

Advanced User Guide

Unidrive

Universal Variable Speed Drive
for induction and servo motors

Part Number: 0447-1001

Issue Number: 1

General information

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General Note

Important! Drive software version

This product is supplied with the latest version of user interface and machine control software. Please check that this is compatible with your application, i.e. if you already have Drives running in a system, there may be some differences between the existing software and the updated product software, causing varying functionality. This may also apply to Drives returned from a Control Techniques Service Centre.

If in any doubt, please contact your nearest Control Techniques Drive Centre.

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1.1 Menu and Parameter Structure

Unidrive parameters are organised in a tabular fashion as a two dimensional array. The major index value is the menu, this is the table column. The minor index value is the parameter number, the table row. Every Unidrive parameter is specified by it's menu and parameter number, the row and column in the table of values. The parameter 'number' is specified as a decimal number, where the digit(s) to the left of the decimal point are the menu, and the digits to the right of the decimal point are the parameter number (including leading zeros) within that menu. For example, motor active current is in menu 4, parameter number 2, so this is parameter **4.02**. Conversely, parameter number **5.18** is parameter 18 in menu 5, the PWM switching frequency. The reduced table below illustrates the parameter number arrangement.

Parameter	Menu				
	0	1	2	3	4
0	00.00	01.00	02.00	03.00	04.00
1	00.01	01.01	02.01	03.01	04.01
2	00.02	01.02	02.02	03.02	04.02
3	00.03	01.03	02.03	03.03	04.03
4	00.04	01.04	02.04	03.04	04.04
5	00.05	01.05	02.05	03.05	04.05

1.2 Menus

Unidrive has 21 menus, each with up to 50 parameters, which organise the 700 plus parameters into functional groups. Menu zero is available in all drive types and irrespective of security status. All the other menus can only be accessed with standard security unlocked (see Security section). Menus 16 and 20 are only present with option modules fitted. Menu 15 is only present in Regen mode, and when in this mode menus 1 to 5, and some parameters in menu 6, which are concerned with motor control are not present. The following table summaries each menu function and which are available in each mode of operation.

Menu	Function	Open Loop	Closed loop Vector	Servo	Regen
0	General purpose user programmable	✓	✓	✓	✓
1	Speed reference selection, limits and filters	✓	✓	✓	
2	Ramps	✓	✓	✓	
3	Frequency slaving, Speed loop control	✓	✓	✓	
4	Current control	✓	✓	✓	
5	Machine control	✓	✓	✓	
6	Drive sequencer and Timers	✓	✓	✓	✓
7	Analogue inputs and outputs	✓	✓	✓	✓
8	Digital inputs and outputs	✓	✓	✓	✓
9	Programmable logic and motorised pot	✓	✓	✓	✓
10	Drive status and trip information	✓	✓	✓	✓
11	Drive setup	✓	✓	✓	✓
12	Programmable thresholds	✓	✓	✓	✓
13	Position control and Frequency input setup	✓	✓	✓	
14	PID loop	✓	✓	✓	✓
15	Regen input bridge setup				✓
16	Small option module setup	1	1	1	1
17	Large option module setup	✓	✓	✓	✓
18	Application menu 1	✓	✓	✓	✓
19	Application menu 2	✓	✓	✓	✓
20	LAM menu	2	2	2	2

Notes:

✓ **Menu available (with security unlocked)**

1 Menu only present with Small Option Module fitted.

2 Menu only present with second processor Large Application Module fitted.

1.3 Parameter Descriptions

Type of parameter

The following types of parameters are present:

..selector	select from a number of settings
..select	select from two settings
..enable	make or allow a function to operate
..disable	stop or disallow a function from operating
..indicator	the value can only be read

Coding

There are two fundamental types of parameters in the drive, read only (R/O) and read/write (R/W). The read only parameters cannot be changed by the user and are there to give the user useful information about the state of the drive. Read/write parameters are for the user to set up the way in which the drive operates.

Parameters can be further broken down into Bit parameters and Non-bit parameters. Bit parameters are two state only (0 or 1) and if R/W are used as switches or two state input variables to the drive logic, or if R/W indicate various drive conditions which are either true (1) or false (0). Non-bit parameters have more than two values, the range of each being given in the following descriptions.

Some parameters are represented as strings, rather than numeric values which give a more informative indication of the parameter setting. However in the descriptions below, numeric values are given as well as the string value because setting up via the serial interface requires numeric data.

Most parameters when being adjusted take immediate effect, but there are some which do not. These are generally parameters which could cause a malfunction in the operation of the drive if an intermediary value were taken during the adjustment, such as parameters defining the destination of programmable inputs. For the new value of one of these parameters to take effect a 'Drive Reset' must be carried out (see below). Parameters which require a 'Drive Reset' before any new value becomes effective are coded with an R in the following descriptions.

Except for a very few parameters, any adjustment made to RW parameters will be lost when power is removed unless the new values are stored in EEPROM. The few parameters which do not require to be stored manually are coded with an S in the following descriptions to indicate that they are stored at power down.

It will be seen later that Bit parameters can be controlled by programmable logic inputs or internal logic functions, and Non-bit parameters can be controlled by programmable analogue inputs or internal drive functions. However, some parameters are of such a sensitive nature that they are protected from being controlled by programmable inputs and functions and these are coded with a P in the following descriptions.

Abbreviations used in the parameter descriptions are as follows:

RW	Read/Write.
RO	Read Only.
Bit	Two state only parameter, 0 or 1.
Bi	Bipolar - can have positive and negative values.
Uni	Unipolar - can have positive values only.
Txt	Parameter value is represented on the display with strings of Text.
R	Requires a 'Drive Reset' before any new value will be implemented.
S	Parameter is Saved at power down.
P	Parameter is Protected from being controlled by programmable inputs and functions.

Symbols used in the parameter descriptions are as follows:

⇒	default value
↑	range of values
[...]	indicates the value of parameters
~	indicates a range of values (in the case of bit parameters, ~ indicates or)

Range

This defines the numerical range for each parameter. For unipolar parameters the range is 0 to maximum value, and for bipolar parameters the range is from -(maximum value) to +(maximum value). Bit parameters can only have the value 0 or 1. Note that for string parameters each numerical parameter value has a corresponding string description.

Units

This defines the units in which the parameter is measured (where appropriate).

Default setting

This defines the value that a parameter will be set to if 'Factory defaults' are loaded. Note that for some parameters the value depends on the drive type selected.

1.4 Storing Drive parameters

Parameters are stored by setting Parameter 0 to a value of 1000 and performing a 'Drive reset'. Because a 'Drive Reset' causes the values of certain parameters to be implemented, storing parameters has the effect of implementing all new values as the store takes place.

1.5 Security

To gain access to any menu other than 0 a security code must first be entered. In the drives default state any parameter in menu 0 which is read/write can be adjusted immediately, and once access is gained to the other menus read/write parameters within them can be adjusted. A user security level can be programmed which if set must be unlocked before any parameter can be adjusted. The user security is independent of the standard security and unlocking it alone does not allow exit from menu 0. Security levels are unlocked by entering the appropriate code into parameter 0. The code to gain access to any menu other than menu 0 is 149.

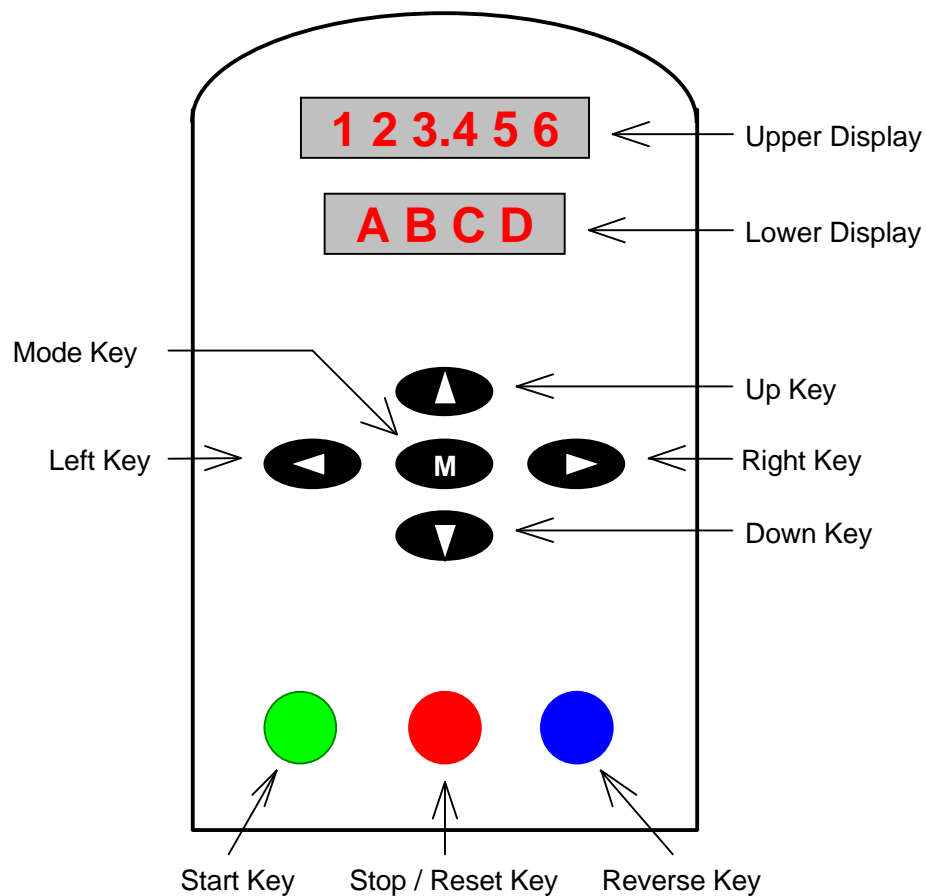
Security can be locked at any time without powering the drive off by entering a value of 2000 in parameter 0.

1.6 Drive types

Although the drive can be set up as either an Open loop inverter, Closed loop vector, Closed loop servo, or Regen; as far as the parameter set is concerned most parameters are common across all three motor drive types and where the menu is present in Regen as well.

2.1 Keypad and Display

Unidrive has a two line LED display and eight control keys, of these five are used for changing the display mode, moving around the parameter menus, and changing parameter values, and three are for controlling and resetting the Drive. The following diagram shows the position of each key and the display.



The display shows the following types of parameter on each line:

Upper Display	Parameter value in numerical or text format
Lower Display	Status string, alarm string or parameter number

Basic key functions are as follows:

Up key	Move up a parameter or increase a parameter value
Down key	Move down a parameter or decrease a parameter value
Left key	Move down a menu or to a more significant parameter digit
Right key	Move up a menu or to a less significant parameter digit
Mode key	Change display mode
Start key	Start the Drive in keypad mode
Stop/Reset key	Stop the Drive in keypad mode or reset the Drive
Reverse key	Reverse the direction of rotation in keypad mode

Note that in some circumstances the keys do not have the functions as described above, for instance when rolling over from the top of a menu to the bottom the up key actually causes the parameter number to decrease. The more detailed descriptions of key actions that follow should be referred to for a full explanation of what each key does.

2.2 Display Modes

The display has several modes of operation in which the display has the format shown below:

Status Mode

The upper display shows the parameter value, and the lower display shows the status string.

```
Parameter.Value  
Status.String
```

Parameter Mode

The upper display shows the parameter value, and the lower display the menu and parameter number.

```
Parameter.Value  
Menu.Param
```

Edit Mode

The upper display flashes showing the parameter value, and the lower display the menu and parameter number.

```
Parameter.Value  
Menu.Param
```

Alarm Mode

The upper display shows the parameter value, and the lower display flashes between the alarm string and the parameter number.

Parameter.Value
Alarm.String

Trip Mode

The upper display flashes showing the trip string, and the lower display shows 'trip'.

Trip.String
Trip

A list of the status and alarm strings can be found later in this section. For a list of all the trip strings see the description of parameter **10.20**.

2.3 Alarm Strings

During an alarm condition the lower display will flash between the alarm string and the current parameter number. Apart from the LO.PS alarm all the other alarms are caused by some form of Drive overload, and indicate that a parameter is getting close to the trip threshold. Unless action is taken to remove the overload the Drive will trip. Alarm strings shown on the display have the following meanings:

br.rS	Brake resistor alarm
OVLd	Motor overload alarm
hot	Heatsink temperature alarm
Air	Control module ambient temperature alarm
LO.PS	Drive is running from UD78 option module power supply
	IGBTs will not operate
	Power down parameters have been saved
	A full parameter save is not possible

2.4 Status Strings

In the default display mode (status) the Drive status is shown on the lower display. This indicates what the Drive is doing at the present time. Drive status strings have the following meanings:

inh	Drive inhibited (output bridge disabled)
rdY	Drive ready (output bridge disabled)
StoP	Drive holding zero speed
SCAN	Drive catching a spinning motor
run	Motor running
AC.UU	AC supply under voltage, mains loss mode entered
dEC	Decelerating to stop
dc	DC injection braking
POS	Moving to stop position in orientation mode
triP	Drive tripped
act	Regen mode input converter active

In regen mode some strings have different meanings:

inh	Drive is not enabled, or is enabled, but the soft-start contactor is not closed when it should be
StoP	Drive is waiting for the dc bus voltage to stabilise or the AC supply voltage is too low
SCAN	Drive is synchronising to the AC supply

2.5 Keypad Operation – Parameter and Mode Setting

There are five keys used for changing the display mode and setting the parameter number and value; the up, down, left, right and mode keys. These keys can be used to change the display mode between the status, parameter and edit modes as described previously. The action of the keys in each of these modes is described here:

Status Mode

When in status mode, pressing any one of the Left, Right or Mode keys will change the display mode to Parameter mode. If the Keypad reference (**1.17**) is not selected then the Up and Down keys will also change the display mode to parameter mode, but when the keypad reference is selected the Up and Down keys change the Keypad reference and hence the motor speed. Depending on the settings of parameters **1.08** (Negative min speed select) and **1.10** (Bipolar), the range of the keypad reference will be as follows, where parameters **1.06** and **1.07** are the maximum and minimum speed respectively:

1.08	1.10	Speed range	
0	0	1.07 to 1.06	(Positive only)
0	1	-1.06 to 1.06	
1	0	0 to 1.06	
1	1	1.07 to 1.06	(Both signs)

The rate at which the speed reference changes increases as the Up or Down keys are held longer. Pressing the Up and Down keys simultaneously will set the keypad reference to 0.

Status mode is automatically entered in the event of a Drive trip.

Parameter Mode

In this mode the Up and Down keys are used to select the parameter within the selected menu. Holding the Up key will cause the parameter number to increment until the top of the menu is reached. A single Up key action when the last parameter in a menu is being displayed will cause the parameter number to roll over to 0. Similarly holding the Down key will cause the parameter number to decrement until parameter 0 is reached and a single Down key action will cause the parameter number to roll under to the top of the menu. Pressing the Up and Down keys simultaneously will select parameter 0 in the presently selected menu.

The Left and Right keys are used to select the required menu (provided the security has been unlocked to allow access to menus other than 0). Holding the Right key will cause the menu number to increment until the last menu is reached. A single Right key action when the last menu is being displayed will cause the menu number to roll over to 0. Similarly holding the Left key will cause the menu number to decrement to 0 and a single key action will cause the menu number to roll under to the last menu. Pressing the Left and Right keys simultaneously will select menu 0.

The Drive remembers the parameter last accessed in each menu such that when a new menu is entered the last parameter viewed in that menu will re-appear. This allows the user to change between parameters in menus very quickly.

If the selected parameter is RW and is not protected by security, pressing the Mode key will change the display mode to Edit mode for parameter adjustment. Conversely if the parameter is RO or protected by security, pressing the Mode key will take the Drive back into Status mode.

If none of the five adjustment keys are pressed for a period of 8 seconds the Status mode is entered automatically.

Edit mode

Up and Down keys are used to increase and decrease parameter values respectively. If a parameters maximum value is greater than 9 and it is not represented by strings, then the Left and Right keys can be used to select a digit to adjust. The number of digits which can be independently selected for adjustment depends on the maximum value of the parameter and can be up to a maximum of the full six digits. Pressing the Right key when the least significant digit is selected will cause the most significant digit to be selected, and vice-versa if the Left key is pressed when the most significant digit is selected. When a digit value is not being changed by the Up or Down keys the selected digit flashes to indicate which one is currently selected. For string type parameters the whole string flashes when adjustment is not occurring because there is no digit selection.

During adjustment of a parameter value with the Up or Down keys the display does not flash, providing the parameter value is in range, such that the user can see the value being edited without interruption. Adjustment of a numerical value can be done in one of two ways; firstly by using the Up and Down keys only, the selected digit remaining the least significant digit; and secondly by selecting each digit in turn and adjusting them to the required value. Holding the Up or Down key in the first method will cause the parameters value to change more rapidly the longer the key is held, until such time that the parameters maximum or minimum is reached. However with the second method an increasing rate of change does not take place when adjusting any other digit than the least significant digit since a digit can only have one of 10 different values. Holding the Up or Down will cause an auto repeat and roll over to more significant digits but the rate of change is unaltered. If the maximum or minimum is hit when adjusting any other digit than the least significant one, the maximum value will flash on the display to warn the user that the maximum or minimum has been reached. If the user releases the Up or Down key before the flashing stops the last in range value will re-appear on the display. If the Up or Down key is held the display will stop flashing after 3 seconds and the maximum value will be written to the parameter. This feature is to prevent users accidentally altering digits that have already been set by taking a more significant digit outside the parameters range.

Parameters can be set to 0 very quickly by simultaneously pressing the Up and Down keys, and pressing the Left and Right keys simultaneously will select the least significant digit.

Parameter mode is re-entered from edit mode by pressing the Mode key.

Alarm display mode

When the Drive is flashing the display in alarm mode the keypad mode of operation is unaffected.

Trip display mode

When the Drive trips the keypad automatically enters status mode, and the display enters trip mode. This is a special status mode in which the status is 'trip' and the parameter value, in this case the trip string, is shown flashing. If whilst in this mode any of the five editing keys are pressed the display will return to parameter mode and show the parameter that was being shown before the Drive tripped. Following a trip condition all RO parameters within the Drive are stored at their last value before the trip occurred.

2.6 Keypad Operation – Drive Control

Keypad mode enables the Drive speed (or frequency) and direction to be controlled from the front panel keypad without the need for any analogue or digital I/O, other than the Enable digital input.

Keypad mode is entered by setting the speed (or frequency) reference select parameter **1.14** to 4 (or in menu 0 parameter **0.05**). In this mode the only digital I/O connection required is the Enable input. Once in keypad mode run forward and run reverse sequencer bits 6.30 and 6.32, normally controlled from digital inputs F4 and F5 (Din1 and 2), have no effect. Analogue input 1 and 2 will have no effect on the speed (frequency) reference (unless deliberately programmed to do so). The value of the speed (frequency) reference in keypad mode is stored in parameter **1.17**. Although this parameter does not appear in menu 0 by default, parameter **0.11** can be used to check the final speed (frequency) reference. The keypad has the following functions:

In status mode:

In this mode the up and down keys alter the keypad reference, parameter **1.17**, and hence motor speed when running. Note that this parameter can not be changed in edit mode, and the current parameter does not need to be the keypad reference in order to adjust it's value. Key actions are as follows:

Up	Increase keypad reference
Down	Decrease keypad reference
Up and Down	Set keypad reference to zero

In other display modes:

Key actions as in menu and parameter mode

In all modes:

Start	Start the Drive
Stop	Stop the Drive
Reverse	Change the direction of rotation
Stop and Start when running	
Perform a Drive reset and keep on running	
Stop and Start when not running	
Drive does not start	

2.7 Drive Reset

Drive reset functions:

A Drive reset is required for a number of reasons:

- To reset the Drive from a tripped state
- To change the Drive type
- To implement a change in the value of certain parameters
- To initiate the saving of parameters in EEPROM

The later two of these can be done while the Drive is running.

Performing a Drive reset:

The Drive can be reset from the keypad, digital I/O or via serial comms thus:

1. The Stop/Reset key. If the Drive has been set up such that the stop key is not operative then the key has a Drive reset function only. When the stop key is being used to stop the Drive, a Drive reset can be done while the Drive is running by holding the Run key while the Stop/Reset key is activated. When the Drive is not running the Stop/Reset key will always reset the Drive.
2. The Drive will be reset when a 0 to 1 transition of the Drive Reset parameter (**10.33**). This parameter is provided for a programmable digital input to be programmed to such that a terminal can be used to reset the Drive.
3. By the serial interface or an intelligent large option module such as the UD70. This Drive reset is triggered by a value of 100 being written to the User trip parameter (**10.38**).

Drive reset when auto-restart is programmed

If the Drive is set in a latching sequencing mode, the run forward and run reverse inputs are not active, the Drive is programmed for auto restart, and has tripped, then pressing the front panel reset key whilst in the trip state will reset the trip and also clear the run latch. This will prevent the Drive doing an auto restart when the trip is cleared. Note that this function only applies to a keypad reset, not a reset from the digital I/O or from serial comms.

3 Advanced Parameters



These advanced parameters are listed for reference purposes only.

Warning

The lists in this chapter do not include sufficient information for adjusting these parameters. Incorrect adjustment can affect the safety of the system, and damage the Drive and or external equipment. Before attempting to adjust any of these parameters, refer to the *Unidrive Advanced User Guide*.

MENU 1

Frequency/speed-reference selection

Frequency/speed limits

Skip frequencies/speeds

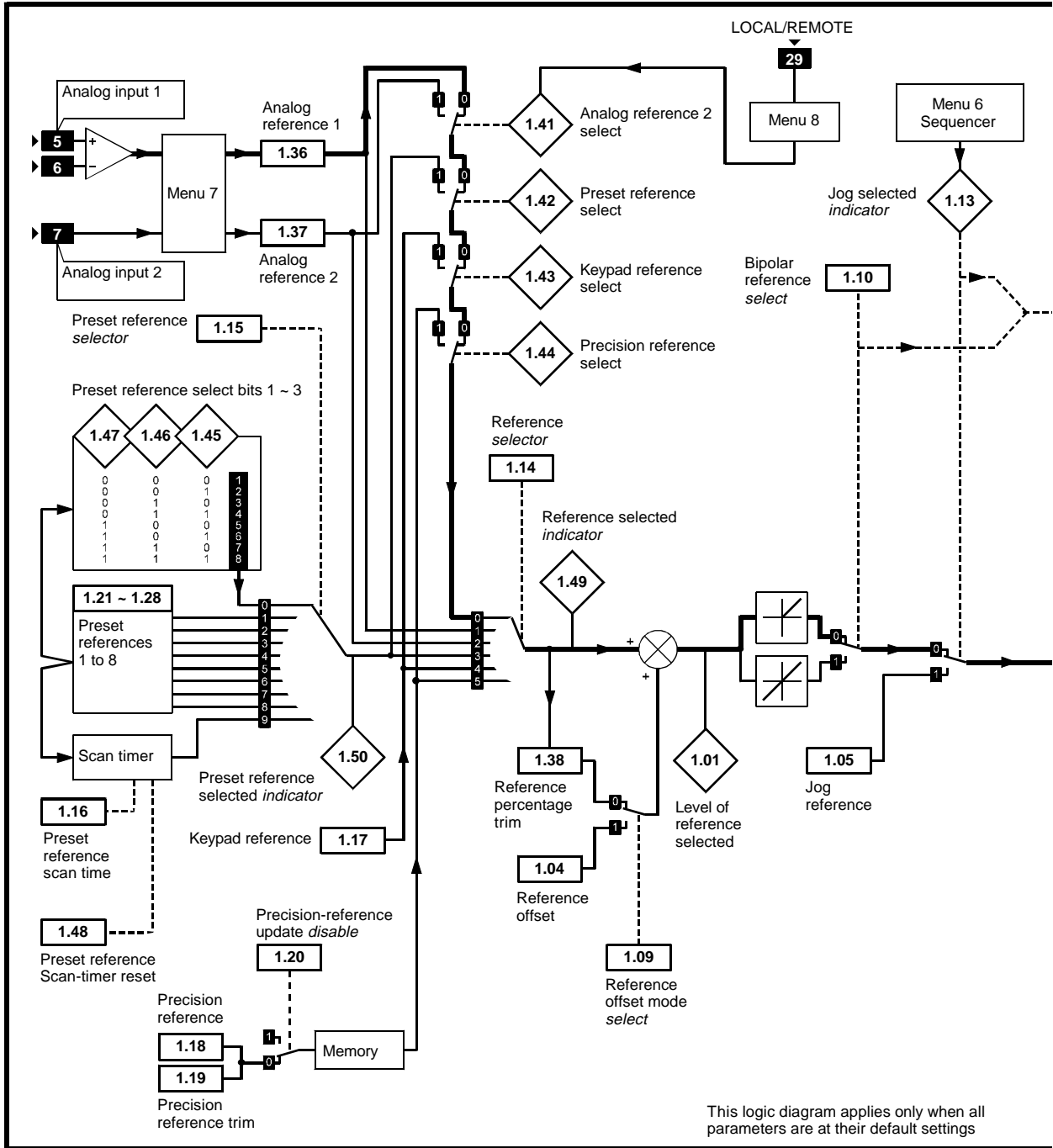
Refer to the next page.

