4	Spd Hyst	0	0.00	200.00	1.00	Speed feedback comparitor hysteresis value. Default = 1%.

MENU	NAME	ID	MIN	MAX	DEFAULT	DESCRIPTION
2.7.5	Spd Decimal	0	0	2	2	Speed comparitor number of deciaml points for the inputs. Default to 2 decimal points.
2.7.6	Max Speed Per	0	0.00	327.67	100.00	MAx speed in percent of motor. Default to 100 %
2.8	L2 Scaling					Menu Name
2.8.1	LS to Freq	1282	-32.767	32.767	0.600	Scaling factor to convert speed reference units (%) to motor units (Hz)
2.8.2	LS Scl Div	1281	-32767	32767	1000	Scaling factor to convert speed reference units (%) to motor units (Hz)
2.8.3	SD Mlt Stpt	1289	0.00	10.00	0.50	Slow down multiplier for analog reference. Default 0.50.
2.9	L2 Anlg Config					Menu Name
2.9.1	Joyst Sel	0	0	15	2	Joystick Reference. Default to the first analog input.
2.9.2	Cur Lim Sel	0	0	10	10	Selection for current limit. Default to parameter Current Limit.
2.10	L2 Enables					Menu Name
2.10.1	EndSt Maint	0	0	1	0	Temporary disables the end stop to test ultimate limit.
2.10.2	Stop Function	0	0	2	2	Stop function, 0=coasting, 1=framp 2= ramp with Runenable = coast
2.10.3	Brake Chopper	504	0	3		
2.10.4	Overvolt Contr	607	0	1		Overvoltage controller://0 = Controller is not operating //1 = Controller is operating
2.10.5	Undervolt Contr	608	0	1		Undervoltage controller://0 = Controller is not operating //1 = Controller is operating
2.10.6	Joyst Pol En	0	0	1	0	Enables joystick direction from input polarity.
2.11	L2 I/O					Menu Name
2.11.1	Digital Inputs					Menu Name
2.11.1.1	Run Fwd Sel	0	0	15	2	Selects from the digital input for the Run forward command. Default to First digital input.
2.11.1.2	Run Rev Sel	0	0	15	3	Selects from the digital input for the Run reverse command. Default to second digital input.
2.11.1.3	Fast Stop Sel	0	0	15	1	Fast stop input. Default to TRUE.
2.11.1.4	Coast Stop	0	0	15	1	Coast stop input. Default to TRUE.
2.11.1.5	EndSt Fwd Sel	0	0	15	1	End stop in forward position input. Default to TRUE.
2.11.1.6	EndSt Rev Sel	0	0	15	1	End stop in reverse direction. Default to TRUE.
2.11.1.7	Digital Sel	0	0	15	1	Use digital speed setpoints versus analog. Default to Digital.
2.11.1.8	Spd2 Sel	0	0	15	4	Second digital speed enable. Default to second digital input
2.11.1.9	Spd3 Sel	0	0	15	0	Third digtal speed enable. Default to FALSE.
2.11.1.10	Spd4 Sel	0	0	15	0	Fourth digital speed enable. Default to FALSE.
2.11.1.11	Fwd SD Sel	0	0	15	1	Forward slow down input. Default to off.
2.11.1.12	Rev SD Sel	0	0	15	1	Reverse slow down input. Default to Off.
2.11.1.13	Spd Up Sel	0	0	15	4	Speed up input for infinite variable mode. Default changes by wizard for digital input 3.
2.11.1.14	Inf Var En	0	0	15	1	Enables the infinite variable function. Also need to set ramp up bit.
2.11.1.15	Brk Aux Sel	0	0	15	1	Brake aux contact input to verify brakes have released. optional function.
2.11.1.16	Watchdog In	0	0	15	0	Communications watchdog timer input from PLC. Default to Zero Bit.
2.11.2	Digital Outputs					Menu Name
2.11.2.1	DOUT1 Config	0	0	15	2	Selection for standard digital output. Default to drive faulted.
2.11.2.2	DOUT2 Config	0	0	15	7	Selection for optional digital output. Default to release brakes.
2.11.3	Analog Inputs					Menu Name
2.11.3.1	AIN1 Gain	0	-320.00	320.00	1.00	First analog inout gain scaling factor.
2.11.3.2	AIN1 Off	0	-320.00	320.00	0.00	First analog inout offset scaling factor.
2.11.3.3	AIN1 Tc	0	0.00	5.00	0.10	First analog input low pass filter. default 0.1 seconds.
2.11.3.4	AIN2 Gain	0	-320.00	320.00	1.00	Second analog inout gain scaling factor.
2.11.3.5	AIN2 Off	0	-320.00	320.00	0.00	Second analog inout offset scaling factor.
2.11.3.6	AIN2 Tc	0	0.00	5.00	0.10	Second analog input low pass filter. default 0.1 seconds.
2.11.4	Analog Outputs					Menu Name
2.11.4.1	AOut1 Config	0	0	4	0	Selects the value for the analog output
2.11.4.2	AOUT1 Zero	0	-327.67	327.67	0.00	Offset for the first analog output.
2.11.4.3	AOUT1 Cal	0	-327.67	327.67	1.00	Scaling factor for the first analog output
2.11.4.4	AOUT1 TC	0	0.00	5.00	0.10	Low pass filter for the first analog output. Default to 0.1 seconds.
2.11.4.5	AOut2 Config	0	0	4	1	Selects the value for the optional analog output. Requires additional option board.

MENU	NAME	ID	MIN	MAX	DEFAULT	DESCRIPTION
2.11.4.6	AOUT2 Zero	0	-327.67	327.67	0.00	Offset for the second analog output.
2.11.4.7	AOUT2 Cal	0	-327.67	327.67	1.00	Scaling factor for the second analog output
2.11.4.8	AOUT2 TC	0	0.00	5.00	0.10	Low pass filter for the second analog output. Default to 0.1 seconds.
2.11.4.9	AOUT2 Slot ID	0	0	59	0	Set to the slot and offset for the optional second analog output if used.
2.12	L2 Motor					Menu Name
2.12.1	Motor Ctrl Mode	600	0	ControlModeMax		Motor control mode://0=frequency control//1=speed controll
2.12.2	DC-Brake Current	507	MotorCurrentMin	MotorCurrentMax		DC brake current used in start
2.12.3	FluxBrakeCurrent	519	MotorCurrentMin	MotorCurrentMax		Flux brake current: Default=MotorNomCurrent.
2.12.4	Voltage at FWP	603	10.00	200.00		Motor voltage (%*NotorNomVoltage) at field weakening point
2.12.5	U/f Mid Freq	604	0.00	FieldWeakeningPoint		Programmable U/F curve middle point, f[Hz]
2.12.6	U/f Mid Voltg	605	0.00	100.00		Motor voltage in % of Motor Nominal Voltage at programmable U/F curve middle point
2.12.7	Zero Freq Voltg	606	0.00	40.00		Motor voltage in % of Motor Nominal Voltage at programmable U/F curve zero point
2.12.8	Switching Freq	601	1.0	SwitchingFreqMax		Switching frequency in kHz
2.12.9	Slip Adjsut	0	0	300		Slip adjust gain(100 = 100%)
2.12.10	Stop DC-BrakeTm	508	0.00	600.00		Dc brake time [s] in ramp stop
2.12.11	Stop DC-BrakeFr	515	0.10	10.00		Dc-brake is allowed under this frequency limit
2.12.12	Start DC-BrakeTm	516	0.00	600.00		DC brake time in start
2.12.13	Motor Cos Phi	120	0.30	1.00		Motor Cos Phii
2.12.14	U/f Ratio Select	108	0	3		
2.12.15	U/f Optimization	109	0	1		U/F optimization selection, 0=none, 1=automatic torque boost
2.12.16	Flux Brake	520	0	1		1=flux brakeing is enabled.
2.12.17	Field WeakngPnt	602	30.00	320.00		Field weakening point
2.12.18	Rs Voltage Drop	662	0	30000		[W] Measured Voltage drop at stator resistanse between two phases with nom current of motor. Unit: 256=10%.
2.13	L2 Comms					Menu Name
2.13.1	FB DIN1 Sel	0	0	15	0	Configures FB DIN1 to a particular bit in FB Fix Cntrl Wrd. Default to bit 0.
2.13.2	FB DIN2 Sel	0	0	15	1	Configures FB DIN2 to a particular bit in FB Fix Cntrl Wrd. Default to bit 1.
2.13.3	FB DIN3 Sel	0	0	15	2	Configures FB DIN3 to a particular bit in FB Fix Cntrl Wrd. Default to bit 2.
2.13.4	FB DIN4 Sel	0	0	15	3	Configures FB DIN4 to a particular bit in FB Fix Cntrl Wrd. Default to bit 3.
2.13.5	FB DIN5 Sel	0	0	15	4	Configures FB DIN5 to a particular bit in FB Fix Cntrl Wrd. Default to bit 4.
2.13.6	FB AOUT1	0	0	15	2	Configures the data to be sent out the first field bus analog value.
2.13.7	FB AOUT2	0	0	15	1	Configures the data to be sent out the second field bus analog value.
2.13.8	FB AOUT3	0	0	15	3	Configures the data to be sent out the third field bus analog value.
2.13.9	FB AOUT4	0	0	15	0	Configures the data to be sent out the fourth field bus analog value.
2.13.10	FB AOUT5	0	0	15	7	Configures the data to be sent out the fifth field bus analog value.
2.13.11	FB AOUT6	0	0	15	13	Configures the data to be sent out the sixth field bus analog value.
2.14	L2 Constants					Menu Name
3	Keypad Control					Menu Name
3.1	Remote Control	0	0	1	1	Remote versus panel control. Default to remote control.
3.2	Keypad Spd Ref					
3.3	Keypad Spd Dir	0	0	1	0	Speed direction when in local mode.
4	Active Faults					Menu Name
5	Fault History					Menu Name
6	System Menu					Menu Name
7	Expander boards					Menu Name
7.1						Menu Name
7.2						Menu Name