Notes

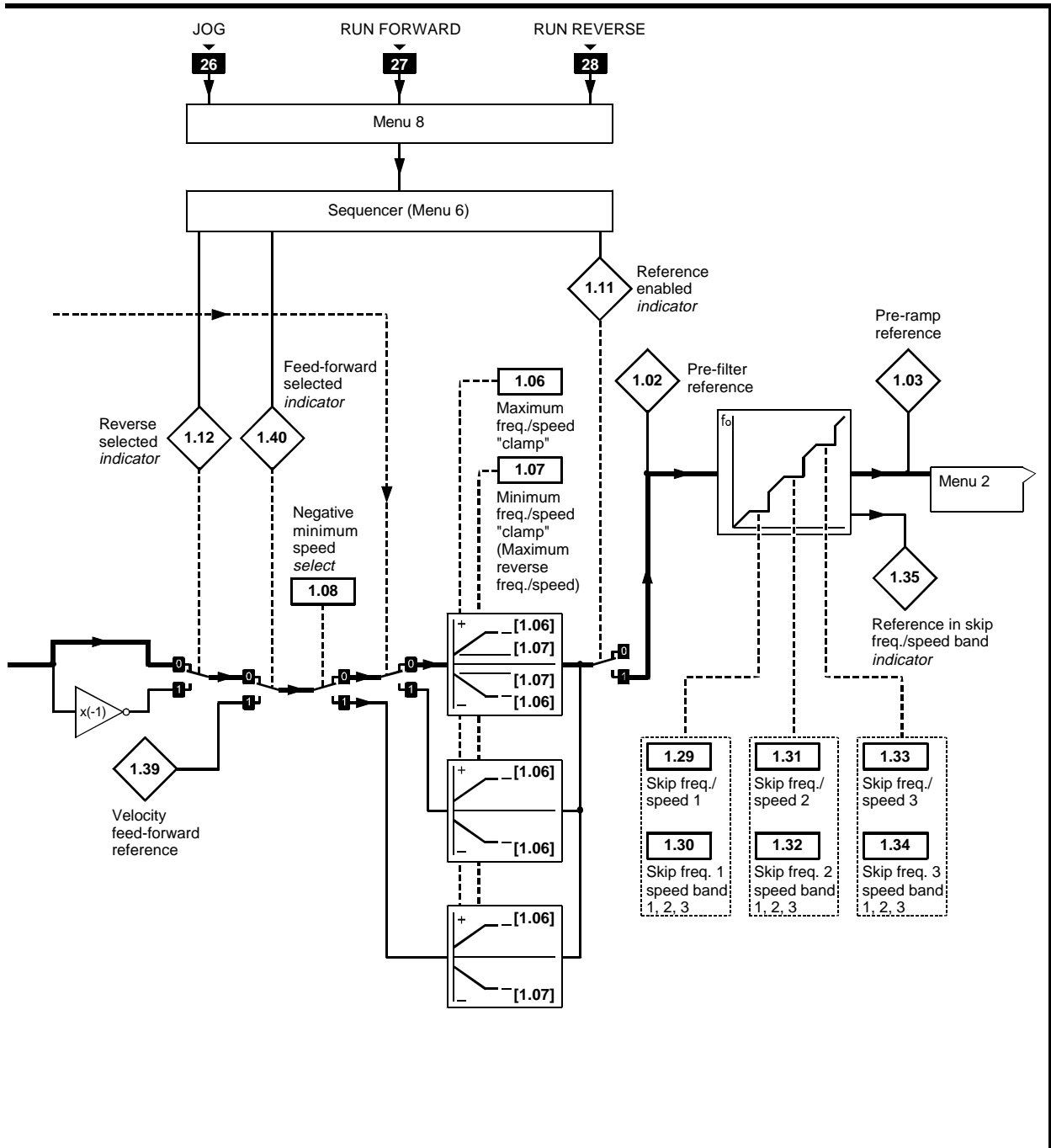
Parameter numbers shown in brackets (...) are the equivalent Menu 0 parameters. Some Menu 0 parameters appear twice since their function depends on the operating mode.

The **Range – CL** column applies to both Closed-loop Vector and Closed-loop Servo. For some parameters, this column applies only to one of these modes; this is indicated accordingly in the **Default** columns.

In some cases, the function or range of a parameter is affected by the setting of another parameter; the information in the lists relates to the default condition of such parameters.



Menu 1 logic diagram



Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
1.01	Level of reference selected	±1000.0 Hz *	±30 000 RPM *				RO	Bi		P
1.02	Pre-filter reference	±1000.0 Hz *	±30 000 RPM *				RO	Bi		P
1.03 (0.11)	Pre-ramp reference	±1000.0 Hz *	±30 000 RPM *				RO	Bi		P
1.04	Reference offset	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.05 (0.14)	Jog reference	0 ~ 400.0 Hz	0 ~ 4000 RPM	1.5	50	50	RW	Uni		
1.06 (0.02)	Maximum frequency/speed clamp	0 ~ 1000.0 Hz	0 ~ 30 000 RPM	50 (EUR) 60 (USA)	1500 (EUR) 1800 (USA)	3000	RW	Uni		
1.07 (0.01)	Minimum frequency/speed clamp	0 ~ [1.06]	0 ~ [1.06]	0	0	0	RW	Bi		
1.08	Negative minimum speed <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
1.09	Reference offset mode <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
1.10	Bipolar reference <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
1.11	Reference enabled <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P

* The maximum value that can be used is limited to the larger value of parameters **1.06** and **1.07**.

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
1.12	Reverse selected <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
1.13	Jog selected <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
1.14 (0.05)	Reference <i>selector</i>	0 ~ 5	0 ~ 5	0 (EUR) 4 (USA)	0 (EUR) 4 (USA)	0 (EUR) 4 (USA)	RW	Uni		
1.15	Preset reference <i>selector</i>	0 ~ 9	0 ~ 9	0	0	0	RW	Uni		
1.16	Preset reference scan time	0 ~ 400.0 s	0 ~ 400.0 s	10	10	10	RW	Uni		
1.17 (0.35)	Keypad reference	±1000.0 Hz	±30000 RPM	0	0	0	RO	Bi	S	P
1.18	Precision reference	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.19	Precision reference trim	0 ~ 0.099 Hz	0 ~ 0.99 RPM	0	0	0	RW	Uni		
1.20	Precision-reference update <i>disable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
1.21	Preset reference 1	±1000.0 Hz	±30000 RPM	0	0	0	RW	Bi		
1.22	Preset reference 2	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.23	Preset reference 3	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.24	Preset reference 4	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.25	Preset reference 5	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.26	Preset reference 6	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.27	Preset reference 7	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.28	Preset reference 8	±1000.0 Hz	±30 000 RPM	0	0	0	RW	Bi		
1.29 (0.20)	Skip freq./speed 1	0 ~ 1000.0 Hz	0 ~ 30 000 RPM	0	0	0	RW	Uni		
1.30 (0.21)	Skip freq./speed band 1	0 ~ 5.0 Hz	0 ~ 50 RPM	0.5	5	5	RW	Uni		
1.31 (0.22)	Skip freq./speed 2	0 ~ 1000.0 Hz	0 ~ 30 000 RPM	0	0	0	RW	Uni		
1.32 (0.23)	Skip freq./speed band 2	0 ~ 5.0 Hz	0 ~ 50 RPM	0.5	5	5	RW	Uni		
1.33	Skip freq./speed 3	0 ~ 1000.0 Hz	0 ~ 30 000 RPM	0	0	0	RW	Uni		
1.34	Skip freq./speed band 3	0 ~ 5.0 Hz	0 ~ 30000 RPM	0.5	5	5	RW	Uni		
1.35	Reference in skip freq./speed band <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
1.36	Analog reference 1	±1000 Hz *	±30 000 RPM *				RO	Bi		
1.37	Analog reference 2	±1000 Hz *	±30 000 RPM *				RO	Bi		
1.38	Reference percentage-trim	±100.0 %	±100.0 %				RO	Bi		
1.39	Velocity feed-forward reference	±1000.0 Hz	±30 000 RPM				RO	Bi		P
1.40	Feed-forward selected <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
1.41	Analog reference 2 select	0 ~ 1	0 ~ 1				RO	Bit		
1.42	Preset reference select	0 ~ 1	0 ~ 1				RO	Bit		
1.43	Keypad reference select	0 ~ 1	0 ~ 1				RO	Bit		
1.44	Precision reference select	0 ~ 1	0 ~ 1				RO	Bit		
1.45	Preset reference select bit 0 (LSB)	0 ~ 1	0 ~ 1				RO	Bit		
1.46	Preset reference select bit 1	0 ~ 1	0 ~ 1				RO	Bit		
1.47	Preset reference select bit 2 (MSB)	0 ~ 1	0 ~ 1				RO	Bit		
1.48	Preset reference Scan-timer reset	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
1.49	Reference selected <i>indicator</i>	1 ~ 5	1 ~ 5				RO	Uni		P
1.50	Preset reference selected <i>indicator</i>	1 ~ 8	1 ~ 8				RO	Uni		P

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

MENU 2

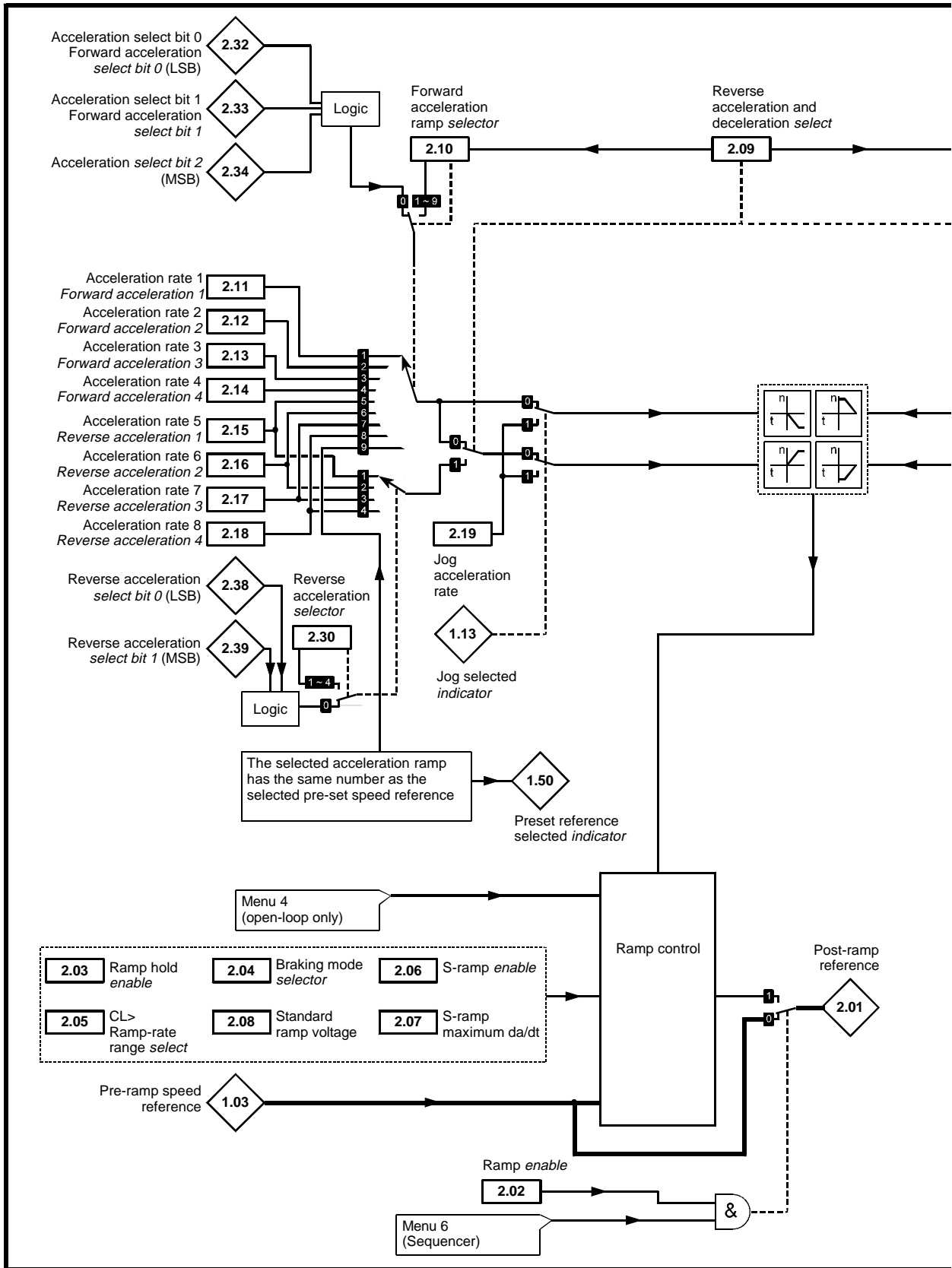
Acceleration and deceleration ramps

Ramp selection, enable selected,

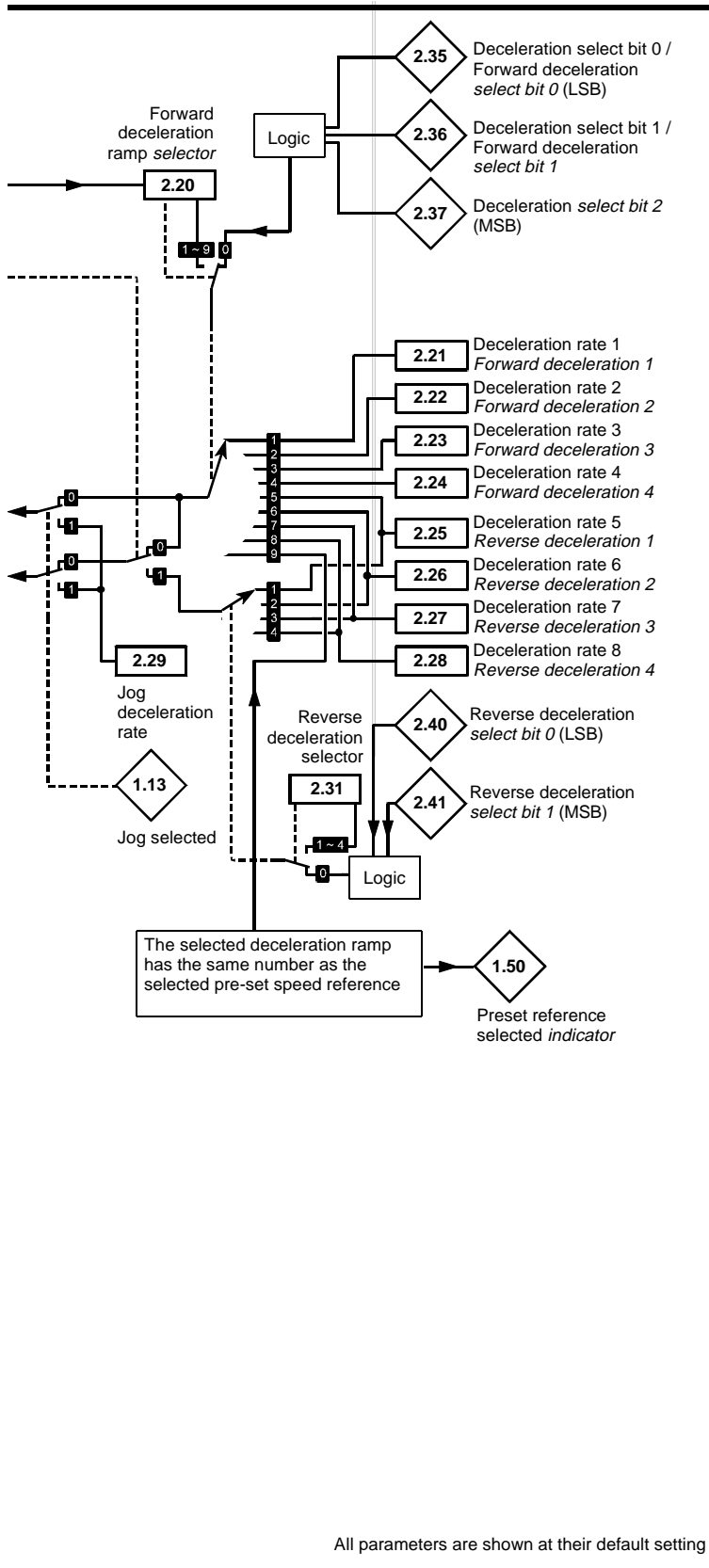
Braking mode selection

S-ramp

Refer to the next page.



Menu 2 logic diagram



Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
2.01 (0.12)	Post-ramp reference	±1000 Hz *	±30 000 RPM *				RO	Bi		P
2.02	Ramp enable		0 ~ 1		0	0	RW	Bit		
2.03	Ramp hold enable	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
2.04 (0.15)	Ramp mode selector	Std.Hd FASt Std.Ct	Std.Hd FASt Std.Ct	Std.Ct	Std.Ct	Std.Ct	RW	Txt		
2.05	Ramp-rate range select		0 ~ 1		0	1	RW	Bit		
2.06 (0.18)	S-ramp enable	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
2.07 (0.19)	S-ramp maximum da/dt	0 ~ 3000.0 s ² /100Hz	0 ~ 30 000 s ² /1000RPM	3.1	1.5	0.03	RW	Uni		
2.08	Standard ramp voltage	0 ~ 800 V	0 ~ 800 V	700 (EUR) 775 (USA)	700 (EUR) 775 (USA)	700 (EUR) 775 (USA)	RW	Uni		
2.09	Reverse acceleration and deceleration select	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
2.10	Forward acceleration ramp selector	0 ~ 9	0 ~ 9	0	0	0	RW	Uni		
2.11 (0.03)	Acceleration rate 1 / Forward acceleration rate 1	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	5	2	0.2	RW	Uni		
2.12	Acceleration rate 2 / Forward acceleration rate 2	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	5	2	0.2	RW	Uni		
2.13	Acceleration rate 3 / Forward acceleration rate 3	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	5	2	0.2	RW	Uni		
2.14	Acceleration rate 4 / Forward acceleration rate 4	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	5	2	0.2	RW	Uni		
2.15	Acceleration rate 5 / Reverse acceleration rate 1	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	5	2	0.2	RW	Uni		
2.16	Acceleration rate 6 / Reverse acceleration rate 2	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	5	2	0.2	RW	Uni		
2.17	Acceleration rate 7 / Reverse acceleration rate 3	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	5	2	0.2	RW	Uni		
2.18	Acceleration rate 8 / Reverse acceleration rate 4	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	5	2	0.2	RW	Uni		

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
2.19	Jog acceleration rate	0 ~ 3200.0 s/100Hz	0 ~ 32.000 s/1000RPM	0.2	0	0	RW	Uni		
2.20	Forward deceleration ramp selector	0 ~ 9	0 ~ 9	0	0	0	RW	Uni		
2.21 (0.04)	Deceleration rate 1 / Forward deceleration rate 1	0 ~ 3200.0 s/100Hz	0 ~ 32.000 s/1000RPM	10	2	0.2	RW	Uni		
2.22	Deceleration rate 2 / Forward deceleration rate 2	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	10	2	0.2	RW	Uni		
2.23	Deceleration rate 3 / Forward deceleration rate 3	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	10	2	0.2	RW	Uni		
2.24	Deceleration rate 4 / Forward deceleration rate 4	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	10	2	0.2	RW	Uni		
2.25	Deceleration rate 5 / Reverse deceleration rate 1	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	10	2	0.2	RW	Uni		
2.26	Deceleration rate 6 / Reverse deceleration rate 2	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	10	2	0.2	RW	Uni		
2.27	Deceleration rate 7 / Reverse deceleration rate 3	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	10	2	0.2	RW	Uni		
2.28	Deceleration rate 8 / Reverse deceleration rate 4	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	10	2	0.2	RW	Uni		
2.29	Jog deceleration rate	0 ~ 3200.0 s/100Hz	VT> 0 ~ 3200 SV> 0 ~ 32.000 s/1000RPM	0.2	0	0	RW	Uni		
2.30	Rev acceleration selector	0 ~ 4	0 ~ 4	0	0	0	RW	Uni		P
2.31	Rev deceleration selector	0 ~ 4	0 ~ 4	0	0	0	RW	Uni		P
2.32	Acceleration select bit 0 / Forward acceleration select bit 0 (LSB)	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P
2.33	Acceleration select bit 1 / Forward acceleration select bit 1	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P
2.34	Acceleration select bit 2 (MSB)	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
2.35	Deceleration select bit 0 / Forward deceleration <i>select bit 0 (LSB)</i>	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P
2.36	Deceleration select bit 1 / Forward deceleration <i>select bit 1</i>	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P
2.37	Deceleration <i>select bit 2 (MSB)</i>	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P
2.38	Reverse acceleration <i>select bit 0 (LSB)</i>	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P
2.39	Reverse acceleration <i>select bit 1 (LSB)</i>	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P
2.40	Reverse deceleration <i>select bit 0 (LSB)</i>	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P
2.41	Reverse deceleration <i>select bit 1 (LSB)</i>	0 ~ 1	0 ~ 1	0	0	0	RO	Bit		P

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

MENU 3

Speed indications

Speed-loop PID gains

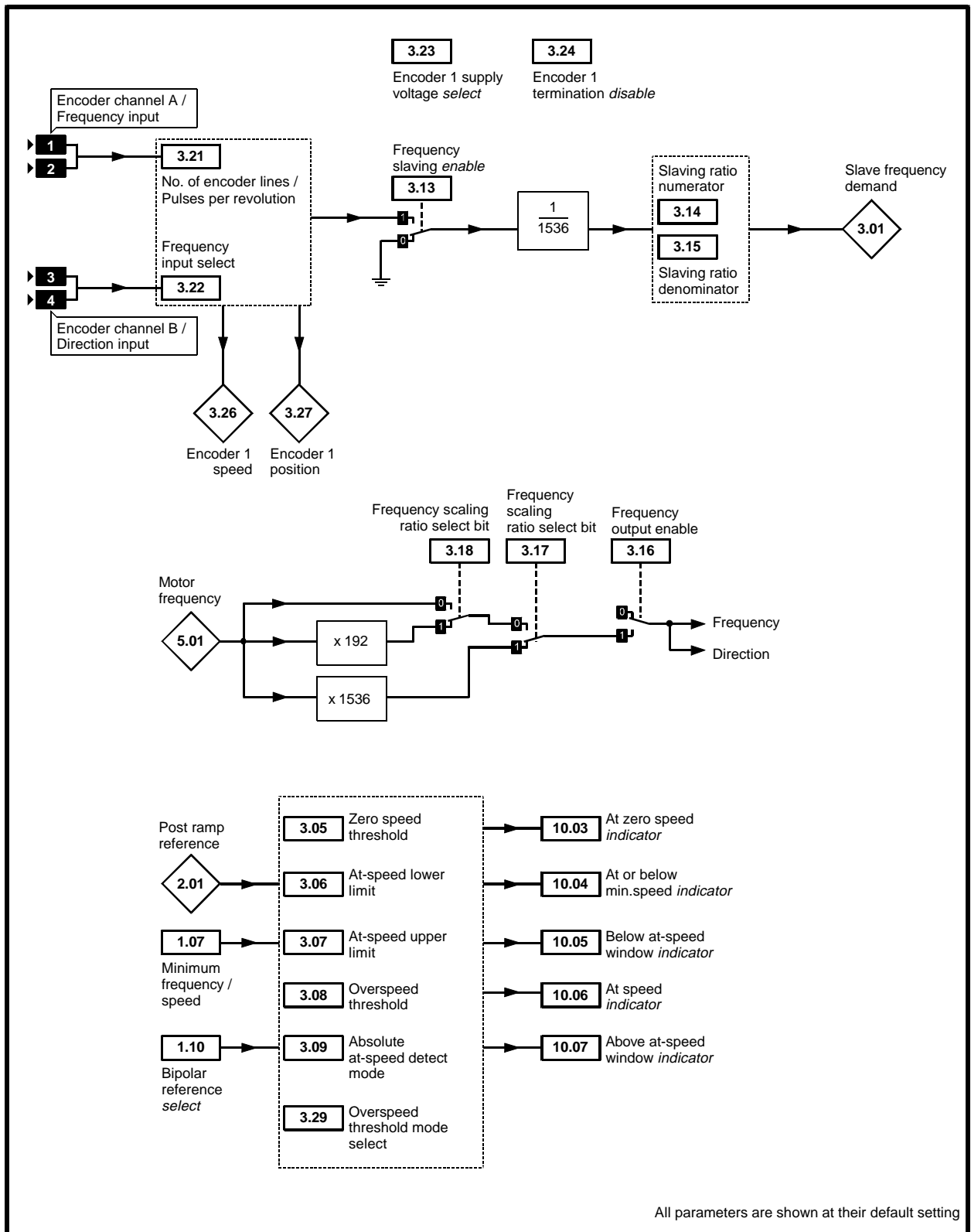
Speed-sensing thresholds

Frequency slaving

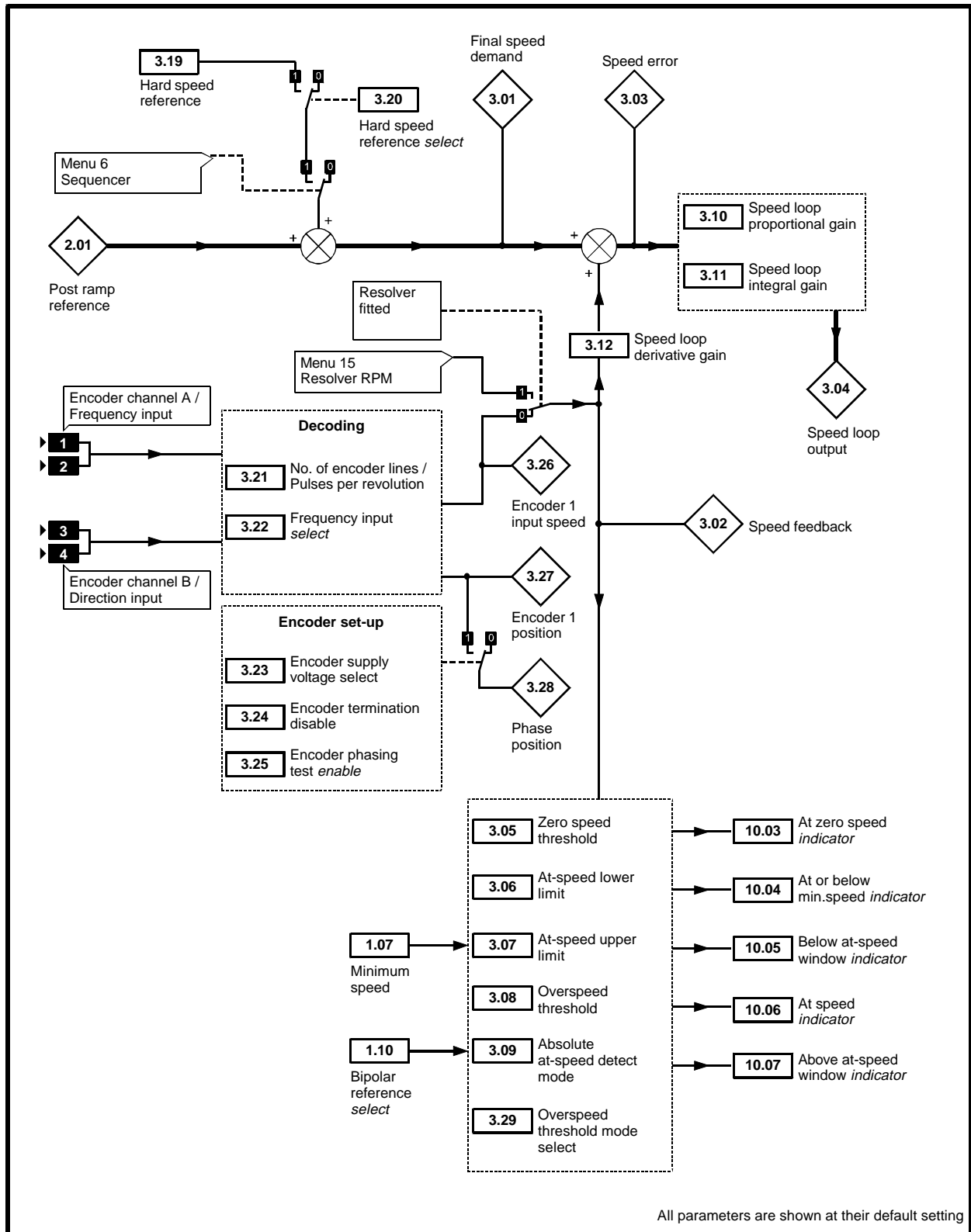
Hard speed reference

Encoder set-up

Refer to the next page.