APPENDIX C

ALPHABETICAL CROSS-REFERENCE

NAME	ID	MENU
Abs Mtr Spd	1501	1.5.1
Abs Per Spd	1512	1.5.9
Abv Base Spd	1129	1.4.10
Accel Time 1	103	2.2.8
Active Flt Last	37	1.5.18
AI1 Type	0	1.6.1
AI2 Type	0	1.6.2
AIN 1	1601	1.3.10
AIN 2	1602	1.3.11
AIN1 Gain	0	2.11.3.1
AIN1 Off	0	2.11.3.2
AIN1 Tc	0	2.11.3.3
AIN2 Gain	0	2.11.3.4
AIN2 Off	0	2.11.3.5
AIN2 Tc	0	2.11.3.6
Anlg Ref	0	1.5.8
AOUT1 Cal	0	2.11.4.3
AOut1 Config	0	2.11.4.1
AOUT1 TC	0	2.11.4.4
AOUT1 Val	1590	1.3.12
AOUT1 Zero	0	2.11.4.2
AOUT2 Cal	0	2.11.4.7
AOut2 Config	0	2.11.4.5
AOUT2 Slot ID	0	2.11.4.9
AOUT2 TC	0	2.11.4.8
AOUT2 Val	1591	1.3.13
AOUT2 Zero	0	2.11.4.6
At Zero Spd	1127	1.1.10
Auto Res Tim	0	2.3.31
Auto Reset	0	2.3.30
Blw Brk Spd	1131	1.4.9
Brake Chopper	504	2.10.3
Brake Chopper	1509	1.5.13
BrakeResistor	1511	1.5.15
Brk Aux Sel	0	2.11.1.15
Brk Hld Bit	1133	1.1.8
Brk Hld Spd	1266	2.4.1
Brk Opn Dly	0	2.1.7
Brk Opn FTime	1268	2.3.20
Cntrl Inhib	1099	1.4.2
Coast Stop	0	2.11.1.4
Command	0	1.1.11
Control Place	1505	1.5.5
Cur Lim Sel	0	2.9.2
Current Limit	107	2.7.1
Current Scale	0	1.5.19
DC-Brake Current	507	2.12.2
DC-link Voltage	7	1.2.2
Decel Time 1	104	2.2.9