Menu 3 Open-loop logic diagram



Menu 3 Closed-loop logic diagram

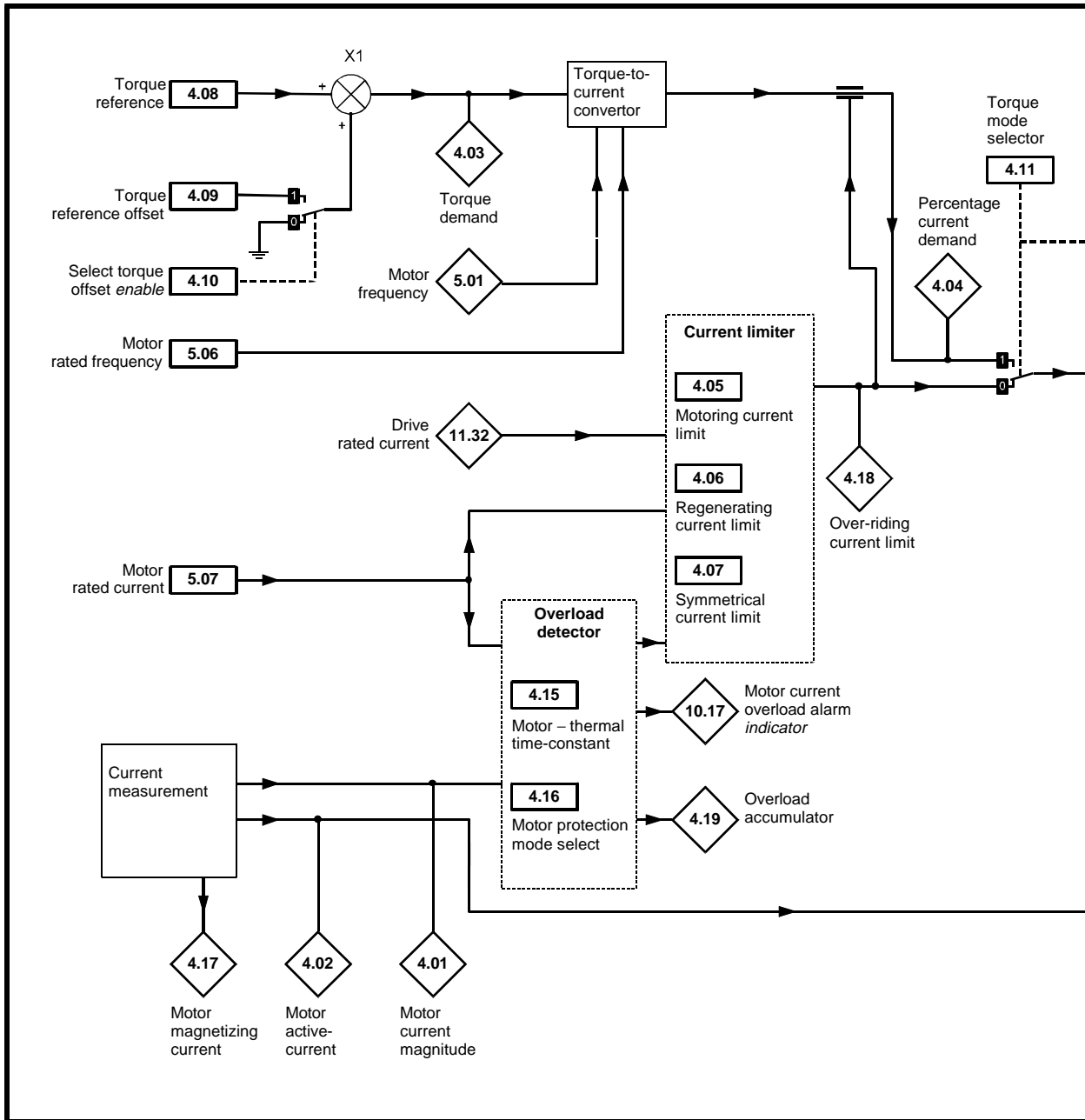
Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
3.01	OL> Slave frequency-demand CL> Final speed demand	±1000.0 Hz	±30 000 RPM				RO	Bi		P
3.02 (0.10)	Speed feedback		±30 000 RPM				RO	Bi		P
3.03	Speed error		±30 000 RPM				RO	Bi		P
3.04	Speed loop output		±I _{MAX} % *				RO	Bi		P
3.05	Zero-speed threshold	0 ~ 20.0 Hz	0 ~ 200 RPM	1	5	5	RW	Uni		
3.06	At-speed lower limit	0 ~ 1000.0 Hz	0 ~ 30 000 RPM	1	5	5	RW	Uni		
3.07	At-speed upper limit	0 ~ 1000.0 Hz	0 ~ 30 000 RPM	1	5	5	RW	Uni		
3.08	Over-speed threshold	0 ~ 1000.0 Hz	0 ~ 30 000 RPM	1000	2000	4000	RW	Uni		
3.09	Absolute at-speed detect mode	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
3.10 (0.07)	Speed-loop proportional gain		0 ~ 32000		200	200	RW	Uni		
3.11 (0.08)	Speed-loop integral gain		0 ~ 32000		100	100	RW	Uni		
3.12 (0.09)	Speed-loop derivative gain		0 ~ 32000		0	0	RW	Uni		
3.13	Frequency slaving enable	0 ~ 1		0			RW	Bit		
3.14	Slaving ratio numerator	0 ~ 1.000		1			RW	Uni		
3.15	Slaving ratio denominator	0.001 ~ 1.000		1			RW	Uni		
3.16	Frequency output enable	0 ~ 1		0			RW	Bit		
3.17	Frequency scaling ratio <i>select bit</i>	0 ~ 1		1			RW	Bit		
3.18	Frequency scaling ratio <i>select bit</i>	0 ~ 1		0			RW	Bit		

* For definition of ±I_{MAX} %, see Menu 4.

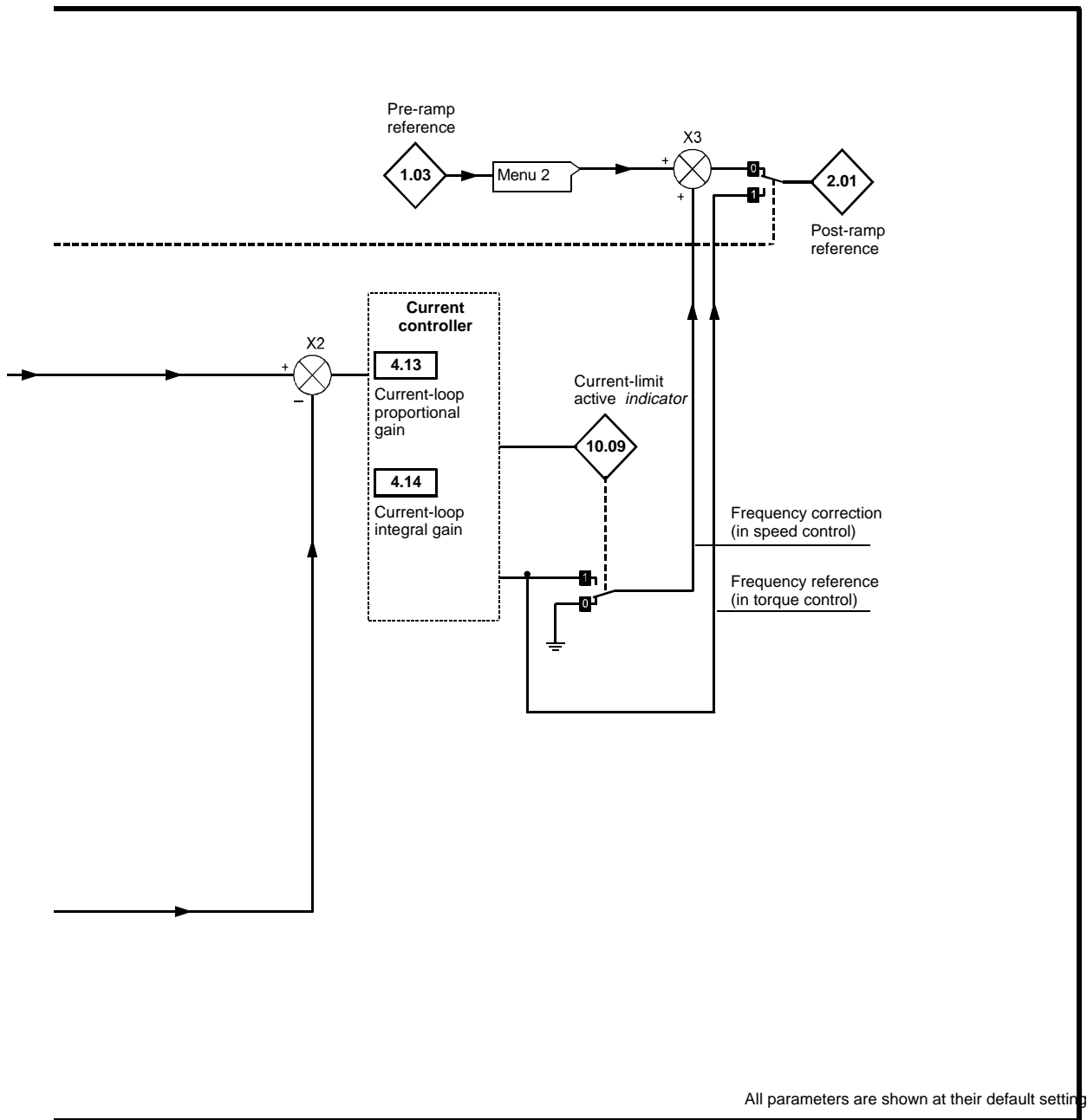
R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

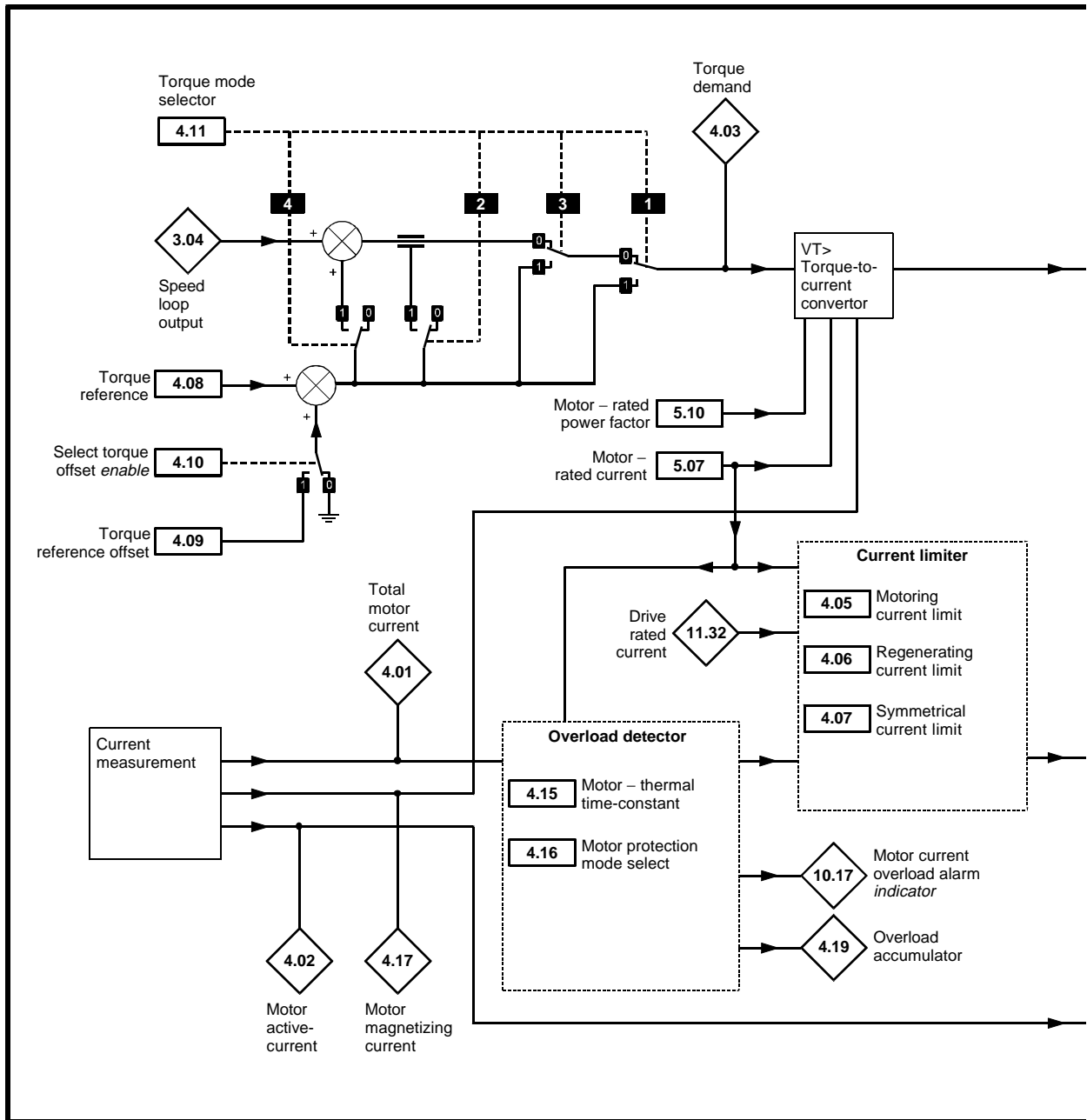
Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
3.19	Hard speed reference		±[1.06]		0	0	RW	Bi		
3.20	Hard speed reference <i>select</i>		0 ~ 1		0	0	RW	Bit		
3.21	No. of encoder lines / Pulses per revolution	256 ~ 8192 <i>Encoder lines / Pulses per rev</i>	256 ~ 4096 <i>Encoder lines / Pulses per rev</i>	1024	1024	4096	RW	Uni		
3.22	Frequency input <i>select</i>	0 ~ 1	0 ~ 1	1	0	0	RW	Bit		
3.23	Encoder 1 supply voltage <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
3.24	Encoder 1 termination <i>disable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
3.25 (0.40)	Encoder 1 phasing test <i>enable</i>		0 ~ 1			0	RW	Bit		
3.26	Encoder 1 speed	±30 000 <i>RPM</i>	±30 000 <i>RPM</i>				RO	Bi		P
3.27	Encoder 1 position	0 ~ 16383 <i>revs/16384</i>	0 ~ 16383 <i>revs/16384</i>				RO	Uni		P
3.28	<u>Encoder 1 phase offset</u>	0 ~ 6143 <i>rev/6143</i>	0 ~ 6143 <i>rev/6143</i>				RW	Uni	S	P
3.29	Over-speed threshold mode <i>select</i>	0 ~ 1		0			RW	Bit		
3.30	Speed feedback filter		0 ~ 10.0 <i>ms</i>		0	0	RW	Uni		
3.31	Servo phasing fail (ENC9) detection <i>disable</i>		0 ~ 1		0	0	RW	Bit		

MENU 4
Current monitoring
Current limiting in speed control
Current-loop gains
Torque control
Motor protection

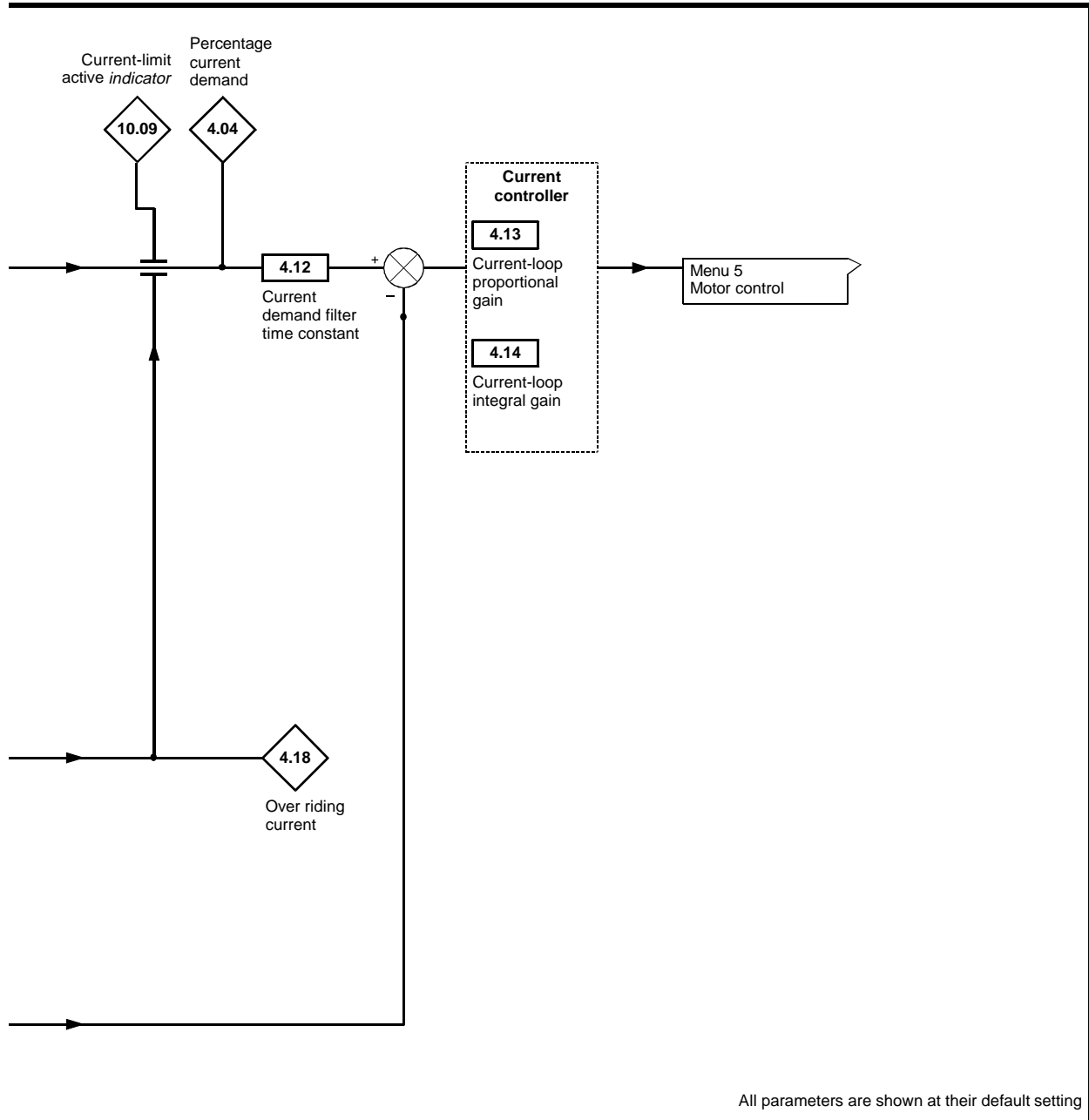


Menu 4 Open-loop logic diagram





Menu 4 Closed-loop logic diagram



Types of current range

FLC Rated current of the Drive (maximum continuous output current up to 40°C ambient temperature)

I_{MAX} A Maximum overload output current of the Drive up to 40°C ambient temperature, derived as follows:

OL > 150% x FLC

CL > 175% x FLC

I_{MAX} % The range is the maximum permissible percentage of I_{MAX} where this maximum is derived from the equations for [0.06]_{MAX} in *Setting the torque-producing current limit* in Chapter 3 *Setting up the Drive*.