NAME	ID	MENU
Digital Sel	0	2.11.1.7
DIN 1	1011	1.3.1
DIN 2	1012	1.3.2
DIN 3	1013	1.3.3
DIN 4	1014	1.3.4
DIN 5	1015	1.3.5
DIN 6	1016	1.3.6
DIN 7	1017	1.3.7
DIN 8	1018	1.3.8
DIN 9	1019	1.3.9
Dir Flt Resp	0	2.3.23
DOUT1 Config	0	2.11.2.1
DOUT2 Config	0	2.11.2.2
Drive OK	1088	1.4.1
Earth fault	703	2.3.8
Earth Flt Resp	0	2.3.7
EndSt Fwd Sel	0	2.11.1.5
EndSt Maint	0	2.10.1
EndSt Perm	1135	1.1.6
EndSt Rev Sel	0	2.11.1.6
Est DC Nom V	1567	1.5.14
Fast Stop Sel	0	2.11.1.3
Fast Stop Tim	0	2.5.2
Fault Reset Sel	0	2.3.1
FB AIN1	1611	1.7.2.1
FB AIN2	1612	1.7.2.2
FB AIN3	1613	1.7.2.3
FB AIN4	1614	1.7.2.4
FB AIN5	1615	1.7.2.5
FB AIN6	1616	1.7.2.6
FB AOUT1	0	2.13.6
FB AOUT2	0	2.13.7
FB AOUT3	0	2.13.8
FB AOUT4	0	2.13.9
FB AOUT5	0	2.13.10
FB AOUT6	0	2.13.11
FB Data Out 1	1622	1.7.3.1
FB Data Out 2	1623	1.7.3.2
FB Data Out 3	1624	1.7.3.3
FB Data Out 4	1625	1.7.3.4
FB Data Out 5	1626	1.7.3.5
FB Data Out 6	1627	1.7.3.6
FB DIN 1	1043	1.7.1.1
FB DIN 2	1044	1.7.1.2
FB DIN 3	1045	1.7.1.3
FB DIN 4	1046	1.7.1.4
FB DIN 5	1047	1.7.1.5
FB DIN1 Sel	0	2.13.1
FB DIN2 Sel	0	2.13.2