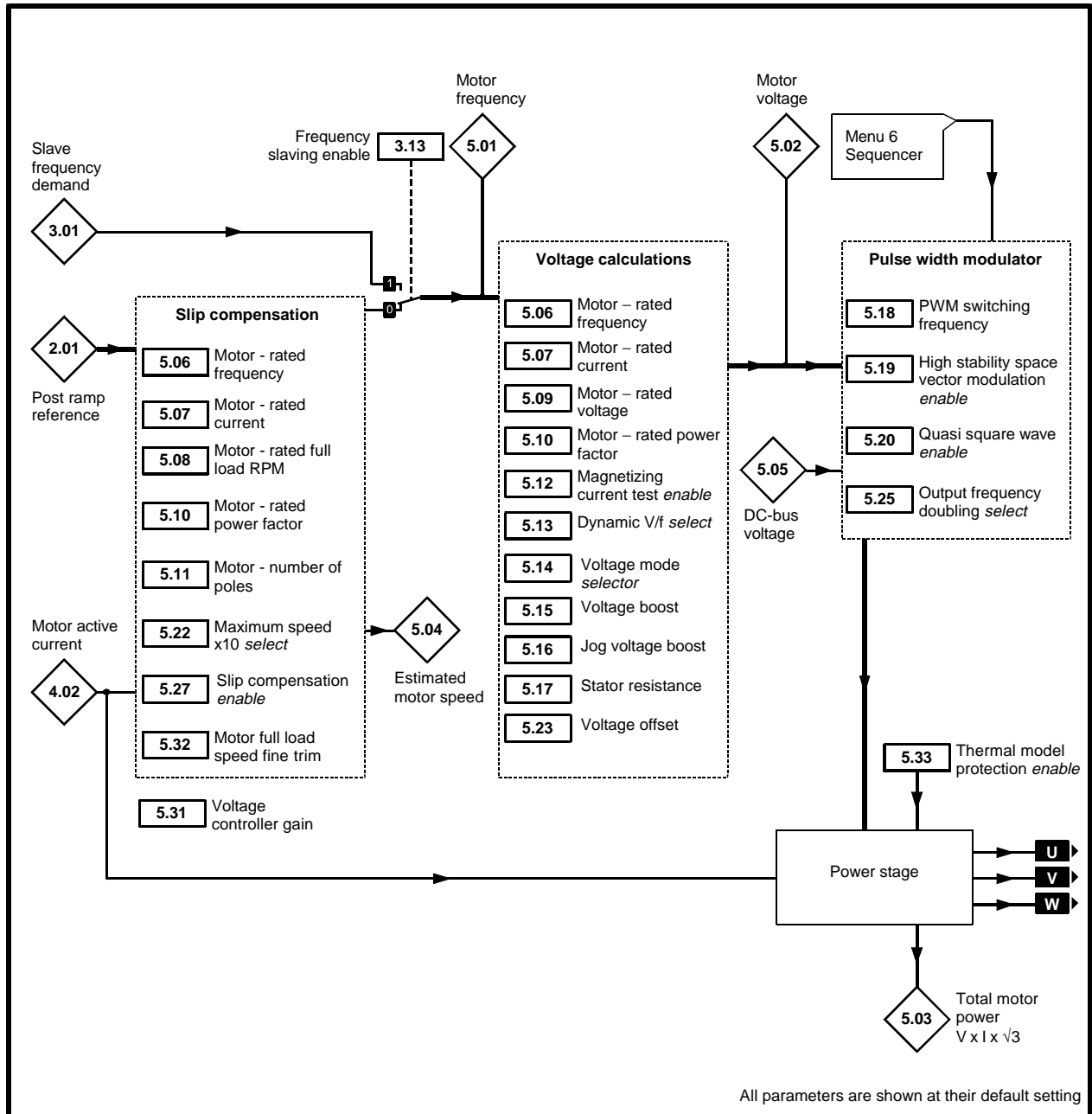
$$I_{\text{RATIO}} = \frac{\text{FLC}}{[0.46]}$$

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
4.01	Motor current magnitude	0 ~ I _{MAX} A	0 ~ I _{MAX} A				RO	Uni		P
4.02 (0.13)	Motor active-current	± I _{MAX} A	± I _{MAX} A				RO	Bi		P
4.03	Torque demand	± I _{MAX} %	± I _{MAX} %				RO	Bi		P
4.04	Current demand	± I _{MAX} %	± I _{MAX} %				RO	Bi		P
4.05	Motoring current limit	0 ~ I _{MAX} %	0 ~ I _{MAX} %	150	150	175	RW	Uni		
4.06	Regenerating current limit	0 ~ I _{MAX} %	0 ~ I _{MAX} %	150	150	175	RW	Uni		
4.07 (0.06)	Symmetrical current limit	0 ~ I _{MAX} %	0 ~ I _{MAX} %	150	150	175	RW	Uni		
4.08	Torque reference	± I _{MAX} %	± I _{MAX} %	0	0	0	RW	Bi		
4.09	Torque reference offset	± I _{MAX} %	± I _{MAX} %	0	0	0	RW	Bi		
4.10	Torque reference offset <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
4.11 (0.17)	Torque mode <i>selector</i>	0 ~ 1	0 ~ 4	0	0	0	RW	Uni		P

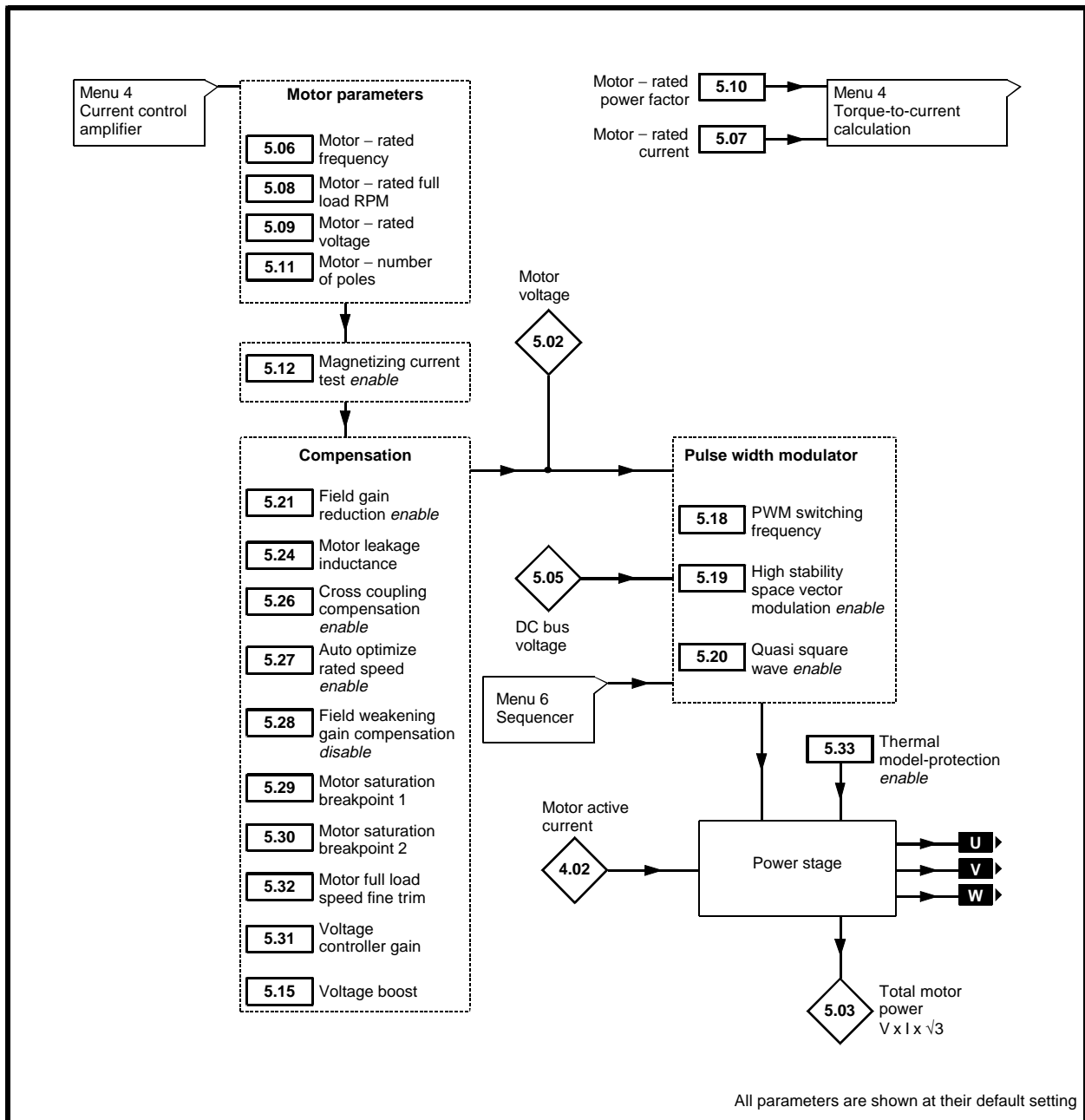
R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

Parameter		Range		Default			Type				
		OL	CL	OL	VT	SV					
4.12	Current-demand filter time-constant		0 ~ 250 ms		0	0	RW	Uni			
4.13	Current-loop proportional gain	0 ~ 30 000	0 ~ 30 000	20	150	130	RW	Uni			
4.14	Current-loop integral gain	0 ~ 30 000	0 ~ 30 000	40	2000	1200	RW	Uni			
4.15	Motor thermal time-constant	0 ~ 400.0 s	0 ~ 400.0 s	89	89	7	RW	Uni			
4.16	Motor protection mode <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit			
4.17	Motor magnetizing current	$\pm I_{MAX}$ A	$\pm I_{MAX}$ A				RO	Bi			P
4.18	Over-riding current limit	0 ~ I_{MAX} %	0 ~ I_{MAX} %				RO	Uni			P
4.19	Overload accumulator	0 ~ 100 %	0 ~ 100 %				RO	Uni			P
4.20	Percentage torque current	0 ~ I_{MAX} %	0 ~ I_{MAX} %				RO	Bi			P

MENU 5
Motor monitoring
Motor ratings
Voltage boost
Autotune
PWM switching frequency
Slip compensation



Menu 5 Open-loop logic diagram



Menu 5 Closed-loop logic diagram

Power rating

$$P_{MAX} = \sqrt{3} \times I_{MAX} \times \frac{[5.09]}{1000}$$

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
5.01	Motor frequency	±[1.06]					RO	Bi		P
5.02	Motor voltage	0 ~ 528 V	0 ~ 528 V				RO	Bi		P
5.03	Total motor power	± P _{MAX} kW	± P _{MAX} kW				RO	Bi		P
5.04 (0.10)	Estimated motor speed	± 6000 RPM					RO	Bi		P
5.05	DC-bus voltage	0 ~ 830 V	0 ~ 830 V				RO	Uni		P
5.06 (0.47)	Motor – rated frequency	0 ~ 1000.0 Hz	0 ~ 1000.0 Hz	50 (EUR) 60 (USA)	50 (EUR) 60 (USA)		RW	Uni		
5.07 (0.46)	Motor – rated current	0 ~ FLC A	0 ~ FLC A	FLC	FLC	FLC	RW	Uni		
5.08 (0.45)	Motor – rated full load RPM	0 ~ 6000 RPM	0 ~ 30 000 RPM	0	1450 (EUR) 1770 (USA)		RW	Uni		
5.09 (0.44)	Motor – rated voltage	0 ~ 480 V	0 ~ 480 V	400 (EUR) 460 (USA)	400 (EUR) 460 (USA)		RW	Uni		
5.10 (0.43)	Motor – rated power factor	0 ~ 1.000	0 ~ 1.000	0.92	0.92		RW	Uni	S	P
5.11 (0.42)	Motor – number of poles	2 ~ 32	2 ~ 32	4	4	6	RW	Txt		P
5.12 (0.40)	Magnetizing current test <i>enable</i>	0 ~ 1	0 ~ 1	0	0		RW	Bit		P
5.13 (0.09)	Dynamic V/f <i>select</i>	0 ~ 1		0			RW	Bit		

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
5.14 (0.07)	Voltage mode <i>selector</i>	0 ~ 3		1			RW	Uni		P
5.15 (0.08)	Boost voltage	0 ~ 25.0 %		3			RW	Uni		
5.16	Jog boost-voltage	0 ~ 25.0 %		3			RW	Uni		
5.17	Stator resistance	0 ~ 32.000 Ω		0			RW	Uni	S	P
5.18 (0.41)	PWM switching frequency <i>selector</i>	3 4.5 6 9 12 kHz	3 4.5 6 9 12 kHz	3	3	3	RW	Txt		P
5.19	High-stability space-vector modulation <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
5.20	Quasi square-wave <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
5.21	Field-gain reduction <i>enable</i>		0 ~ 1		1		RW	Bit		
5.22	Maximum speed x10 <i>select</i>	0 ~ 1		0			RW	Bit		
5.23	Voltage offset	0 ~ 25.5 V					RO	Uni		P
5.24	Motor leakage inductance		0 ~ 320.00 mH		0	0	RW	Uni	S	P
5.25	Output frequency doubling <i>select</i>	0 ~ 1		0			RW	Bit		
5.26	Cross-coupling compensation <i>enable</i>		0 ~ 1		0	0	RW	Bit		
5.27	Slip compensation <i>enable</i>	0 ~ 1		0			RW	Bit		
5.27	Auto-optimize rated speed <i>enable</i>		0 ~ 1		0		RW	Bit		
5.28	Field-weakening gain compensation <i>disable</i>		0 ~ 1		0		RW	Bit		
5.29	Motor saturation breakpoint 1		0 ~ 100 %		50		RW	Uni		P
5.30	Motor saturation breakpoint 2		0 ~ 100 %		75		RW	Uni		P
5.31	Voltage-controller gain	0 ~ 30	0 ~ 30	1	1	1	RW	Uni		P
5.32	Motor full load speed fine trim	0 ~ 0.99 RPM	0 ~ 0.99 RPM	0	0		RW	Uni		P
5.33	Thermal model protection <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		

MENU 6

Drive sequencer

Auto-start

AC supply loss

Jog time

Limit switches

Injection braking

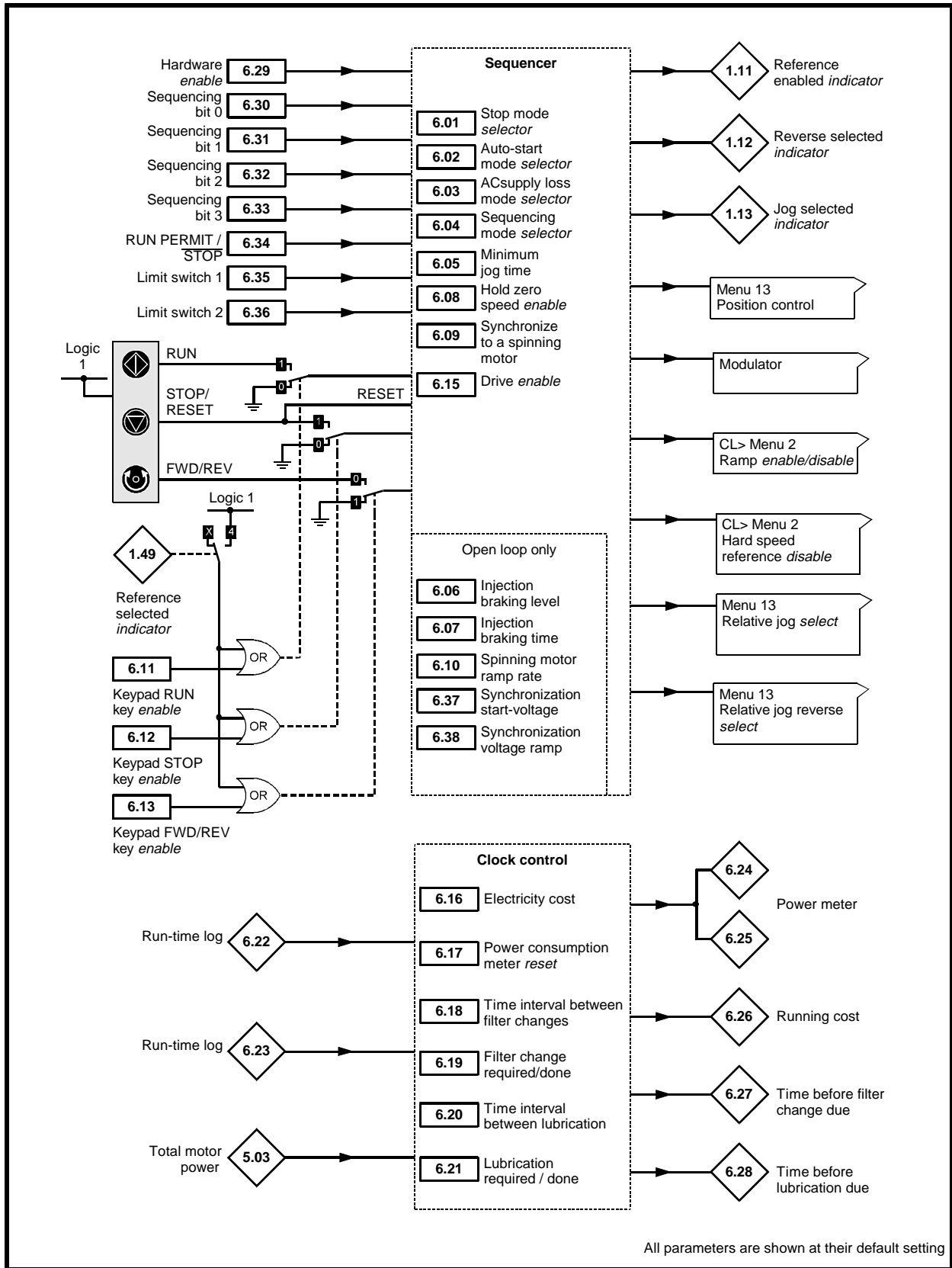
Synchronize to a spinning motor

Keypad enable

Run-time log

Electricity cost

Refer to the next page.



All parameters are shown at their default setting

Menu 6 logic diagram

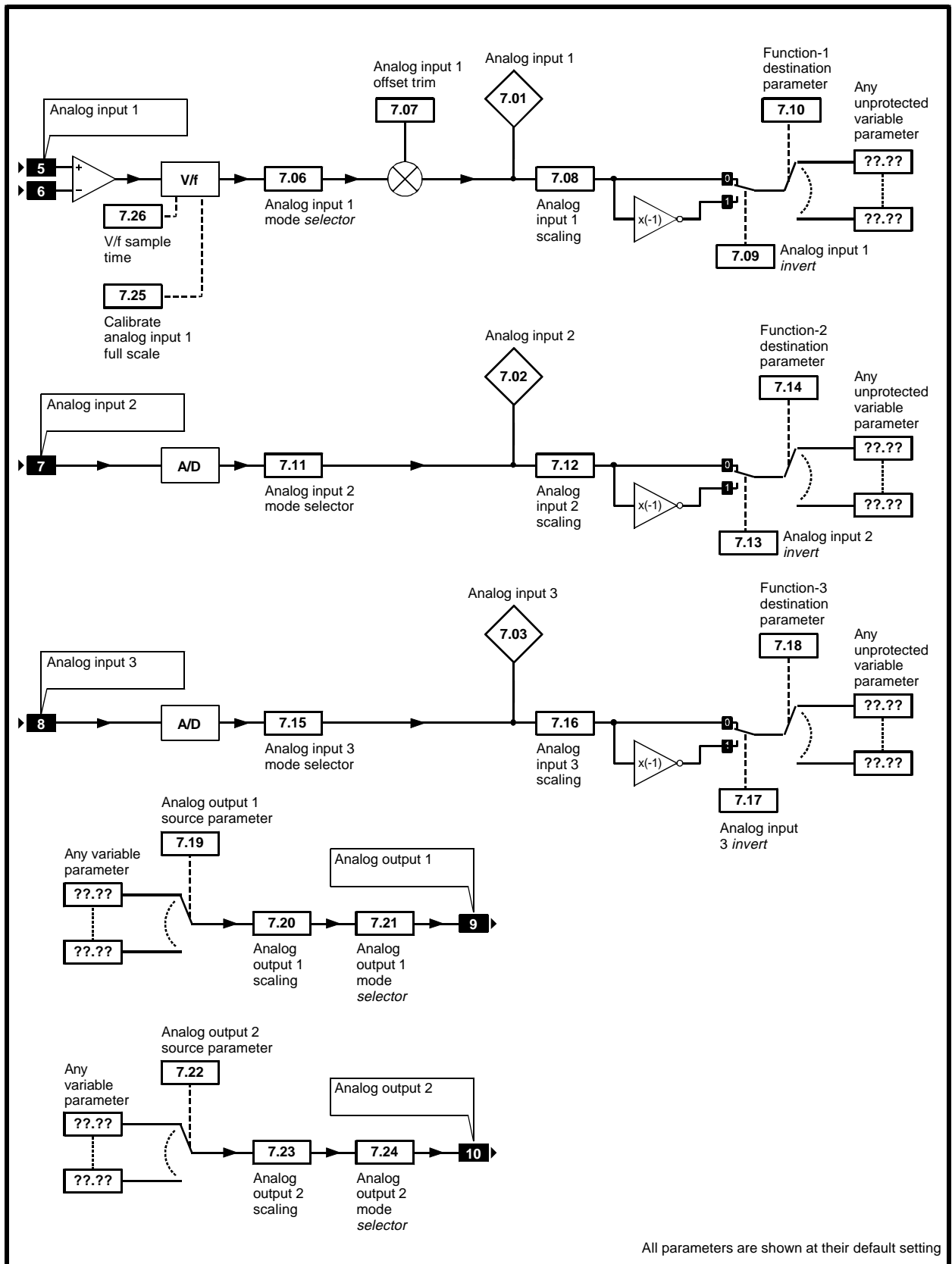
Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
6.01 (0.16)	Stop mode <i>selector</i>	COASt (0) rP (1) rP-dcl (2) dcl (3) td.dcl (4)	COASt (0) rP (1) no.rP (2) rP-POS (3)	rP	rP	no.rP	RW	Txt		
6.02	Auto-start mode <i>selector</i>	diS (0) ALYS (1) Pd.dP (2)	diS (0) ALYS (1) Pd.dP (2)	diS	diS	diS	RW	Txt		
6.03	AC supply loss mode <i>selector</i>	diS (0) StoP (1) ridE.th (2)	diS (0) StoP (1) ridE.th (2)	diS	diS	diS	RW	Txt		P
6.04	Sequencing mode <i>selector</i>	0 ~ 4	0 ~ 4	4	4	4	RW	Uni		P
6.05	Minimum jog time	0 ~ 25.0 s	0 ~ 25.0 s	0	0	0	RW	Uni		
6.06	Injection braking level	0 ~ 100.0 %FLC		100			RW	Uni		
6.07	Injection braking time	0 ~ 25.0 s		5			RW	Uni		
6.08	Hold zero speed <i>enable</i>	0 ~ 1	0 ~ 1	0	0	1	RW	Bit		
6.09 (0.39)	Synchronize to a spinning motor	0 ~ 1	0 ~ 1	0	1	1	RW	Bit		
6.10	Spinning motor ramp rate	0 ~ 25.0 s/100Hz		5			RW	Uni		

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

Parameter		Range		Default			Type					
		OL	CL	OL	VT	SV						
6.11	Keypad RUN key <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.12	Keypad STOP key <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.13	Keypad FWD/REV key <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.15	Drive <i>enable</i>	0 ~ 1	0 ~ 1	1	1	1	RW	Bit				
6.16	Electricity cost / kWh	0 ~ 600.0 <i>Currency/kWh</i>	0 ~ 600.0 <i>Currency/kWh</i>	0	0	0	RW	Uni				
6.17	Power consumption meter <i>reset</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.18	Time interval between filter changes	0 ~ 30 000 <i>h</i>	0 ~ 30 000 <i>h</i>	0	0	0	RW	Uni				
6.19	Filter change required/done	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.20	Time interval between lubrication	0 ~ 30 000 <i>h</i>	0 ~ 30 000 <i>h</i>	0	0	0	RW	Uni				
6.21	Lubrication required/done	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.22	Run-time log	0 ~ 30.365 <i>years.days</i>	0 ~ 30.365 <i>years.days</i>				RO	Uni	S	P		
6.23	Run-time log	0 ~ 23.59 <i>h. m.</i>	0 ~ 23.59 <i>h. m.</i>				RO	Uni	S	P		
6.24	Power meter	0 ~ 30 000 <i>MWh</i>	0 ~ 30 000 <i>MWh</i>				RO	Uni	S	P		
6.25	Power meter	0 ~ 999.9 <i>kWh</i>	0 ~ 999.9 <i>kWh</i>				RO	Uni	S	P		
6.26	Running cost	0 ~ 32000 <i>Currency/h</i>	0 ~ 32000 <i>Currency/h</i>				RO	Uni	S	P		
6.27	Time before filter change due	0 ~ 30 000 <i>h</i>	0 ~ 30 000 <i>h</i>				RO	Uni	S	P		
6.28	Time before lubrication due	0 ~ 30 000 <i>h</i>	0 ~ 30 000 <i>h</i>				RO	Uni	S	P		
6.29	Hardware <i>enable</i>	0 ~ 1	0 ~ 1				RO	Bit			P	
6.30	Sequencing bit 0	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.31	Sequencing bit 1	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.32	Sequencing bit 2	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.33	Sequencing bit 3	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.34	RUN PERMIT / STOP	0 ~ 1	0 ~ 1	0	0	0	RW	Bit				
6.35	Limit switch 1	0 ~ 1	0 ~ 1				RO	Bit				
6.36	Limit switch 2	0 ~ 1	0 ~ 1				RO	Bit				
6.37	Spinning motor start-voltage	0 ~ 100.0 %		25			RW	Uni				
6.38	Spinning motor voltage-ramp	0 ~ 2.5 <i>s</i>		0.25			RW	Uni				

MENU 7
Analog I/O
Temperatures
Large option module

Refer to the next page.