NAME	ID	MENU
FB DIN3 Sel	0	2.13.3
FB DIN4 Sel	0	2.13.4
FB DIN5 Sel	0	2.13.5
FB Fix Cntrl Wrd	1621	1.7.1.6
FB Gen Sts Word	1631	1.7.3.7
FB Spd Ref	1632	1.7.2.7
FBComm.FaultResp	733	2.3.17
Field WeakngPnt	602	2.12.17
Flux Brake	520	2.12.16
FluxBrakeCurrent	519	2.12.3
Freq Stpt	1503	1.5.10
FreqRampOut	1568	1.5.12
FreqReference	25	1.5.11
Fwd SD Sel	0	2.11.1.11
Inf Var En	0	2.11.1.14
Input Sts Word	1633	1.7.3.8
Joyst Flt St	0	2.3.24
Joyst Pol En	0	2.10.6
Joyst Resp	0	2.3.25
Joyst Sel	0	2.9.1
Keypad Spd Dir	0	3.3
Keypad Spd Ref		3.2
LS Scl Div	1281	2.8.2
LS to Freq	1282	2.8.1
Max Frequency	102	2.2.7
Max Speed Per	0	2.7.6
MC At Speed	1118	1.1.5
MC Fault	1116	1.1.3
MC Out	1106	1.4.6
MC Ready	1115	1.1.2
MC Reverse	1086	1.1.4
MC Run	1098	1.1.1
Min Frequency	101	2.2.6
Mot Therm 0 Spd	706	2.3.10
MotAmbTempFactor	705	2.3.9
Motor Cos Phi	120	2.12.13
Motor Ctrl Mode	600	2.12.1
Motor Current	3	1.2.3
Motor Duty Cycle	708	2.3.12
Motor Nom Currnt	113	2.2.3
Motor Nom Freq	111	2.2.5
Motor Nom Speed	112	2.2.4
Motor Nom Voltg	110	2.2.2
Motor Power	5	1.5.3
Motor Speed	2	1.2.1
Motor Torque	4	1.2.4
Motor Voltage	6	1.2.5
MotorTemperature	9	1.5.4
Mtr Cur TC	0	2.5.4
Mtr Fil IA	1524	1.5.2
Mtr Therm TC	707	2.3.11
Mtr Trq Unfil	1125	1.5.7
MtrRegStatus	1525	1.5.16
Output Frequency	1	1.2.8
Overspeed Resp	0	2.3.4
Overvolt Contr	607	2.10.4
Ovr Spd Stp	1258	2.7.2
Password	0	2.1.8
Phase Supv F	702	2.3.6

NAME	ID	MENU
Ramp Hold	1143	1.4.8
Ref Mode	0	2.2.1
Rel Brakes	1144	1.1.9
Rel Rmp Dly	0	2.1.6
Remote Control	0	3.1
Rev SD Sel	0	2.11.1.12
Reverse	1128	1.4.7
Rs Voltage Drop	662	2.12.18
Run Cmd Inp	1110	1.4.11
Run Fwd Cmd	1147	1.4.4
Run Fwd Sel	0	2.11.1.1
Run Off Resp	0	2.3.21
Run Off Tim	0	2.3.22
Run OK	1091	1.4.3
Run Rev Cmd	1148	1.4.5
Run Rev Sel	0	2.11.1.2
Run Time Cntr	1513	1.2.7
RunRequest	1090	1.4.12
SC Control Word	0	1.5.6
SC Spd Ref	1527	1.5.17
SD Mlt Stpt	1289	2.8.3
SD Speed	0	2.1.5
Self Tune Motor	631	2.2.10
Slip Adjsut	0	2.12.9
Slow Down Cmd	1149	1.1.7
Smooth Ratio	500	2.5.1
Smooth Ratio 2	501	2.5.3
Sp Cal1	1330	2.4.2
Sp Cal2	1331	2.4.3
Sp Cal3	1332	2.4.4
Sp Cal4	1333	2.4.5
Sp Cal5	1334	2.4.6
Sp Cal6	1335	2.4.7
Spd Cmp Fil TC	0	2.5.5
Spd Decimal	0	2.7.5
Spd Hyst	0	2.7.4
Spd Up Sel	0	2.11.1.13
Spd2 Sel	0	2.11.1.8
Spd3 Sel	0	2.11.1.9
Spd4 Sel	0	2.11.1.10
Speed 1	1313	2.1.1
Speed 2	1314	2.1.2
Speed 3	1315	2.1.3
Speed 4	1316	2.1.4
Speed Control Kp	0	2.6.1
Speed Control Ti	0	2.6.2
SPI Flt Resp	734	2.3.18
Stall Current	710	2.3.29
Stall Flt Resp	709	2.3.26
Stall Freq Lim	712	2.3.27
Stall Time Lim	711	2.3.28
Start DC-BrakeTm	516	2.12.12
Stop DC-BrakeFr	515	2.12.11
Stop DC-BrakeTm	508	2.12.10
Stop Function	0	2.10.2
StopSlow	0	1.1.12
Switching Freq	601	2.12.8
U/f Mid Freq	604	2.12.5
U/f Mid Voltg	605	2.12.6

NAME	ID	MENU
U/f Optimization	109	2.12.15
U/f Ratio Select	108	2.12.14
Uload Protect F	713	2.3.13
Under Ld State T	716	2.3.16
Under Ld Trq 0	715	2.3.15
Under Ld Trq Nom	714	2.3.14
Undervolt Contr	608	2.10.5
Unit Temperature	8	1.2.6
User Flt1 Sel	0	2.3.2
User Flt2 Sel	0	2.3.3
User Password	0	2.4.8
UV Fault Resp	0	2.3.5
Voltage at FWP	603	2.12.4
Watchdog In	0	2.11.1.16
Watchdog Out	1003	1.4.13
WD Com Dly	0	2.5.6
WD Ftl Response	0	2.3.19
WD Init Dly Tim	0	2.5.7
Zero Detect	1259	2.7.3
Zero Freq Voltg	606	2.12.7

APPENDIX D

PARAMETER ID NUMBER CROSS-REFERENCE

ID	NAME	MENU
1	Output Frequency	1.2.8
2	Motor Speed	1.2.1
3	Motor Current	1.2.3
4	Motor Torque	1.2.4
5	Motor Power	1.5.3
6	Motor Voltage	1.2.5
7	DC-link Voltage	1.2.2
8	Unit Temperature	1.2.6
9	MotorTemperature	1.5.4
25	FreqReference	1.5.11
37	Active Flt Last	1.5.18
101	Min Frequency	2.2.6
102	Max Frequency	2.2.7
103	Accel Time 1	2.2.8
104	Decel Time 1	2.2.9
107	Current Limit	2.7.1
108	U/f Ratio Select	2.12.14
109	U/f Optimization	2.12.15
110	Motor Nom Voltg	2.2.2
111	Motor Nom Freq	2.2.5
112	Motor Nom Speed	2.2.4
113	Motor Nom Currnt	2.2.3
120	Motor Cos Phi	2.12.13
500	Smooth Ratio	2.5.1
501	Smooth Ratio 2	2.5.3
504	Brake Chopper	2.10.3
507	DC-Brake Current	2.12.2
508	Stop DC-BrakeTm	2.12.10
515	Stop DC-BrakeFr	2.12.11
516	Start DC-BrakeTm	2.12.12
519	FluxBrakeCurrent	2.12.3
520	Flux Brake	2.12.16
600	Motor Ctrl Mode	2.12.1
601	Switching Freq	2.12.8
602	Field WeakngPnt	2.12.17
603	Voltage at FWP	2.12.4
604	U/f Mid Freq	2.12.5
605	U/f Mid Voltg	2.12.6
606	Zero Freq Voltg	2.12.7
607	Overvolt Contr	2.10.4
608	Undervolt Contr	2.10.5
631	Self Tune Motor	2.2.10
662	Rs Voltage Drop	2.12.18
702	Phase Supv F	2.3.6
703	Earth fault	2.3.8
705	MotAmbTempFactor	2.3.9
706	Mot Therm 0 Spd	2.3.10
707	Mtr Therm TC	2.3.11
708	Motor Duty Cycle	2.3.12
709	Stall Flt Resp	2.3.26