Menu 7 logic diagram

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
7.01	Analog input 1	±100.0 %	±100.0 %				RO	Bi		P
7.02	Analog input 2	±100.0 %	±100.0 %				RO	Bi		P
7.03	Analog input 3	±100.0 %	±100.0 %				RO	Bi		P
7.04	Heatsink temperature	0 ~ 100 °C	0 ~ 100 °C				RO	Uni		P
7.05	Control board temperature	0 ~ 100 °C	0 ~ 100 °C				RO	Uni		P
7.06 (0.24)	Analog input 1 mode selector	VOLt 0 – 20 20 – 0 4 – 20.tr 20 – 4.tr 4 – 20.Lo 20 – 4.Lo 4 – 20.Pr 20 – 4.Pr	VOLt 0 – 20 20 – 0 4 – 20.tr 20 – 4.tr 4 – 20.Lo 20 – 4.Lo 4 – 20.Pr 20 – 4.Pr	VOLt	VOLt	VOLt	RW	Txt		P
7.07	Analog input 1 offset trim	±10.000 %	±10.000 %	0	0	0	RW	Bi		P
7.08	Analog input 1 scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.09	Analog input 1 invert	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
7.10	Analog input 1 destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.36	1.36	1.36	RW	Uni	R	P
7.11 (0.25)	Analog input 2 mode selector	(as 7.06)	(as 7.06)	VOLt	VOLt	VOLt	RW	Txt		P
7.12	Analog input 2 scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.13	Analog input 2 invert	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
7.14 (0.26)	Analog input 2 destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.37	1.37	1.37	RW	Uni	R	P

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

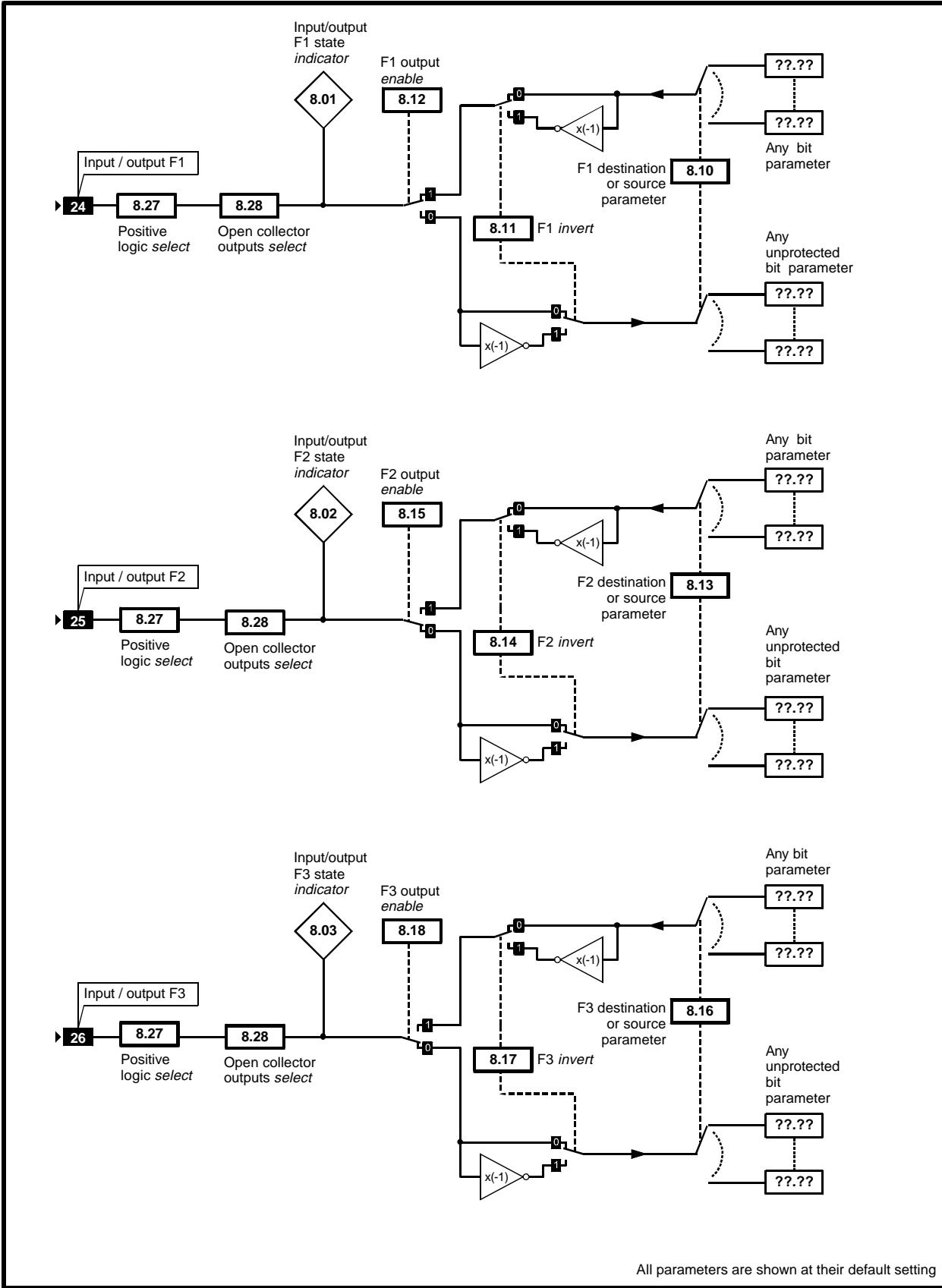
Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
7.15	Analog input 3 mode <i>selector</i>	VOLt 0 – 20 20 – 0 4 – 20.tr 20 – 4.tr 4 – 20.Lo 20 – 4.Lo 4 – 20.Pr 20 – 4.Pr th.SC th	VOLt 0 – 20 20 – 0 4 – 20.tr 20 – 4.tr 4 – 20.Lo 20 – 4.Lo 4 – 20.Pr 20 – 4.Pr th.SC th	th (EUR) VOLt (USA)	th (EUR) VOLt (USA)	th (EUR) VOLt (USA)	RW	Txt		P
7.16	Analog input 3 scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.17	Analog input 3 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
7.18	Analog input 3 destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P
7.19	Analog output 1 source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	5.01	3.02	3.02	RW	Uni		P
7.20	Analog output 1 scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.21	Analog output 1 mode <i>selector</i>	VOLt 0 – 20 4 – 20	VOLt 0 – 20 4 – 20	VOLt	VOLt	VOLt	RW	Txt		P
7.22	Analog output 2 source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	4.02	4.02	4.02	RW	Uni		P
7.23	Analog output 2 scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
7.24	Analog output 2 mode <i>selector</i>	VOLt 0 – 20 4 – 20	VOLt 0 – 20 4 – 20	VOLt	VOLt	VOLt	RW	Txt		P
7.25	Calibrate analog input 1 full scale	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
7.26	V/f sample time		0 ~ 5.0 ms		4	4	RW	Uni		
7.27	Analog input 1 current loss <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
7.28	Analog input 2 current loss <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
7.29	Analog input 3 current loss <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
7.30	Analog output short cut <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
7.31	UD78 large option module fitted <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
7.32	IGBT junction temperature	0 ~ 150 °C	0 ~ 150 °C				RO	Uni		P

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MENU 8

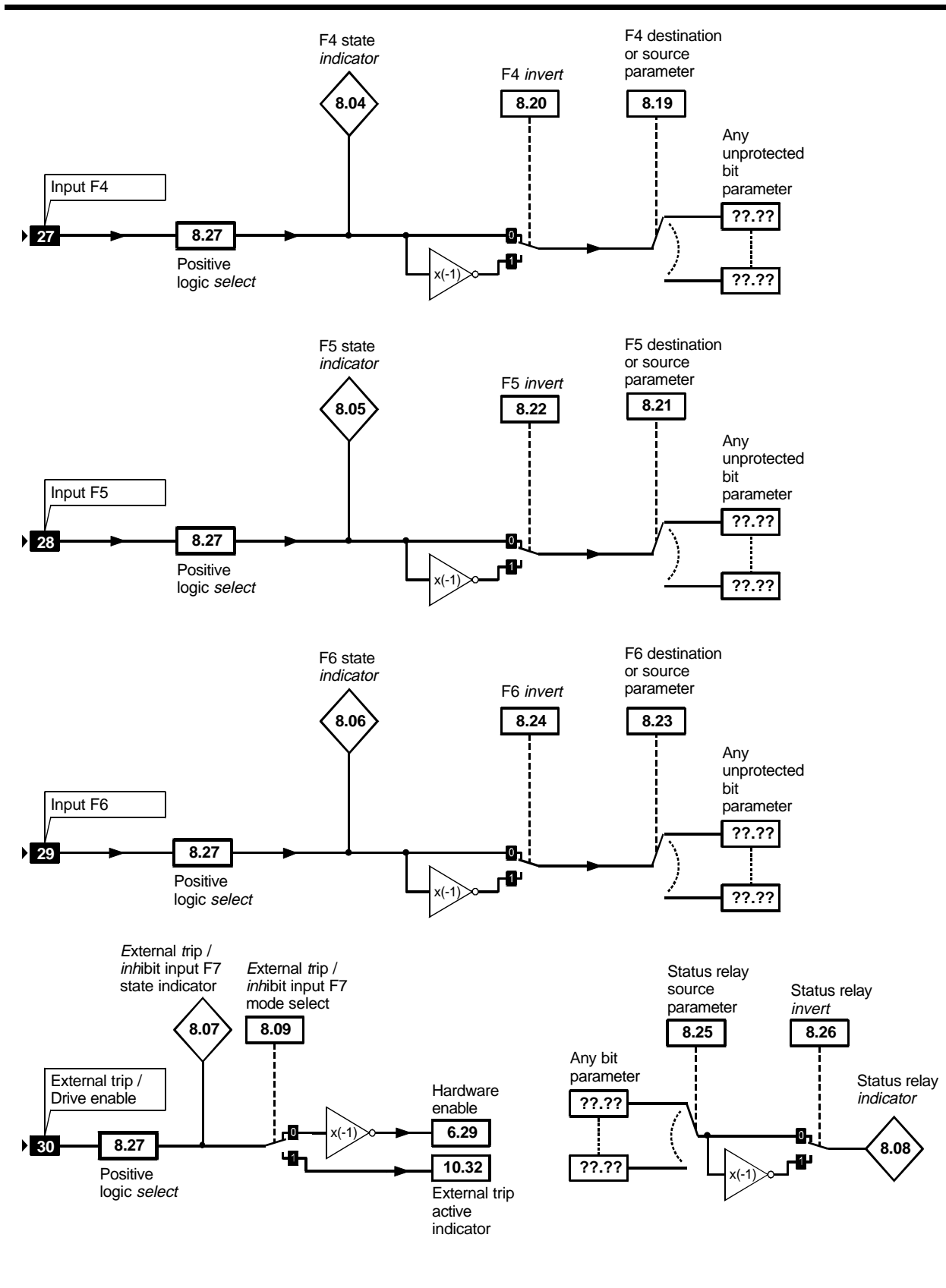
Digital I/O

Refer to the next page.



All parameters are shown at their default setting

Menu 8 logic diagram

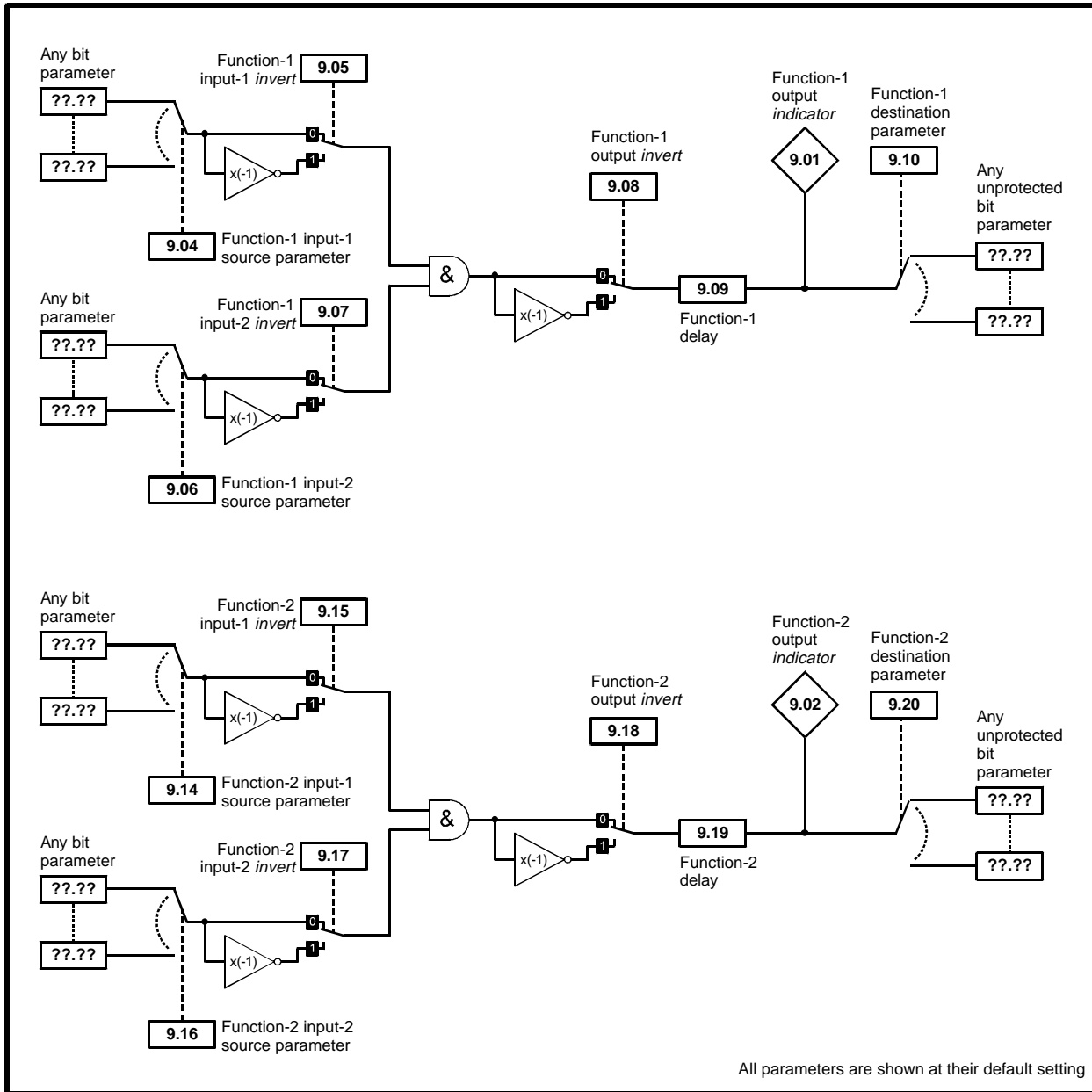


Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
8.01	Digital input/output F1 state	0 ~ 1	0 ~ 1				RO	Bit		P
8.02	Digital input/output F2 state	0 ~ 1	0 ~ 1				RO	Bit		P
8.03	Digital input/output F3 state	0 ~ 1	0 ~ 1				RO	Bit		P
8.04	Digital input F4 state	0 ~ 1	0 ~ 1				RO	Bit		P
8.05	Digital input F5 state	0 ~ 1	0 ~ 1				RO	Bit		P
8.06	Digital input F6 state	0 ~ 1	0 ~ 1				RO	Bit		P
8.07	External trip/inhibit input F7 state indicator	0 ~ 1	0 ~ 1				RO	Bit		P
8.08	Status relay <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
8.09	External trip/inhibit input F7 mode select	0 ~ 1	0 ~ 1	0	1	1	RW	Bit		
8.10	F1 destination or source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	10.06	10.03	10.03	RW	Uni	R	P
8.11	F1 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
8.12	F1 output <i>enable</i>	0 ~ 1	0 ~ 1	1	1	1	RW	Bit	R	
8.13	F2 destination or source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	10.33	10.33	10.33	RW	Uni	R	P
8.14	F2 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
8.15	F2 output <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit	R	
8.16	F3 destination or source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	6.31	6.31	6.31	RW	Uni	R	P
8.17	F3 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
8.18	F3 output <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit	R	
8.19	F4 destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	6.30	6.30	6.30	RW	Uni	R	P
8.20	F4 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
8.21	F5 destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	6.32	6.32	6.32	RW	Uni	R	P
8.22	F5 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
8.23	F6 destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.41	1.41	1.41	RW	Uni	R	P
8.24	F6 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
8.25	Status relay source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	10.01	10.01	10.01	RW	Uni		P
8.26	Status relay <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
8.27	Positive logic <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit	R	P
8.28	Open-collector outputs <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit	R	P

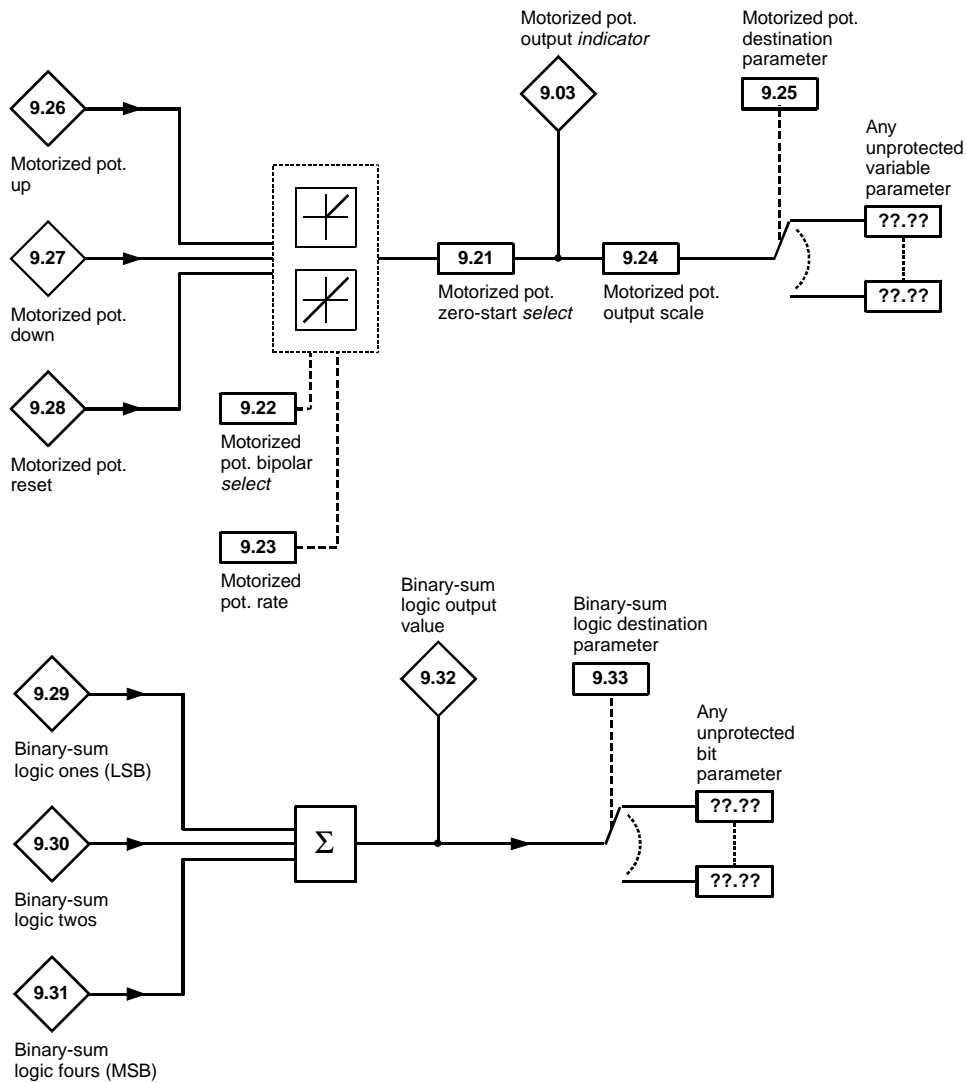
R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

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MENU 9
Programmable logic
Motorized potentiometer
Binary-sum logic



Menu 9 logic diagram



Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
9.01	Prog.-logic function 1 output <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
9.02	Prog.-logic function 2 output <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
9.03	Motorized pot. output <i>indicator</i>	±100.0 %	±100.0 %				RO	Bi	S	P
9.04	Prog.-logic function 1 input 1 source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
9.05	Prog.-logic function 1 input 1 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
9.06	Prog.-logic function 1 input 2 source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
9.07	Prog.-logic function 1 input 2 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
9.08	Prog.-logic function 1 output <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
9.09	Prog.-logic function 1 delay	0 ~ 25.0 s	0 ~ 25.0 s	0	0	0	RW	Uni		
9.10	Prog.-logic function 1 destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P
9.14	Prog.-logic function 2 input 1 source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
9.15	Prog.-logic function 2 input 1 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
9.16	Prog.-logic function 2 input 2 source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
9.17	Prog.-logic function 2 input 2 <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
9.18	Prog.-logic function 2 output <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
9.19	Prog.-logic function 2 delay	0 ~ 25.0 s	0 ~ 25.0 s	0	0	0	RW	Uni		
9.20	Prog.-logic function 2 destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P
9.21	Motorized pot. zero-start <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
9.22	Motorized pot. bipolar <i>select</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
9.23	Motorized pot. rate	0 ~ 250 s	0 ~ 250 s	20	20	20	RW	Uni		

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
9.24	Motorized pot. output scale factor	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
9.25	Motorized pot. destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P
9.26	Motorized pot. up	0 ~ 1	0 ~ 1				RO	Bit		
9.27	Motorized pot. down	0 ~ 1	0 ~ 1				RO	Bit		
9.28	Motorized pot. reset	0 ~ 1	0 ~ 1				RO	Bit		
9.29	Binary-sum logic ones (LSB)	0 ~ 1	0 ~ 1				RO	Bit		
9.30	Binary-sum logic twos	0 ~ 1	0 ~ 1				RO	Bit		
9.31	Binary-sum logic fours (MSB)	0 ~ 1	0 ~ 1				RO	Bit		
9.32	Binary-sum logic output value	0 ~ 7	0 ~ 7				RO	Uni		P
9.33	Binary-sum logic destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P

MENU 10
Status and diagnostic information
Process-generated trips
UD78 power-supply indicator

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
10.01	Drive normal <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.02	Drive running <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.03	At zero speed <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.04	At or below min. speed <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.05	Below at-speed window <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.06	At speed <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.07	Above at-speed window <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.08	At 100% load "reached" <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.09	Current-limit active <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.10	Motor regenerating <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.11	Dynamic brake active <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.12	Dynamic brake alarm <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.13	Direction demanded <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.14	Direction running <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.15	AC supply loss <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.16	Motor thermistor over-temperature <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.17	Motor current overload alarm <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.18	Heatsink temperature alarm <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
10.19	Ambient temperature alarm <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
10.20	Last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.21	Second last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.22	Third last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.23	Fourth last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.24	Fifth last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.25	Sixth last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.26	Seventh last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.27	Eighth last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.28	Ninth last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.29	Tenth last trip	0 ~ 151	0 ~ 151				RO	Txt		P
10.30	Max. full-power braking time	0 ~ 400.0 s	0 ~ 400.0 s	0	0	0	RW	Uni		
10.31	Max. full-power braking interval	0 ~ 25.0 m	0 ~ 25.0 m	0	0	0	RW	Uni		
10.32	External trip	0 ~ 1	0 ~ 1				RO	Bit		
10.33	Drive reset	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
10.34	Number of auto-reset attempts	0 ~ 5	0 ~ 5	0	0	0	RW	Uni		
10.35	Auto-reset time delay	0 ~ 25.0 s	0 ~ 25.0 s	1	1	1	RW	Uni		
10.36	Hold Drive normal (10.01) until last auto reset attempt	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
10.37	Stop Drive on non-important trips	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
10.38	User trip	0 ~ 200	0 ~ 200	0	0	0	RW	Uni		P
10.39	Braking-energy overload accumulator	0 ~ 100.0 %	0 ~ 100.0 %				RO	Uni		P
10.40	Status word	0 ~ 32767	0 ~ 32767				RO	Uni		P
10.41	UD78 auxiliary power supply active indicator	0 ~ 1	0 ~ 1				RO	Bit		P
10.42	IGBT junction temperature above 135°C indicator	0 ~ 1	0 ~ 1				RO	Bit		P

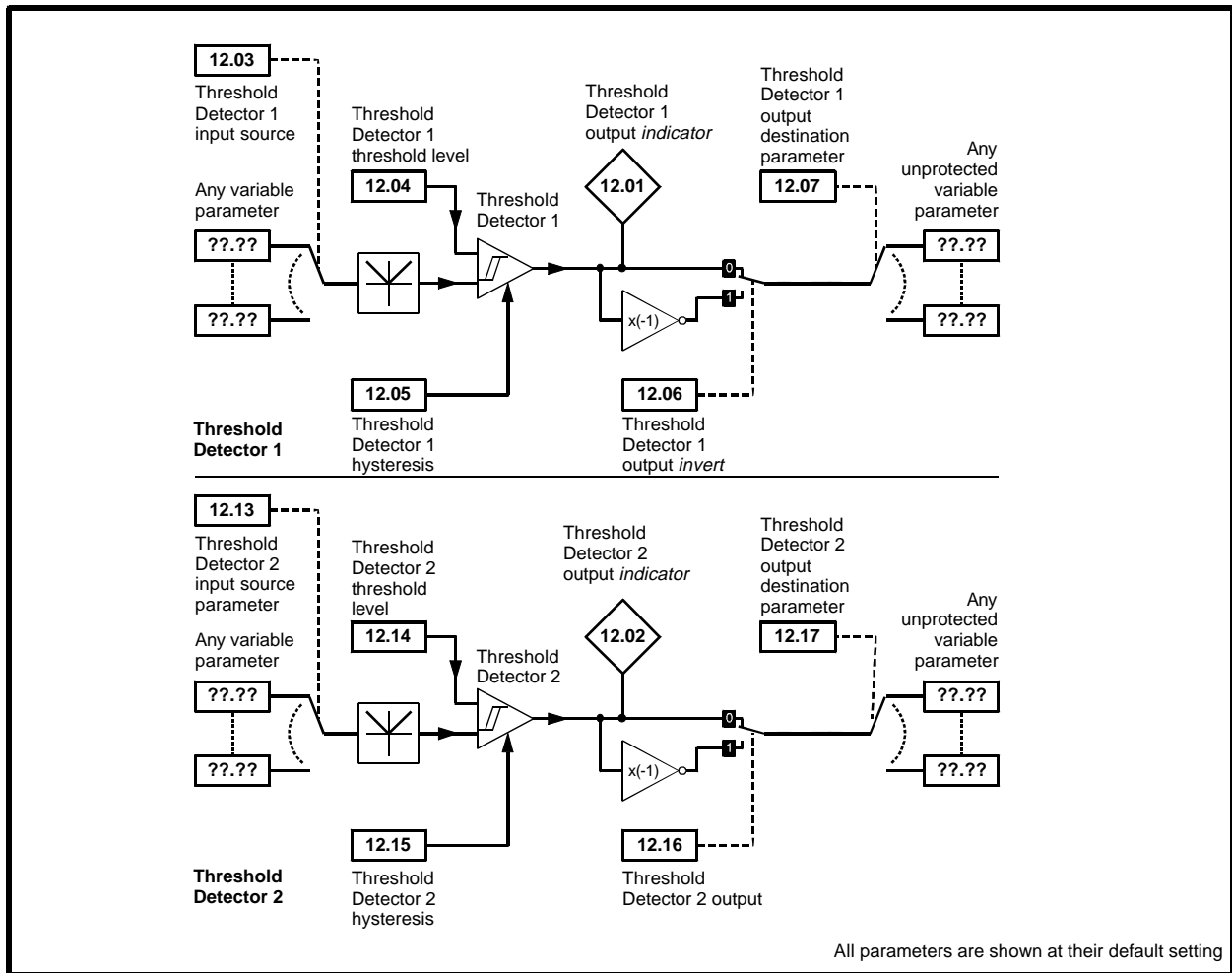
MENU 11
Menu 0 assignments
Scale factors
Initial parameter displayed
Serial communications
Drive information

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
11.01	Parameter 0.11 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.03	1.03	1.03	RW	Uni		P
11.02	Parameter 0.12 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	2.01	2.01	2.01	RW	Uni		P
11.03	Parameter 0.13 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	4.02	4.02	4.02	RW	Uni		P
11.04	Parameter 0.14 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.05	1.05	1.05	RW	Uni		P
11.05	Parameter 0.15 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	2.04	2.04	2.04	RW	Uni		P
11.06	Parameter 0.16 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	6.01	6.01	6.01	RW	Uni		P
11.07	Parameter 0.17 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	4.11	4.11	4.11	RW	Uni		P
11.08	Parameter 0.18 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	2.06	2.06	2.06	RW	Uni		P
11.09	Parameter 0.19 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	2.07	2.07	2.07	RW	Uni		P
11.10	Parameter 0.20 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.29	1.29	1.29	RW	Uni		P
11.11	Parameter 0.21 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.30	1.30	1.30	RW	Uni		P
11.12	Parameter 0.22 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.31	1.31	1.31	RW	Uni		P
11.13	Parameter 0.23 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	1.32	1.32	1.32	RW	Uni		P
11.14	Parameter 0.24 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	7.06	7.06	7.06	RW	Uni		P
11.15	Parameter 0.25 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	7.11	7.11	7.11	RW	Uni		P
11.16	Parameter 0.26 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	7.14	7.14	7.14	RW	Uni		P
11.17	Parameter 0.27 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	8.27 (EUR) 6.04 (USA)	8.27 (EUR) 6.04 (USA)	8.27 (EUR) 6.04 (USA)	RW	Uni		P
11.18	Parameter 0.28 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	4.13 (EUR) 1.01 (USA)	4.13 (EUR) 1.01 (USA)	4.13 (EUR) 1.01 (USA)	RW	Uni		P
11.19	Parameter 0.29 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	4.14 (EUR) 8.23 (USA)	4.14 (EUR) 8.23 (USA)	4.14 (EUR) 8.23 (USA)	RW	Uni		P
11.20	Parameter 0.30 assignment	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	6.13	6.13	6.13	RW	Uni		P
11.21	Parameter 0.30 scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		P

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
11.22 (0.38)	Power up parameter display select	0 ~ 0.50 <i>menu.parameter</i>	0 ~ 0.50 <i>menu.parameter</i>	0.10	0.10	0.10	RW	Uni		P
11.23	Serial comms. address	0 ~ 9.9 <i>group.unit</i>	0 ~ 9.9 <i>group.unit</i>	1.1	1.1	1.1	RW	Uni		P
11.24	Serial comms. mode	ANSI 2 (0) ANSI 4 (1) OUtPUt (2) INPUt (3)	ANSI 2 (0) ANSI 4 (1) OUtPUt (2) INPUt (3)	ANSI 4	ANSI 4	ANSI 4	RW	Txt	R	P
11.25	Serial comms. baud rate	4800 (0) 9600 (1) 19200 (2) <i>baud</i>	4800 (0) 9600 (1) 19200 (2) <i>baud</i>	4800	4800	4800	RW	Txt		P
11.26	Serial comms two-wire mode delay selector	0 ~ 255 <i>ms</i>	0 ~ 255 <i>ms</i>	0	0	0	RW	Uni		
11.27	Macro loaded number	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P
11.28	Serial comms. parameter scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
11.29	Drive software version	1.00 ~ 99.99	1.00 ~ 99.99				RO	Uni		P
11.30	User security code	0 ~ 255	0 ~ 255	149	149	149	RW	Uni	S	P
11.31	Drive operating mode	OPENLP CL.VECT SErVO rEGEN	OPENLP CL.VECT SErVO rEGEN				RW	Txt	R	P
11.32	Drive rated continuous currents	2.10 ~ 1920 A	2.10 ~ 1920 A				RO	Uni		P
11.33	Drive voltage rating	220 ~ 690 V	220 ~ 690 V				RO	Uni		P
11.34	Drive software build number	0 ~ 99	0 ~ 99				RO	Uni		P
11.35	Number of size-5 modules connected	0 ~ 255	0 ~ 255				RO	Uni		P
11.37	Macro loaded number	0 ~ 9	0 ~ 9				RO	Uni		
11.38	Cloning module parameter set	0 ~ 8	0 ~ 8	0	0	0	RW	Uni		
11.39	Cloning module parameter set Drive type	OPENLP CL.VECT SErVO rEGEN FrFF	OPENLP CL.VECT SErVO rEGEN FrFF	0 1 2 3 4	0 1 2 3 4	0 1 2 3 4	RO	Uni		
11.40	Cloning module parameter checksum	0 ~ 16383	0 ~ 16383				RO	Uni		

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

MENU 12 Programmable comparators

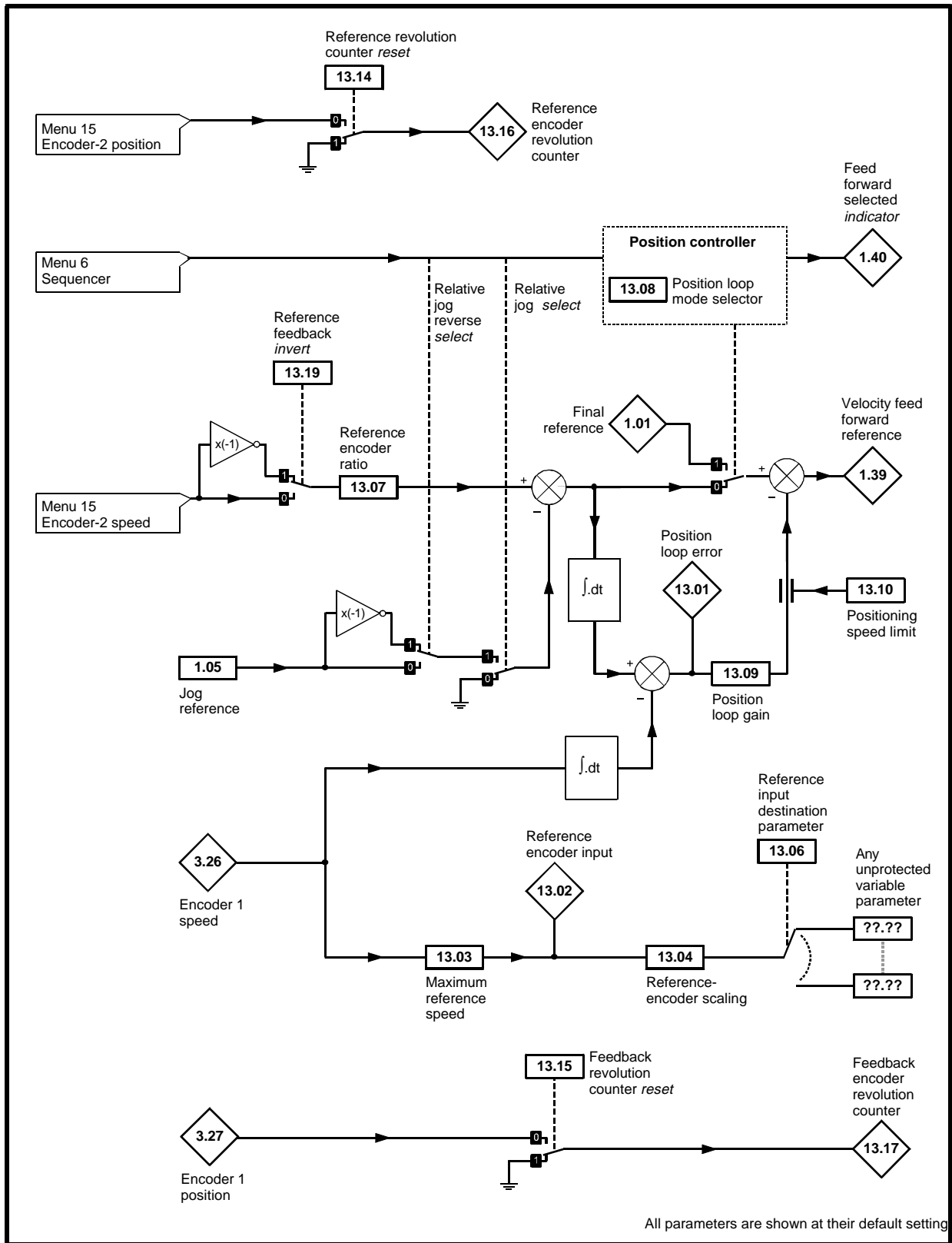


Menu 12 logic diagram

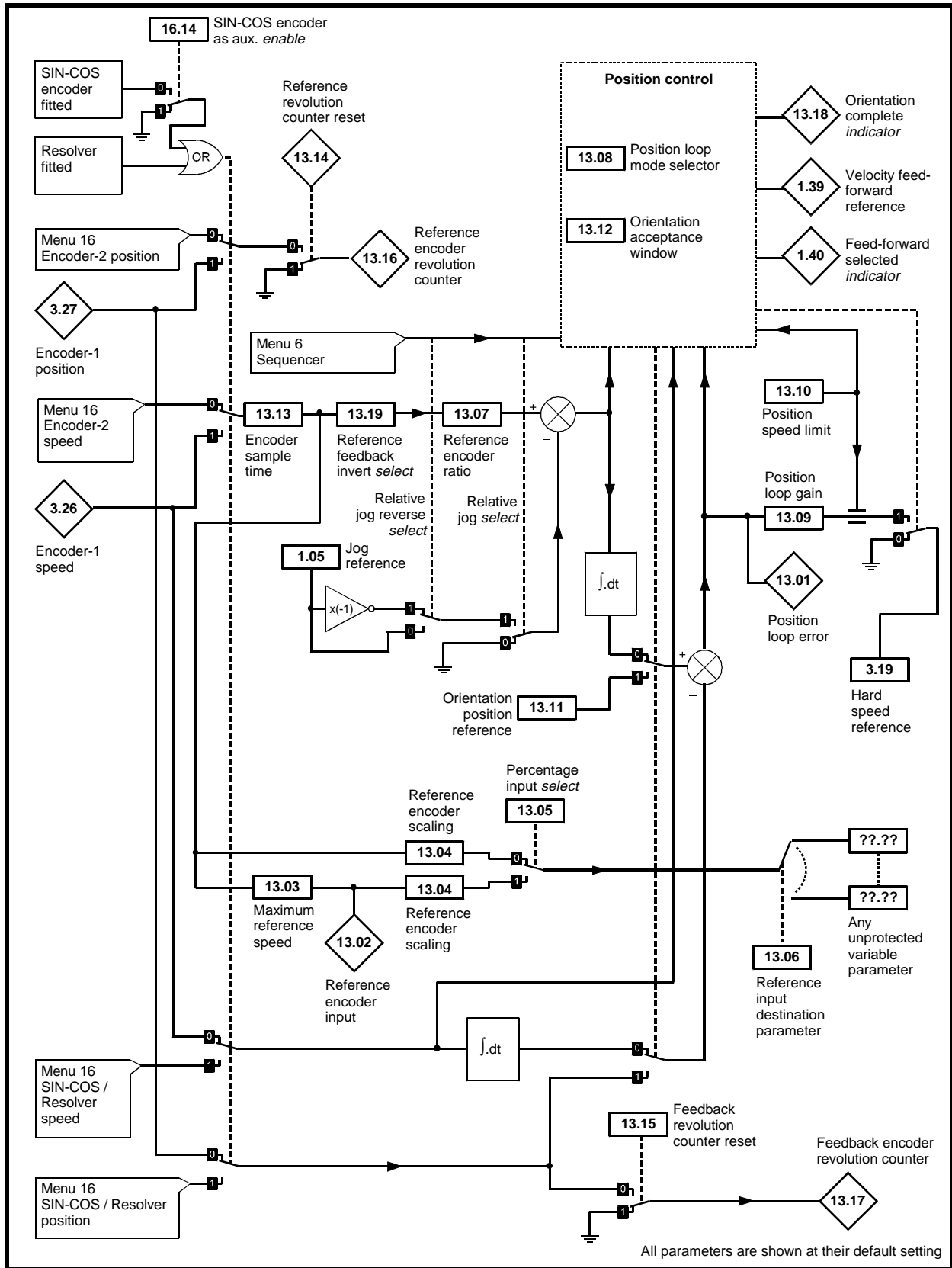
Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
12.01	Threshold Detector 1 output <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
12.02	Threshold Detector 2 output <i>indicator</i>	0 ~ 1	0 ~ 1				RO	Bit		P
12.03	Threshold Detector 1 input source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
12.04	Threshold Detector 1 threshold level	0 ~ 100.0 %	0 ~ 100.0 %	0	0	0	RW	Uni		
12.05	Threshold Detector 1 hysteresis	0 ~ 25.0 %	0 ~ 25.0 %	0	0	0	RW	Uni		
12.06	Threshold Detector 1 output <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
12.07	Threshold Detector 1 output destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P
12.13	Threshold Detector 2 input source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
12.14	Threshold Detector 2 threshold level	0 ~ 100.0 %	0 ~ 100.0 %	0	0	0	RW	Uni		
12.15	Threshold Detector 2 hysteresis	0 ~ 25.0 %	0 ~ 25.0 %	0	0	0	RW	Uni		
12.16	Threshold Detector 2 output <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
12.17	Threshold Detector 2 output destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

MENU 13 Position control



Menu 13 Open-loop logic diagram

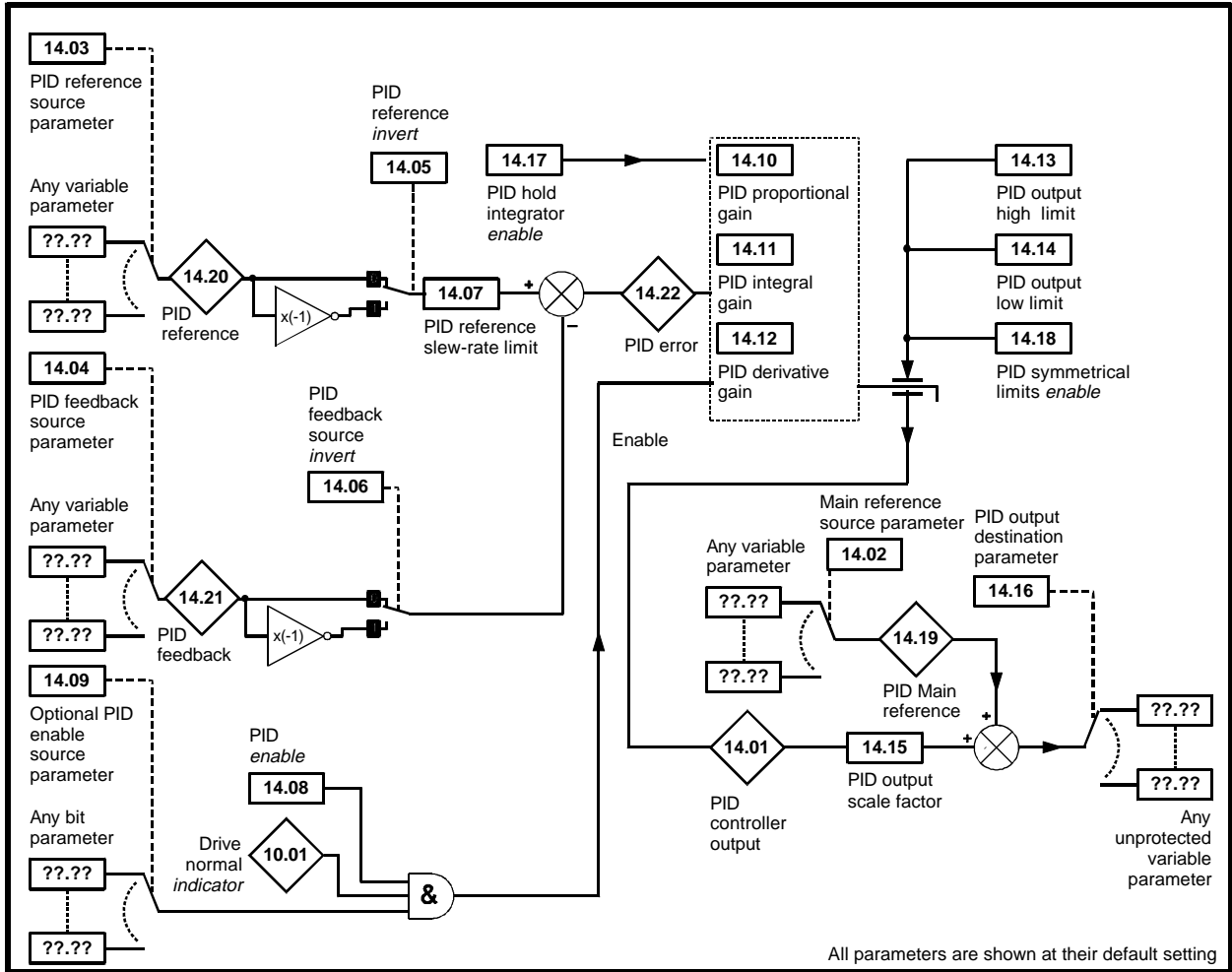


Menu 13 Closed-loop logic diagram

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
13.01	Position-loop error	± 16384 $\frac{1}{16384} \text{ rev}$	± 16384 $\frac{1}{16384} \text{ rev}$				RO	Bi		P
13.02	Reference-encoder input	$\pm 100.0 \%$	$\pm 100.0 \%$				RO	Bi		P
13.03	Maximum reference speed	0 ~ 30 000 RPM	0 ~ 30 000 RPM	1500	1500	3000	RW	Uni		
13.04	Reference-encoder scaling	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
13.05	Percentage input select		0 ~ 1		0	0	RW	Bit		
13.06	Reference input destination selector	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P
13.07	Reference-encoder ratio	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
13.08	Position-loop mode selector	0 ~ 2	0 ~ 6	0	0	0	RW	Uni		
13.09	Position-loop gain	0 ~ 4.000	0 ~ 4.000	0.1	0.1	0.1	RW	Uni		
13.10	Positioning speed-limit	0 ~ 250 RPM	0 ~ 250 RPM	150	150	150	RW	Uni		
13.11	Orientation position reference		0 to 4095 $\frac{1}{4096} \text{ rev}$		0	0	RW	Uni		
13.12	Orientation acceptance window		0 ~ 200 $\frac{1}{4096} \text{ rev}$		20	20	RW	Uni		
13.13	Encoder sample time		0 ~ 5.0 ms		4.0	4.0	RW	Uni		
13.14	Reference revolution counter reset	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
13.15	Feedback revolution counter reset	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
13.16	Reference-encoder revolution counter	0 ~ 16384 <i>revolutions</i>	0 ~ 16384 <i>revolutions</i>				RO	Bi		P
13.17	Feedback-encoder revolution counter	0 ~ 16384 <i>revolutions</i>	0 ~ 16384 <i>revolutions</i>				RO	Bi		P
13.18	Orientation complete indicator		0 ~ 1				RO	Bit		P
13.19	Reference feedback invert select	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

MENU 14 PID controller



Menu 14 logic diagram

Parameter		Range		Default			Type			
		OL	CL	OL	VT	SV				
14.01	PID controller output	±100.0 %	±100.0 %				RO	Bi		P
14.02	Main reference source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
14.03	PID reference source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
14.04	PID feedback source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
14.05	PID reference <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
14.06	PID feedback source <i>invert</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
14.07	PID reference slew-rate limit	0 ~ 3200.0 <i>s</i>	0 ~ 3200.0 <i>s</i>	0	0	0	RW	Uni		
14.08	PID <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
14.09	Optional PID-enable source parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni		P
14.10	PID proportional gain	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
14.11	PID integral gain	0 ~ 4.000	0 ~ 4.000	0.5	0.5	0.5	RW	Uni		
14.12	PID derivative gain	0 ~ 4.000	0 ~ 4.000	0	0	0	RW	Uni		
14.13	PID output high limit	0 ~ 100.0 %	0 ~ 100.0 %	100	100	100	RW	Uni		
14.14	PID output low limit	±100.0 %	±100.0 %	-100	-100	-100	RW	Bi		
14.15	PID output scale factor	0 ~ 4.000	0 ~ 4.000	1	1	1	RW	Uni		
14.16	PID output destination parameter	0 ~ 20.50 <i>menu.parameter</i>	0 ~ 20.50 <i>menu.parameter</i>	0	0	0	RW	Uni	R	P
14.17	PID hold integrator <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
14.18	PID symmetrical limits <i>enable</i>	0 ~ 1	0 ~ 1	0	0	0	RW	Bit		
14.19	PID Main reference	±100.0	±100.0	%	%	%	RO	Bi		
14.20	PID reference	±100.0	±100.0	%	%	%	RO	Bi		
14.21	PID feedback	±100.0	±100.0	%	%	%	RO	Bi		
14.22	PID error	±100.0	±100.0	%	%	%	RO	Bi		

R	Reset required for new value to take effect	Uni	Unipolar variable parameter
S	New parameter-value saved at power-down	Bi	Bipolar variable parameter
P	Protected; forbidden as destination parameter	Txt	Text variable parameter
FLC	Full-load current (max. continuous)	Bit	Bit parameter

1 Menu 1

Parameter descriptions

1.1 Introduction

Menu 1 controls the main reference selection. When the Unidrive operates in open-loop mode a frequency reference is produced, and when Unidrive operates in closed-loop vector or servo modes a speed reference is produced.

Reference update rate

Sample rates vary with switching frequency. In the following the sample rate is given for 3, 6 and 12kHz switching followed by an alternative value in square brackets for 4.5 and 9kHz switching. Speed and frequency references are generally updated from analog inputs and parameter values every 5.5ms [7.4ms], however, a better update rate can be obtained as follows.

Analog input references (not including small option module inputs)

For a faster update rate these must be connected via parameters **1.36** or **1.37**. The frequency reference is sampled every 1.4ms [1.9ms]. To obtain 12 bit resolution from analog input 1, which is based on a V to F converter, a sliding window technique is used over three samples. Therefore a full change of reference takes 4.2ms [5.6ms]. Analog inputs 2 and 3 are based on A to D converters, and so the reference is updated every 1.4ms [1.9ms]. The speed reference is sampled every 345 μ s [460 μ s]. A sliding window may be applied to analog input 1 if required (time defined by parameter **7.26**).

Analog Input References – small option module

The analog inputs on the small option module are only sampled every 5.5ms [7.4ms], even when they are used as a speed or frequency reference.

UD70 large option module

For a faster update rate large option module parameter **91.02** must be used (this parameter is only visible from the UD70). Any value written to **91.02** is automatically mapped into preset speed parameter **1.21**. The frequency reference is sampled every 1.4ms [1.9ms]. The speed reference is sampled every 345 μ s [460 μ s].

Encoder reference

Fast updating of the speed reference from an A,B (quadrature encoder) or F,D (frequency and direction signal) digital reference is possible. This type of reference would come from a UD51 encoder module. The speed reference is sampled every 345µs [460µs]. This type of fast updating can be used to provide a simple form of digital speed locking, see Menu 13 for set-up procedure. The speed loop counts all pulses from the reference and feedback encoders without losing any. Therefore the speed loop integrator maintains a count of the position difference between the reference and feedback. (Counts are lost if the speed reference hits a limit or zero in unipolar mode. Therefore bipolar mode should be used. The destination from menu 13 must be one of the preset speeds.)

1.2 Parameter descriptions

1.01	Level of reference selected									
⇅	OL>	±1000.0*	⇅		Hz	RO	Bi			P
⇅	CL>	±30000*	⇅		RPM					

* This is the maximum range for further restrictions see below:

Indication of the reference being used by the Drive is given for system setup and fault finding.

The range of this parameter is restricted so that it cannot be larger than the range set by parameters **1.06** (maximum speed clamp) and **1.07** (minimum speed clamp).

1.02	Pre-filter reference									
1.03	Pre-ramp reference									
⇅	OL>	±1000.0*	⇅		Hz	RO	Bi			P
⇅	CL>	±30000*	⇅		RPM					

* This is the maximum range for further restrictions see below:

Indication of the reference being used by the Drive is given for system setup and fault finding.

The range of this parameter is restricted so that it cannot be larger than the range set by parameters **1.06** (maximum speed clamp) and **1.07** (minimum speed clamp).

1.04	Reference offset									
⇅	OL>	±1000.0	⇅	0	Hz	RW	Bi			
⇅	CL>	±30000	⇅	0	RPM					

This reference is added to the selected reference if parameter **1.09** is set to 1. It can be used as a trim to finely adjust the main reference being selected or to provided a reference that is the sum of two input values.

1.05 Jog reference

⇅	OL> 0 ~ 400.0	⇒	1.5	Hz	RW	Uni			
⇅	CL> 0 ~ 4000	⇒	50	RPM					

Speed reference used for jogging. See notes in menu 6 on when the jog mode can be activated. The jog reference can be used for relative jogging in digital lock mode, (see menu 13).

1.06 Maximum frequency/speed clamp

EUR >

⇅	OL> 0 ~ 1000.0	⇒	50.0	Hz	RW	Uni			
⇅	VT> 0 ~ 30000	⇒	1500	RPM					
⇅	SV> 0 ~ 30000	⇒	3000	RPM					

USA >

⇅	OL> 0 ~ 1000.0	⇒	60	Hz	RW	Uni			
⇅	VT> 0 ~ 30000	⇒	1800	RPM					
⇅	SV> 0 ~ 30000	⇒	3000	RPM					

If parameter **1.08** is 0, this parameter is a symmetrical limit on both directions of rotation. When **1.08** is 1 this is a clamp on the forward direction only.

Open loop

Defines drive absolute maximum frequency reference. Slip compensation and operation under regenerating current limit can increase the motor frequency further. Overspeed detection is provided to prevent excessive frequencies - see parameter **3.29**.

Closed loop

Clamp on the speed reference. (See parameter **3.21** for further restrictions.)

1.07 Minimum frequency/speed clamp

⇅	OL> ±1000.0*	⇒	0	Hz	RW	Bi			
⇅	CL> ±30,000*	⇒	0	RPM					

*This is the maximum range for further restrictions see below.