ID	NAME	MENU
710	Stall Current	2.3.29
711	Stall Time Lim	2.3.28
712	Stall Freq Lim	2.3.27
713	Uload Protect F	2.3.13
714	Under Ld Trq Nom	2.3.14
715	Under Ld Trq 0	2.3.15
716	Under Ld State T	2.3.16
733	FBComm.FaultResp	2.3.17
734	SPI Flt Resp	2.3.18
1003	Watchdog Out	1.4.13
1011	DIN 1	1.3.1
1012	DIN 2	1.3.2
1013	DIN 3	1.3.3
1014	DIN 4	1.3.4
1015	DIN 5	1.3.5
1016	DIN 6	1.3.6
1017	DIN 7	1.3.7
1018	DIN 8	1.3.8
1019	DIN 9	1.3.9
1043	FB DIN 1	1.7.1.1
1044	FB DIN 2	1.7.1.2
1045	FB DIN 3	1.7.1.3
1046	FB DIN 4	1.7.1.4
1047	FB DIN 5	1.7.1.5
1086	MC Reverse	1.1.4
1088	Drive OK	1.4.1
1090	RunRequest	1.4.12
1091	Run OK	1.4.3
1098	MC Run	1.1.1
1099	Cntrl Inhib	1.4.2
1106	MC Out	1.4.6
1110	Run Cmd Inp	1.4.11
1115	MC Ready	1.1.2
1116	MC Fault	1.1.3
1118	MC At Speed	1.1.5
1125	Mtr Trq Unfil	1.5.7
1127	At Zero Spd	1.1.10
1128	Reverse	1.4.7
1129	Abv Base Spd	1.4.10
1131	Blw Brk Spd	1.4.9
1133	Brk Hld Bit	1.1.8
1135	EndSt Perm	1.1.6
1143	Ramp Hold	1.4.8
1144	Rel Brakes	1.1.9
1147	Run Fwd Cmd	1.4.4
1148	Run Rev Cmd	1.4.5
1149	Slow Down Cmd	1.1.7
1258	Ovr Spd Stp	2.7.2
1259	Zero Detect	2.7.3
1266	Brk Hld Spd	2.4.1

ID	NAME	MENU
1268	Brk Opn FTime	2.3.20
1281	LS Scl Div	2.8.2
1282	LS to Freq	2.8.1
1289	SD Mlt Stpt	2.8.3
1313	Speed 1	2.1.1
1314	Speed 2	2.1.2
1315	Speed 3	2.1.3
1316	Speed 4	2.1.4
1330	Sp Cal1	2.4.2
1331	Sp Cal2	2.4.3
1332	Sp Cal3	2.4.4
1333	Sp Cal4	2.4.5
1334	Sp Cal5	2.4.6
1335	Sp Cal6	2.4.7
1501	Abs Mtr Spd	1.5.1
1503	Freq Stpt	1.5.10
1505	Control Place	1.5.5
1509	Brake Chopper	1.5.13
1511	BrakeResistor	1.5.15
1512	Abs Per Spd	1.5.9
1513	Run Time Cntr	1.2.7
1524	Mtr Fil IA	1.5.2
1525	MtrRegStatus	1.5.16
1527	SC Spd Ref	1.5.17

ID	NAME	MENU
1567	Est DC Nom V	1.5.14
1568	FreqRampOut	1.5.12
1590	AOUT1 Val	1.3.12
1591	AOUT2 Val	1.3.13
1601	AIN 1	1.3.10
1602	AIN 2	1.3.11
1611	FB AIN1	1.7.2.1
1612	FB AIN2	1.7.2.2
1613	FB AIN3	1.7.2.3
1614	FB AIN4	1.7.2.4
1615	FB AIN5	1.7.2.5
1616	FB AIN6	1.7.2.6
1621	FB Fix Cntrl Wrd	1.7.1.6
1622	FB Data Out 1	1.7.3.1
1623	FB Data Out 2	1.7.3.2
1624	FB Data Out 3	1.7.3.3
1625	FB Data Out 4	1.7.3.4
1626	FB Data Out 5	1.7.3.5
1627	FB Data Out 6	1.7.3.6
1631	FB Gen Sts Word	1.7.3.7
1632	FB Spd Ref	1.7.2.7
1633	Input Sts Word	1.7.3.8