	1.08 = 0	1.08 = 1
Open loop	0 to Pr1.06	-1000.0 to 0
Closed loop	0 to Pr1.06	-30,000 to 0

If parameter **1.08** is 0, parameter **1.07** is used in unipolar mode to define drive minimum speed. Inactive during jogging.

When parameter **1.08** is 1, parameter **1.07** is the negative clamp on the speed reference limiting the speed set point in the reverse direction.

1.08 Negative minimum speed select

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

When this parameter is 0, parameter **1.07** can be set to a positive value between 0 and the value of parameter **1.06** only. Providing minimum speed clamp (parameter **1.07**) has not been disabled (by bipolar mode being selected or jog being selected) then the Drive will run at a speed no lower than **+1.07** in the forward direction and no lower than **-1.07** in the reverse direction. Parameter **1.06** provides a symmetrical clamp on maximum speed in both directions and is used as the maximum value of parameters **1.36** and **1.37** for correct scaling of analog inputs.

Setting this parameter to 1 changes the range of **1.07**; 0 to -1000.0Hz for the open loop drive or 0 to -30000rpm for the closed loop drives. The maximum speed for the forward direction is parameter **1.06** and maximum speed for the reverse direction is **1.07**. Either parameter **1.06** or the modulus of parameter **1.07**, which ever is the greater, defines the maximum value of parameters **1.36** and **1.37** for scaling of analog inputs.

1.09 Reference offset mode select

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

When this parameter is at 0 the offset added is a percentage trim derived from the selected reference and the percentage trim parameter (**1.38**).

When set to 1 the offset added is the reference offset (**1.04**).

The trim values only have a resolution of 1rpm.

1.10 Bipolar reference select

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

If the user requires to change the direction of rotation with a bipolar reference this parameter should be set. If it is not, all negative references are treated as zero.

1.11	Reference enabled indicator
1.12	Reverse selected indicator
1.13	Jog selected indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

These indicators are controlled by the Drive sequencer defined in Menu 6. They select the appropriate reference as commanded by the Drive logic.

1.14	Reference selector
-------------	---------------------------

⇕	OL> 0 ~ 5	⇒	0		RW	Uni			
⇕	CL> 0 ~ 5	⇒	0						

Parameter **1.14** selects a speed reference as follows:

- 0 Reference selection by terminal input
- 1 Analog reference 1 selected
- 2 Analog reference 2 selected
- 3 Preset reference selected
- 4 Keypad reference selected
- 5 Precision reference selected

0: Reference selection by terminal input

The reference selected depends on the state of bit parameters **1.41** to **1.44**. These bits are for control by digital inputs such that references can be selected by external control. If any of the bits are set, the appropriate reference is selected (indicated by parameter **1.49**). If more than one bit is set the highest numbered will have priority.

1 or 2: Analog reference 1 or 2 selected

The reference selected is either one of the analog inputs, see parameters **1.36** and **1.37** for a complete description.

3: Preset reference Selected

The reference is one of the eight preset speeds, see parameters **1.15** and **1.21** to **1.28** for further details.

4: Keypad reference selected

The Drive sequencing (parameter **6.04**) is ignored, sequencing bits (parameters **6.30** to **6.33**) have no effect, and the keypad controls stop, run and reverse. Jog is disabled.

5: Precision reference selected

Precision speed reference is selected, see parameters **1.18** and **1.19** for further details.

1.15 Preset reference selector

↕	OL> 0 ~ 9	⇒	0		RW	Uni			
↕	CL> 0 ~ 9	⇒	0						

Parameter **1.15** selects a preset speed reference as follows:

0	Preset selection by terminal input
1	Preset 1 selected
2	Preset 2 selected
3	Preset 3 selected
4	Preset 4 selected
5	Preset 5 selected
6	Preset 6 selected
7	Preset 7 selected
8	Preset 8 selected
9	Preset selection by timer

0: Preset selection by terminal input

The preset selected depends on the state of bit parameters **1.45** to **1.47**. These bits are for control by digital inputs such that presets can be selected by external control. The preset selected depends on the binary code generated by these bits as follows:

1.47	1.46	1.45	Preset selected
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

9: Preset selection by timer

The presets to be selected in turn automatically. Parameter **1.16** defines the time between each change.

Parameter **1.50** indicates the preset selected at all times.

1.16 Preset reference scan time

↕	OL> 0 - 400.0	⇒	10.0	s	RW	Uni			
↕	CL> 0 - 400.0	⇒	10.0	s					

This parameter defines the time between preset reference change when parameter **1.15** is set to 9. If parameter **1.48** is set to 1 then the preset counter and timer are reset and preset 1 will be selected.

1.17 Keypad reference.

⇅	OL> ±1000.0 *	⇒	0	Hz	RO	Bi	S		P
⇅	CL> ±30,000 *	⇒	0	RPM					

* This is the maximum range for further restrictions see below.

When this parameter is selected as the reference (parameter **1.14**=4), it is adjusted by the Up and Down keys when the display is in status mode. It is saved on power down such that the speed reference does not have to be set up again on power up.

The range depends on the setting of parameters **1.08** and **1.10**:

1.08	1.10	Range	
0	0	1.07 to 1.06	(1.07 positive only)
0	1	± 1.06	
1	0	0 to 1.06	
1	1	1.07 to 1.06	(1.07 negative or 0)

1.18 Precision reference

⇅	OL> ±1000.0	⇒	0.0	Hz	RW	Bi			
⇅	CL> ±30000	⇒	0	RPM					

1.19 Precision reference trim

⇅	OL> 0 ~ 0.099	⇒	0.000	Hz	RW	Uni			
⇅	CL> 0 ~ 0.99	⇒	0.00	RPM					

Open loop

For normal resolution control the Drive has a maximum frequency range from 0 to 1kHz represented internally as a value from 0 to $(2^{15} - 1)$ (0.03Hz resolution). Although frequency demand inputs may restrict the resolution further, it is not possible to obtain better resolution than 0.03Hz unless high resolution control is used.

Selecting these two parameters as a reference automatically selects high resolution control (unless a frequency limit is reached). The frequency in this case will have a resolution of 0.001Hz. Parameter **1.18** defines the reference (either positive or negative) with a resolution of 0.01Hz. Parameter **1.19** defines the fine part of the reference (always positive). The final reference is given by **1.18** + **1.19**. Therefore **1.19** increases positive references away from zero, and decreases negative references towards zero.

Closed loop

As with open loop a higher resolution speed reference can be programmed by selecting these parameters. In this case the speed will have a resolution of 0.01rpm. Parameter **1.18** defines the reference (either positive or negative) with a resolution of 0.1rpm. Parameter **1.19** defines the fine part of the reference (always positive). The final reference is given by **1.18 + 1.19**. Therefore **1.19** increases positive references away from zero, and decreases negative references towards zero.

1.20 Precision reference update disable

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

When this bit is at 0 the precision reference parameters are read and stored in internal memory. Because the precision reference has to be set in two parameters, this bit is provided to prevent the Drive reading the parameters while the reference is being updated. Instead, the Drive uses the value stored in memory thus preventing the possibility of data skew.

1.21 Preset reference 1

1.22 Preset reference 2

1.23 Preset reference 3

1.24 Preset reference 4

1.25 Preset reference 5

1.26 Preset reference 6

1.27 Preset reference 7

1.28 Preset reference 8

↕	OL> ±1000.0	⇒	0	Hz	RW	Bi			
↕	CL> ±30000	⇒	0	RPM					

1.29 Skip freq./speed 1

↕	OL> 0 ~ 1000.0	⇒	0	Hz	RW	Uni			
↕	CL> 0 ~ 30000	⇒	0	RPM					

Three skip speeds are available to prevent continuous operation at a speed that would cause mechanical resonance. When a skip speed parameter is set to 0 that filter is disabled.

1.30 Skip freq./speed band 1

⇅	OL> 0 ~ 5.0	⇒	0.5	Hz	RW	Uni			
⇅	CL > 0 ~ 50	⇒	5	RPM					

The skip speed band parameters define the frequency or rpm range either side of the programmed skip speed, over which references are rejected. The actual reject band is therefore twice that programmed in these parameters, the skip speed parameters defining the centre of the band. When the selected reference is within a band the lower limit of the band is passed through to the ramps such that speed is always less than demanded.

1.31 Skip freq./speed 2

⇅	OL> 0 ~ 1000.0	⇒	0	Hz	RW	Uni			
⇅	CL > 0 ~ 30000	⇒	0	RPM					

Three skip speeds are available to prevent continuous operation at a speed that would cause mechanical resonance. When a skip speed parameter is set to 0 that filter is disabled.

1.32 Skip freq./speed band 2

⇅	OL> 0 ~ 5.0	⇒	0.5	Hz	RW	Uni			
⇅	CL > 0 ~ 50	⇒	5	RPM					

The skip speed band parameters define the frequency or rpm range either side of the programmed skip speed, over which references are rejected. The actual reject band is therefore twice that programmed in these parameters, the skip speed parameters defining the centre of the band. When the selected reference is within a band the lower limit of the band is passed through to the ramps such that speed is always less than demanded.

1.33 Skip freq./speed 3

⇅	OL> 0 ~ 1000.0	⇒	0	Hz	RW	Uni			
⇅	CL > 0 ~ 30000	⇒	0	RPM					

Three skip speeds are available to prevent continuous operation at a speed that would cause mechanical resonance. When a skip speed parameter is set to 0 that filter is disabled.

1.34 Skip freq./speed band 3

⇅	OL> 0 ~ 5.0	⇒	0.5	Hz	RW	Uni			
⇅	CL> 0 ~ 50	⇒	5	RPM					

The skip speed band parameters define the frequency or rpm range either side of the programmed skip speed, over which references are rejected. The actual reject band is therefore twice that programmed in these parameters, the skip speed parameters defining the centre of the band. When the selected reference is within a band the lower limit of the band is passed through to the ramps such that speed is always less than demanded.

1.35 Reference in skip freq./speed band indicator

⇅	OL> 0 ~ 1	⇒			RO	Bit			P
⇅	CL> 0 ~ 1	⇒							

This parameter indicates that the selected reference is within one of the skip speed regions such that the motor speed is not as demanded.

1.36 Analog reference 1

1.37 Analog reference 2

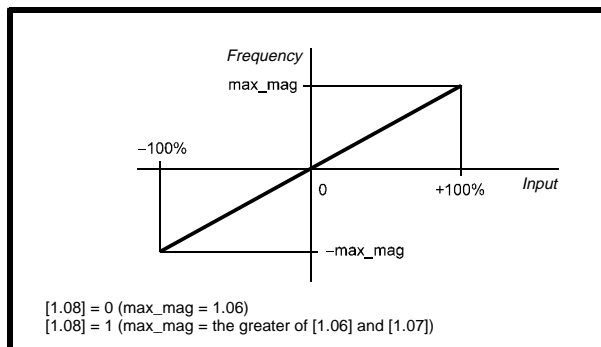
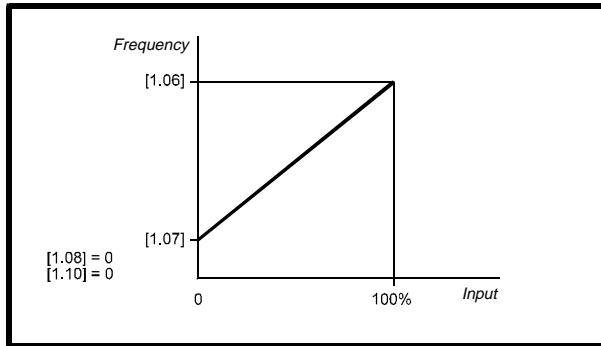
⇅	OL> ±1000*	⇒		Hz	RO	Bi			
⇅	CL> ±30000*	⇒		RPM					

* This is the maximum range for further restrictions see below.

Although most parameters can be controlled from analog inputs, these two parameters are special cases in that if an analog input programmed in voltage mode is directed to one of these parameters, the scan rate of that analog input is increased. See section on reference frequency update at the beginning of menu 1 description.

The range of this parameter is restricted so that it cannot be larger than the range set by parameters **1.06** (maximum speed clamp) and **1.07** (minimum speed clamp).

The programmed input is automatically scaled such that 100.0% input corresponds to the set maximum speed (**1.06** if **1.08** = 0, or maximum of **1.06** and **1.07** if **1.08** = 1). Also the 0% input level corresponds to the minimum speed level (**1.07**) if bipolar (**1.10**) is not selected and parameter **1.08** is set to 0.



1.38 Reference percentage trim

⇅	OL> ±100.0	⇒		%	RO	Bi			
⇅	CL> ±100.0	⇒		%					

If an analog input is routed to this parameter, the selected reference can be trimmed by the analog input. The resolution of the trim is only 1rpm.

$$1.01 = \text{selected ref} + \frac{\text{selected ref} \times \text{Pr 1.38}}{100}$$

1.39 Velocity feed forward reference

⇅	OL> ±1000.0	⇒		Hz	RO	Bi			P
⇅	CL> ±30000	⇒		RPM					

This variable indicates the velocity feed forward reference when position control is being used (Menu 13).

1.40 Feed forward selected indicator

⇅	OL> 0 ~ 1	⇒			RO	Bit			P
⇅	CL> 0 ~ 1	⇒							

This bit indicates that the position control has selected the velocity feed forward as a speed reference for the Drive. This bit is only active for digital lock modes with digital feed forward.

1.41	Analog reference 2 select
1.42	Preset reference select
1.43	Keypad reference select
1.44	Precision reference select
1.45	Preset reference select bit 0 (LSB)
1.46	Preset reference select bit 1
1.47	Preset reference select bit 2 (MSB)

⇕	OL> 0 ~ 1	⇒			RO	Bit			
⇕	CL> 0 ~ 1	⇒							

These bits are provided for control by logic input terminals for external reference selection (see parameters **1.14** and **1.15**).

1.48	Preset reference scan timer reset
-------------	--

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

When this bit is set the timer and counter in the auto preset selection mode (**1.15** = 9) are reset to 0 such that preset 1 is selected. This can be used to start a new sequence of speed selection by a programmable input terminal or function. When this bit is zero the preset selection will follow the timer, see parameters **1.15** and **1.16**, even when the Drive is disabled.

1.49	Reference selected <i>indicator</i>
-------------	--

⇕	OL> 1 ~ 5	⇒			RO	Uni			P
⇕	CL> 1 ~ 5	⇒							

Indicates the reference currently being selected.

1. Analog reference 1 selected
2. Analog reference 2 selected
3. Preset reference selected
4. Keypad reference selected
5. Precision reference selected

1.50	Preset reference selected <i>indicator</i>
-------------	---

⇕	OL> 1 ~ 8	⇒			RO	Uni			P
⇕	CL> 1 ~ 8	⇒							

Indicates the preset currently being selected.

2 Menu 2 Ramps

The pre-ramp frequency or speed reference passes through the ramp block controlled by menu 2 before being used by the Drive to produce the basic output frequency (open loop), or as an input to the speed regulator (closed loop). The ramp block includes:

- Linear ramps
- S ramp function for ramped acceleration and deceleration
- Deceleration ramp control to prevent rises in the d.c. bus voltage within the Drive that would cause an over-voltage trip if no braking resistor is fitted.

2.1 Parameter descriptions

2.01 Post ramp reference

⇅	OL> ±1000*	⇒		Hz	RO	Bi			P
⇅	CL> ±30000*	⇒		RPM					

* This is the maximum range for further restrictions see below.

This is the speed reference after the ramps.

The range of this parameter is restricted so that it cannot be larger than the range set by parameters **1.06** (maximum speed clamp) and **1.07** (minimum speed clamp).

2.02 CL> Ramp enable

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

Set to enable ramps.

2.03 Ramp hold enable

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

If this bit is set the ramp will be held. If S ramp is enabled, see parameter **2.06**, the acceleration will ramp towards zero causing the ramp output to curve towards a constant speed.

2.04 Ramp mode selector

↕	OL> 0 ~ 2	↔	2		RW	Txt		
↕	CL> 0 ~ 2	↔	2					

This parameter has 3 settings as follows:

- | | | |
|---|--------|------------------------------|
| 0 | Std.Hd | Standard ramp with ramp hold |
| 1 | FASt | Fast ramp |
| 2 | Std.Ct | Standard ramp with P control |

The acceleration ramp is not affected by the ramp mode, and the ramp output will rise at the programmed acceleration rate (subject to the current limits programmed in the drive).

1: Fast ramp

The output of the ramp will fall at the programmed deceleration rate (subject to the current limits programmed in the drive).

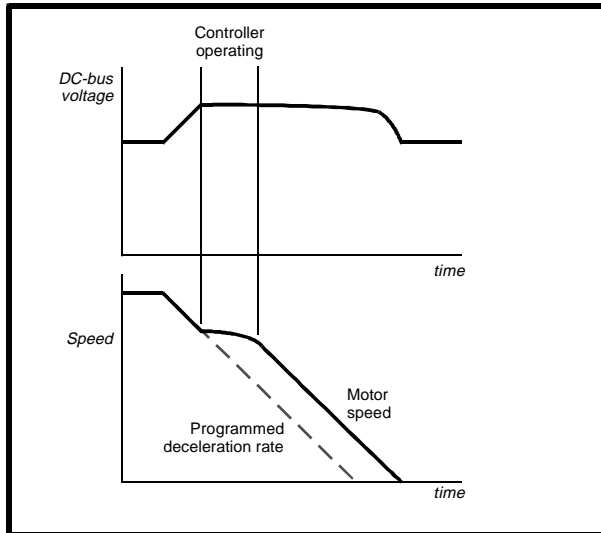
0: Standard ramp with ramp hold

The deceleration ramp will be frozen if the DC Bus voltage rises above the standard ramp voltage (**2.08**). Normally the DC Bus voltage will then begin to fall as the machine should stop regenerating. Once the voltage drops below the standard ramp voltage, the ramp will again begin to fall. This type of control does not usually give smooth deceleration especially if the machine is lightly loaded, however it is easy to set up.

2: Standard ramp with P control

The voltage rising to the standard ramp level (**2.08**) causes a proportional controller to operate, the output of which changes the demanded current in the motor. As the controller regulates the Bus voltage, the motor deceleration increases as the speed approaches zero speed. When the motor deceleration rate reaches the programmed deceleration rate the controller ceases to operate and the Drive continues to decelerate at the programmed rate. This gives smoother control than standard hold mode. If the standard ramp voltage (**2.08**) is set lower than the nominal DC Bus level the Drive will not decelerate but will coast to rest. The standard controlled mode is most likely to be useful in applications where smooth deceleration is required, particularly with lightly loaded machines, or where the supply voltage is high where the Drive would trip on OV (DC Bus over voltage) due to the transients produced in standard hold mode.

The output of the ramp controller (when active) is a current demand that is fed to the frequency changing current controller (open loop) or the torque producing current controller (closed loop). The gain of these controllers can be modified with parameters **4.13** and **4.14**.



2.05 **CL> Ramp rate range select**

⇅	VT>	0 ~ 1	⇒	0		RW	Bit			
⇅	SV>	0 ~ 1	⇒	1						

The ramp rate range when this bit is 0 is 0.0 to 3200.0 seconds and when this bit is set it is 0.000 to 32.000 seconds.

2.06 **S-ramp enable**

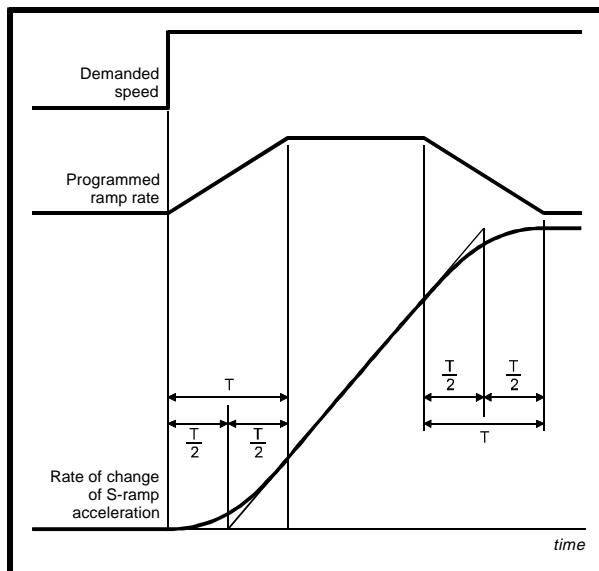
⇅	OL>	0 ~ 1	⇒	0		RW	Bit			
⇅	CL>	0 ~ 1	⇒	0						

Setting this parameter enables the S ramp function. S ramp is disabled during deceleration using Standard ramp with P control (**2.04** = 2). When the motor is accelerated again after decelerating in standard ramp with P control the acceleration ramp used by the S ramp function is reset to zero.

2.07 S-ramp maximum da/dt

↕	OL> 0.0 ~ 3000.0	↔	3.1	$s^2/100Hz$	RW	Uni			
↕	VT> 0.000 ~ 30.000	↔	1.5	$s^2/1000rpm$					
↕	SV> 0.000 ~ 30.000	↔	0.03						

This parameter defines the maximum rate of change of acceleration/deceleration that the Drive will operate with. The default values have been chosen such that for the default ramps and maximum speed, the curved parts of the S will be 25% of the original ramp if S ramp is enabled.



Since the ramp rate is defined in $s/100Hz$ or $s/1000rpm$ and the S ramp parameter is defined in $s^2/100Hz$ or $s^2/1000rpm$, the time T for the 'curved' part of the S can be determined from:

$$T = \text{S ramp rate of change} / \text{Ramp rate}$$

Enabling S ramp increases the total ramp time by the period T since an additional $T/2$ is added to each end of the ramp in producing the S.

2.08 Standard ramp voltage

EUR >

⇅	OL> 0 ~ 800	⇒	700	Volts	RW	Uni			
⇅	CL> 0 ~ 800	⇒	700	Volts					

USA >

⇅	OL> 0 ~ 800	⇒	775	Volts	RW	Uni			
⇅	CL> 0 ~ 800	⇒	775	Volts					

This voltage is used as the level for both standard ramp modes. If hold mode is used and this is set too low the Drive will never stop, and if it is too high and no braking resistor is used the Drive may trip on OV (DC Bus over voltage). If P controlled mode is used and this parameter is set too low the machine will coast to rest, and if it is set too high and no braking resistor is used it may trip on OV. The minimum level should be greater than the voltage produced on the DC Bus by the highest supply voltage. Normally the DC Bus voltage will be approximately the rms supply voltage $\times \sqrt{2}$.

Warning!

Care should be taken in the setting of this parameter. It is recommended that the setting should be at least 50V higher than the maximum expected level of the DC Bus voltage. If this is not done, the motor may fail to decelerate on a STOP command.

2.09 Reverse acceleration/deceleration select

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

When this bit is set to 0 there are 8 acceleration and 8 deceleration rates which are operational in both the forward and reverse directions. Setting this bit to 1 splits the eight acceleration and deceleration rates into 4 forward and 4 reverse.

2.10 Forward acceleration ramp selector

⇅	OL> 0 ~ 9	⇒	0		RW	Uni			
⇅	CL> 0 ~ 9	⇒	0						

This parameter is used to select acceleration ramp rates as follows:

- 0 Ramp rate selection by terminal input
- 1 Ramp rate 1 selected
- 2 Ramp rate 2 selected
- 3 Ramp rate 3 selected
- 4 Ramp rate 4 selected
- 5 Ramp rate 5 selected
- 6 Ramp rate 6 selected
- 7 Ramp rate 7 selected
- 8 Ramp rate 8 selected
- 9 Ramp rate selection by preset reference selection

When parameter **2.10** is set to 0 the acceleration ramp rate selected depends on the state of bit parameters **2.32** to **2.34**. These bits are for control by digital inputs such that ramp rates can be selected by external control. The ramp rate selected depends on the binary code generated by these bits as follows:

2.34,	2.33,	2.32,	Ramp rate selected
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

When parameter **2.10** is set to 9 the appropriate acceleration rate is automatically selected depending on the preset reference selected. Thus an acceleration rate can be programmed to operate with each preset reference. Since the new ramp rate is selected with the new reference, the acceleration or deceleration applies towards the selected preset.

If parameter **2.09** is set such that separate reverse acceleration's and deceleration's are required, these parameters become forward acceleration and deceleration selectors and are only able to select the four forward acceleration and deceleration rates. If acceleration or deceleration rate 5 is selected, acceleration or deceleration rate 1 will be used, and so on up to acceleration or deceleration 8.

2.11	Acceleration rate 1/Forward acceleration rate 1
2.12	Acceleration rate 2/Forward acceleration rate 2
2.13	Acceleration rate 3/Forward acceleration rate 3
2.14	Acceleration rate 4/Forward acceleration rate 4
2.15	Acceleration rate 5/Reverse acceleration rate 1
2.16	Acceleration rate 6/ Reverse acceleration rate 2
2.17	Acceleration rate 7/ Reverse acceleration rate 3
2.18	Acceleration rate 8/ Reverse acceleration rate 4

⇅	OL> 0.0 ~ 3200.0	⇒	5.0	s/100Hz	RW	Uni				
⇅	VT> 0.000 ~ 32.000	⇒	2.0	s/1000rpm						
⇅	SV> 0.000 ~ 32.000	⇒	0.2	s/1000rpm						

The Drive can be set up to have either eight acceleration rates which are used in both forward and reverse directions, or two sets of acceleration rates acting in the forward and reverse directions respectively (Forward acceleration and reverse acceleration). This is selectable via **Pr2.09**.

Open loop

The ramp rates are expressed as time for a change of 100Hz on the ramp output. Therefore with a programmed ramp time of 5 seconds the ramp output will reach 50Hz from 0 in 2.5 seconds.

Closed loop

Ramp rates are expressed as the time in seconds for a change of 1000rpm on the ramp output. There are two ranges for the ramp rate parameters selectable by parameter **2.27**, 0 to 3200.0s (s/1000rpm) and 0 to 32.000s (s/1000rpm, ms ramp range).

2.19		Jog acceleration rate							
⇅	OL> 0.0 ~ 3200.0	⇒	0.2	s/100Hz	RW	Uni			
⇅	CL> 0.000 ~ 32.000	⇒	0.0	s/1000rpm					

Parameters **2.19** and **2.29** are always used for jogging and must be set up for the required acceleration and deceleration rates when jogging.

2.20		Forward deceleration ramp selector					
-------------	--	---	--	--	--	--	--

⇅	OL> 0 ~ 9	⇒	0		RW	Uni			
⇅	CL> 0 ~ 9	⇒	0						

This parameter is used to select deceleration ramp rates as follows:

- 0 Ramp rate selection by terminal input
- 1 Ramp rate 1 selected
- 2 Ramp rate 2 selected
- 3 Ramp rate 3 selected
- 4 Ramp rate 4 selected
- 5 Ramp rate 5 selected
- 6 Ramp rate 6 selected
- 7 Ramp rate 7 selected
- 8 Ramp rate 8 selected
- 9 Ramp rate selection by preset reference selection

When parameter **2.20** is set to 0 the deceleration ramp rate selected depends on the state of bit parameters **2.35** to **2.37**. These bits are for control by digital inputs such that ramp rates can be selected by external control. The ramp rate selected depends on the binary code generated by these bits as follows:

2.37	2.36	2.35	Ramp rate selected
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

When parameter **2.20** is set to 9 the appropriate deceleration rate is automatically selected depending on the preset reference selected. Thus a deceleration rate can be programmed to operate with each preset reference. Since the new ramp rate is selected with the new reference, the deceleration applies towards the selected preset.

If parameter **2.09** is set such that separate reverse acceleration's and deceleration's are required, these parameters become forward acceleration and deceleration selectors and are only able to select the four forward acceleration and deceleration rates. If acceleration or deceleration rate 5 is selected, acceleration or deceleration rate 1 will be used, and so on up to acceleration or deceleration 8.

2.21	Deceleration rate 1/Forward deceleration rate 1
2.22	Deceleration rate 2/Forward deceleration rate 2
2.23	Deceleration rate 3/Forward deceleration rate 3
2.24	Deceleration rate 4/Forward deceleration rate 4
2.25	Deceleration rate 5/Reverse deceleration rate 1
2.26	Deceleration rate 6/ Reverse deceleration rate 2
2.27	Deceleration rate 7/ Reverse deceleration rate 3
2.28	Deceleration rate 8/ Reverse deceleration rate 4

⇅	OL> 0.0 ~ 3200.0	⇒	10.0	s/100Hz	RW	Uni			
⇅	VT> 0.000 ~ 32.000	⇒	2.0	s/1000rpm					
⇅	SV> 0.000 ~ 32.000	⇒	0.2	s/1000rpm					

The Drive can be set up to have either eight deceleration rates which are used in both forward and reverse directions, or two sets of deceleration rates acting in the forward and reverse directions respectively (Forward deceleration and reverse deceleration). This is selectable via **Pr2.09**.

Open loop

The ramp rates are expressed as time for a change of 100Hz on the ramp output. Therefore with a programmed ramp time of 5 seconds the ramp output will reach 50Hz from 0 in 2.5 seconds.

Closed loop

Ramp rates are expressed as the time in seconds for a change of 1000rpm on the ramp output. There are two ranges for the ramp rate parameters selectable by parameter **2.27**, 0 to 3200.0s (s/1000rpm) and 0 to 32.000s (s/1000rpm, ms ramp range).

2.29 Jog deceleration rate

⇅	OL> 0.0 ~ 3200.0	⇒	0.2	s/100Hz	RW	Uni			
⇅	VT> 0.000 ~ 32.000	⇒	0.0	s/1000rpm					

Parameters **2.19** and **2.29** are always used for jogging and must be set up for the required acceleration and deceleration rates when jogging.

2.30	Rev acceleration selector
2.31	Rev deceleration selector

↕	OL> 0 ~ 4	↔	0		RW	Uni		P
↕	CL> 0 ~ 4	↔	0					

When parameter **2.09** is set to 1 for separate reverse acceleration and deceleration, these parameters are used to select reverse acceleration and deceleration ramp rates as follows:

- 0 Ramp rate selection by terminal input
- 1 Reverse ramp rate 1 selected
- 2 Reverse ramp rate 2 selected
- 3 Reverse ramp rate 3 selected
- 4 Reverse ramp rate 4 selected

When parameter **2.30** is set to 0 the reverse acceleration ramp rate selected depends on the state of bit parameters **2.38** & **2.39**, and similarly when **2.31** is set to 0 the reverse deceleration ramp rate selected depends on the state of bit parameters **2.40** & **2.41**. These bits are for control by digital inputs such that ramp rates can be selected by external control. The ramp rate selected depends on the binary code generated by these bits as follows:

2.39, 2.41	2.38, 2.40	Ramp rate selected
0	0	1
0	1	2
1	0	3
1	1	4

2.32	Accel. select bit 0/Forward Accel. select bit 0 (LSB)
2.33	Accel. select bit 1/Forward Accel. select bit 1
2.34	Accel. select bit 2 (MSB)
2.35	Decel. select bit 0/Forward Decel. select bit 0 (LSB)
2.36	Decel. select bit 1/Forward Decel. select bit 1
2.37	Decel. select bit 2 (MSB)
2.38	Reverse Accel. select bit 0 (LSB)
2.39	Reverse Accel. select bit 1 (MSB)
2.40	Reverse Decel. select bit 0 (LSB)
2.41	Reverse Decel. select bit 1 (MSB)

⇕	OL> 0~1	⇒	0		RO	Bit			
⇕	CL> 0~1	⇒	0						

These bits are provided for control by logic input terminals for external ramp selection.

3

Menu 3

Slave frequency and speed control

Open loop

Menu 3 controls frequency slaving, which is where F+D (Frequency and Direction) signals from another Drive (master) are used to define the reference frame position for this Drive (slave). Frequency monitoring functions for normal and slaving control are provided in menu 3.

Closed loop

Closed-loop mode also includes a speed controller. The speed reference from menu 2 and the feedback to the Drive, or small option module feedback device, are fed into a PID controller to produce a torque demand at the output. Speed monitoring functions are also provided in menu 3.

3.1 Parameter descriptions

3.01	OL>	Slave frequency demand							
	CL>	Final speed demand							
↕	OL>	±1000.0	⇒		Hz	RO	Bi		P
↕	CL>	±30,000	⇒		RPM				

Open loop

The slave frequency demand is only relevant if the Drive is operating in frequency slaving mode, in other modes this parameter reads as 0.0. The value shown in slaving mode is the fundamental Drive output frequency.

The frequency slaving mode is used to lock the fundamental frequency produced at the Drive output with an external frequency applied to the main Drive encoder input. This could be used for example to keep the shafts of two synchronous machines in lock, by feeding the F and D output from the master Drive into the encoder input of the slave Drive. Alternatively the two machines could be operated so that the shafts rotate with an exact ratio, i.e. as though the shafts were connected by gears. (See parameters **3.14** and **3.15**.)

The source for frequency slaving mode may be A/B quadrature encoder signals or F and D. With the latter care must be taken to ensure that the D set-up time (10µS) is observed or pulses may be lost. The Drive will not count pulses whilst it is disabled (this parameter will show 0.0), but will maintain lock once enabled even if the direction of rotation reverses.

In frequency slaving mode the Drive current limits are not active, however, the Drive peak limit is active and will try and limit the Drive current to the magnitude limit by modifying the output voltage away from the defined V to F (Voltage to Frequency) characteristic. If synchronous machines are used and the current required exceeds the Drive magnitude limit the slave machine will probably pole slip.

Closed loop

Final speed demand at the input to the speed regulator formed by the sum of the ramp output and the hard speed reference (if the hard speed reference is enabled). If the Drive is disabled this parameter will show 0.0.

3.02 CL> Speed feedback

⇅	±30,000	⇒		RPM	RO	Bi			P
---	---------	---	--	-----	----	----	--	--	---

The speed feedback may be derived from the main Drive encoder or from an alternative feedback device via a small option module, see menu 16 for further details. If a small option module containing a resolver interface is fitted to the Drive the resolver feedback will be selected automatically. If a SINCOS encoder small option module is fitted it may be used to derive the main feedback (see parameter **16.14**).

3.03 CL> Speed error

⇅	±30,000	⇒		RPM	RO	Bi			P
---	---------	---	--	-----	----	----	--	--	---

The speed error is the difference between the final speed demand and the speed feedback after modification by the speed regulator feedback branch. A detailed description of the speed regulator is given with parameter **3.10**.

3.04 CL> Speed loop output

⇅	±maximum current limit	⇒		% torque	RO	Bi			P
---	------------------------	---	--	----------	----	----	--	--	---

Closed loop

The output of the speed regulator forms a torque demand which is used to define the torque producing current in the machine (see parameters **3.10** to **3.12**).

3.05 Zero-speed threshold

↕	OL> 0 ~ 20.0	⇒	1	Hz	RW	Uni			
↕	CL> 0 ~ 200	⇒	5	RPM					

Open loop

If the motor frequency (parameter **5.01**) is at or below the level defined by this parameter in either direction the Zero speed indicator (parameter **10.03**) is 1, otherwise the indicator is 0.

Closed loop

If the speed feedback (parameter **3.02**) is at or below the level defined by this parameter in either direction the Zero speed indicator (parameter **10.03**) is 1, otherwise the indicator is 0.

3.06 At speed lower limit

↕	OL> 0.0 ~ 1000.0	⇒	1.0	Hz	RW	Uni			
↕	CL> 0 ~ 30,000	⇒	5	RPM					

Open loop and Closed loop

Defines the lower threshold for at speed detection. See parameter **3.09** for more details.

3.07 At speed upper limit

↕	OL> 0.0 ~ 1000.0	⇒	1.0	Hz	RW	Uni			
↕	CL> 0 ~ 30,000	⇒	5	RPM					

Open and Closed loop

Defines the upper threshold for at-speed detection. See parameter **3.09** for more details.

3.08 Over-speed threshold

↕	OL> 0.0 ~ 1000.0	⇒	1000	Hz	RW	Uni			
↕	VT> 0 ~ 30,000	⇒	2000	RPM					
↕	SV> 0 ~ 30,000	⇒	4000	RPM					

Open and closed loop

Defines the frequency (open loop) or speed (closed loop) above which the Drive will trip due to overspeed. See parameter **3.29** for details of the open-loop overspeed trip set-up.

3.09 Absolute at speed detect mode

↕	OL> 0 ~ 1	↔	0		RW	Bit		
↕	CL> 0 ~ 1	↔	0					

Open loop

The at-speed detector sets the at-speed indicator (parameter **10.06**) if the motor frequency (parameter **5.01**) is within the 'at speed band'. The speed detector operates on the modulus of frequency. The at speed detector has two alternative modes selected by this parameter. Bits **10.05** and **10.07** indicate if the speed is above or below the required band, a speed equal to either speed boundary is taken as within the 'at speed-band'.

3.09 = 0 reference window mode. The at speed band is from (reference - lower limit) to (reference + upper limit). The reference is the pre-ramp reference (parameter **1.03**). The detector operates with modulus of the frequency values, and so it operates in the same way in either direction. The at speed indicator is active when the following is true:

$$|5.01| \geq (|1.03| - 3.06) \text{ AND } |5.01| \leq (|1.03| + 3.07)$$

3.09 = 1 absolute window mode. The at-speed band is from the lower limit to the upper limit. Again the modulus of the frequency is used, and so it operates in the same way in either direction. The at-speed indicator is active when the following is true:

$$|5.01| \geq 3.06 \text{ AND } |5.01| \leq 3.07$$

Closed loop

The at-speed detector sets the at-speed indicator (parameter **10.06**) if the speed feedback (parameter **3.02**) is within the 'at-speed band'. The speed detector operates on the modulus of speed. The at-speed detector has two alternative modes selected by this parameter. Bits **10.05** and **10.07** indicate if the speed is above or below the required band, a speed equal to either speed boundary is taken as within the 'at speed-band'.

3.09 = 0 reference window mode. The at-speed band is from (reference - lower limit) to (reference + upper limit). The reference is the pre-ramp reference (parameter **1.03**). The detector operates with modulus of the speed values, and so it operates in the same way in either direction. The at-speed indicator is active when the following is true:

$$|3.02| \geq (|1.03| - 3.06) \text{ AND } |3.02| \leq (|1.03| + 3.07)$$

3.09 = 1 absolute window mode. The at-speed band is from the lower limit to the upper limit. Again the modulus of the speed is used, and so it operates in the same way in either direction. The at-speed indicator is active when the following is true:

$$|3.02| \geq 3.06 \text{ AND } |3.02| \leq 3.07$$

3.10 **CL> Speed-loop proportional gain**

⇅	0 ~ 32000	⇒	200		RW	U			
---	-----------	---	-----	--	----	---	--	--	--

3.11 **CL> Speed-loop integral gain**

⇅	0 ~ 32000	⇒	100		RW	U			
---	-----------	---	-----	--	----	---	--	--	--

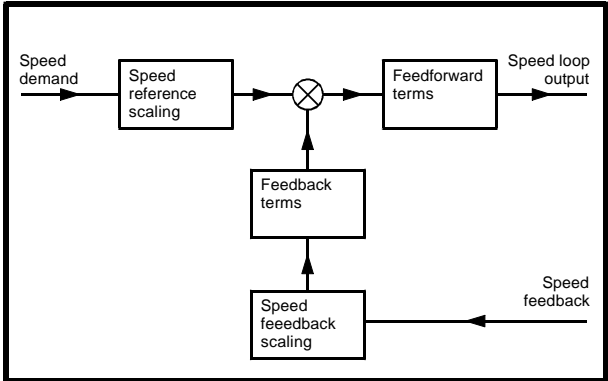
3.12 **CL> Speed-loop derivative gain**

⇅	0 ~ 32000	⇒	0		RW	U			
---	-----------	---	---	--	----	---	--	--	--

The closed loop speed proportional gain has a minimum internal value of 1.

The speed loop consists of a PID (Proportional, Integral and Derivative) controller that uses the speed demand (parameter **3.01**) and the speed feedback (parameter **3.02**) to produce an output value (parameter **3.04**) that is used in deriving the torque demand. The speed loop operates with a sample time of 345µS with a switching frequency of 3, 6 or 12kHz, or a sample time of 460µS with a switching frequency of 4.5 or 9kHz.

In the following description equations are given to calculate the scaling of speed demand and feedback so that the speed loop may be analysed for different systems. From the results it may appear that the resolution is very low, however, the processor in the Drive operates to a far greater accuracy.



Speed feedback scaling:

The speed feedback can either come from an encoder so that the speed feedback used by the controller is the number of pulses counted over one sample period, or from a resolver so that the speed feedback is the difference in angle over one sample period. Although the sample time varies with the switching frequency the speed loop gains are modified internally to achieve the same overall response. Whatever the actual number of encoder pulses or resolver difference the Drive automatically modifies the result so that the input appears to come from a device with 16384 pulses per revolution. The number of pulses counted over a sample period can be calculated as follows:

$$\text{Number of pulses} = 16384 \times 345\mu\text{S} \times (\text{speed in rpm} / 60)$$

For example if the speed is 3000rpm the internal value of speed feedback is $16384 \times 345\mu\text{S} \times (3000\text{rpm} / 60) = 282$.

Speed reference scaling:

The Drive scales the speed reference demand so that the correct speed is produced in rpm.

Speed loop output scaling:

The speed loop output becomes a demand in 'torque' units, which provided the machine is operating below a speed where field weakening is necessary, is the active or torque producing current demand for the Drive. Above base speed the torque demand is modified to compensate for field weakening with an induction motor, (see menu 4). The speed loop output parameter (**3.04**) has a range from -200% to 200%, giving a torque producing current as a percentage of the full load value set up by the user.

For example:

Induction machine
Rated current = 50A
Power factor = 0.85
Assuming no field weakening
Rated active current = $50 \times 0.85 = 42.5\text{A}$
At 100% torque, active current = 42.5A
Servo machine
Rated current = 50A
Rated active current = 50A
At 100% torque, active current = 50A

Although the Drive shows the speed loop output as a percentage for user convenience this cannot be used to determine the system gain. This must be done with absolute levels based on the Drive hardware current scaling. The speed loop output can in theory vary between -2046 and +2046, representing a range between the overcurrent trip levels, although the current limits will keep the actual current demand below this level. The speed loop output should be converted to a proportion of rated torque producing current by including the following gain:

$$(\text{Overcurrent trip level in amps}/2046)/\text{rated active current}$$

Feedforward terms:

The feedforward block takes the speed error and calculates the speed loop output using a proportional term and an integral term. If it is assumed that the feedback terms are a simple gain of unity the output of the speed loop is given by:

$$\begin{aligned} \text{Speed loop output} &= K_p/16 \times \text{speed error} + K_i/256 \times \Sigma \text{ speed error} \\ \text{where speed error} &= \text{speed demand} - \text{speed feedback} \\ \text{and } K_p &= \text{parameter } \mathbf{3.10} \quad (\text{Proportional gain}) \\ \text{and } K_i &= \text{parameter } \mathbf{3.11} \quad (\text{Integral gain}) \end{aligned}$$

If $K_i=0$ then the control loop will have only a proportional gain, and so there must be some speed error in order to produce an output from the speed loop. As the required machine load is increased, so the required torque must be increased therefore the speed loop output must increase. This means that the machine will slow down as load is applied. The change of speed with load is referred to as regulation. In theory the amount of regulation depends on the proportional gain, the higher the gain the less the regulation. If the gain is too high however, the control loop could begin to oscillate and produce an unwanted sinusoidal speed ripple. However with a digital system it is more likely that the system will become 'noisy' before the stability limit is reached. The speed loop output will have superimposed noise and the machine will vibrate. Generally the proportional gain can be increased up to a level just below the point where the machine vibrates noticeably. Usually the worst point for machine noise is at zero speed. If a SINCOS encoder is used as the main feedback device the stability limit may be reached without excessive noise because the feedback resolution is higher.

The integral term ($K_i/256 \times \Sigma \text{ speed error}$) is provided to prevent speed regulation. The error is added up over a period of time and used to produce the necessary speed loop output without any error. Because it takes time to accumulate the necessary value the integral term is slower than the proportional term. Although the speed demand and feedback will become equal this does not occur instantaneously. If the integral term is too high the speed will normally include an unwanted sinusoidal component. Therefore the gain can be increased up to a level below this limit. It should be noted that the proportional gain helps to prevent oscillations due to the integral term, and so both gains should be as high as possible.

Feedback terms:

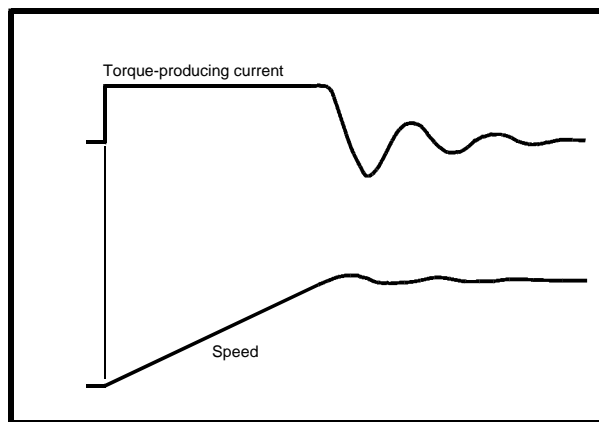
So far it has been assumed that the feedback term is a gain of unity. However the feedback term includes a differential term and is given by:

$$\text{Feedback terms output} = \text{speed feedback} + K_d \times d(\text{speed feedback})/dt$$

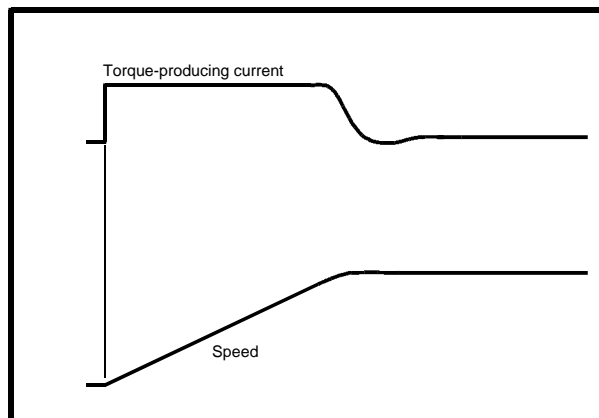
where K_d = parameter **3.12** (Derivative gain)

The actual value of K_d cannot be given in a simple form, but the effect of the differential term is proportional to parameter **3.12**. If parameter **3.12**=0, the differential term has no effect and the feedback gain is unity.

If the feedback gain is unity some overshoot can occur when the speed reaches the demanded value due to the integral term building up a value at the start of the acceleration as shown below:



This effect can be reduced by increasing the differential gain (parameter **3.12**) to obtain a response as shown below. However, if the gain is too high the machine will become noisy in a similar way to that when the proportional gain is too high.



3.13	OL>	Frequency slaving enable
-------------	---------------	---------------------------------

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

Frequency slaving as described in parameter **3.01** is enabled by this parameter. Frequency slaving can be enabled or disabled even when the Drive is enabled. The change from slaving to normal operation will result in the frequency ramping from the slaving frequency to the demanded frequency using whichever ramp rate that is applicable to normal operation. The change from normal operation to slaving will result in an instantaneous change to the slaving frequency. Therefore the slaving frequency should be similar to the demanded frequency before the change is made.

3.14	OL>	Slaving ratio numerator
-------------	---------------	--------------------------------

↕	0 ~ 1.000	⇒	1.000		RW	U			
---	-----------	---	-------	--	----	---	--	--	--

3.15	OL>	Slaving ratio denominator
-------------	---------------	----------------------------------

↕	0.001 ~ 1.000	⇒	1.000		RW	U			
---	---------------	---	-------	--	----	---	--	--	--

The slave frequency input can be scaled before it defines the slave frequency demand (parameter **3.01**) as follows:

F and D input

$$\mathbf{3.01} = (\text{input frequency}/1536) \times (\mathbf{3.14}/\mathbf{3.15})$$

The numerator and denominator can be adjusted whilst the Drive is running without causing jumps in angle. However if the change in ratio causes a large change in frequency the transient current could activate the peak limit or trip the Drive. The input is divided by 1536 so that it is compatible with another Unidrive which is supplying 1536 times its own output frequency. However both CD2 and CDE produce 192 times their output frequencies. To make Unidrive compatible with CD2 or CDE the ratio simply needs to be increased by a factor of 4. It should be noted that the maximum input frequency is 205kHz and that if frequencies higher than this are used pulses may be lost. Whatever ratio is used the Drive will limit the slaving frequency demand to 1kHz.

The frequency slaving mode is primarily designed for locking the outputs of Drives operating in the open loop mode. However it is possible to use A and B signals from an encoder as the slaving reference. The effective input frequency is given by:

$$2 \times (\text{speed in rpm}/60) \times \text{encoder lines}$$

As $1536 = 256 \times 6$, the effect of this division can be cancelled out exactly if an encoder with a power of 2 lines per revolution is used.

3.16 OL> Frequency output enable

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

The frequency output is in the form of F and D signals. At a change of direction the following sequence occurs for x192 and x1536 modes to prevent loss of pulses.

F pulses	No F pulses	D changes at the start of this period. No F pulses	No F pulses	F pulses
----------	-------------	---	-------------	----------

Each period is 345µS if the switching frequency is 3, 6 or 12kHz, or 460µS if the switching frequency is 4.5 or 9kHz. The frequency output may be enabled and disabled whilst the Drive is running without problems.

3.17 OL> Frequency scaling ratio select bit

↕	0 ~ 1	⇒	1		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

3.18 OL> Frequency scaling ratio select bit

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

The frequency of the F and D output is either x1, x192 or x1536 of the fundamental Drive output frequency. The multiplication factor is defined by bits **3.17** and **3.18** as follows:

3.17	3.18	Ratio
0	0	x1
0	1	x192
1	0	x1536
1	1	x1536

3.19 CL> Hard speed reference

↕	±30,000*	⇒	0	RPM	RW	Bi			
---	----------	---	---	-----	----	----	--	--	--

* This is the maximum range for further restrictions see below.

The range of this parameter is limited depending on the maximum speed expected which is the maximum magnitude from **1.06** or **1.07**.

The hard speed reference is a reference value which does not pass through the ramp system (menu 2). It is added to the normal post ramp speed reference. Its value may be written from the keypad, via serial comms, from an analog input or from an encoder input. This parameter can also be used by the position controller (menu 13) as the speed correction input.

This parameter is similar to the analog input parameters (**1.36** and **1.37**) in that if an analog input programmed in voltage mode is directed to it, the scan rate of that analog input is increased (See menu 1). The scaling will be the same as for bipolar mode on parameters **1.36** and **1.37**. It is also possible to obtain a fast update rate if an encoder input is used to derive this speed reference.

3.20 **CL> Hard speed reference select**

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

Enables connection of the hard speed reference.

3.21 **No. of encoder lines/pulses per rev**

↕	OL> 0 ~ 8192 *	⇒	1024	encoder lines/pulses per rev	RW	U				
↕	VT> 0 ~ 8192 *	⇒	1024							
↕	SV> 0 ~ 8192 *	⇒	4096							

* This is the maximum range for further restrictions see below.

Open loop

To obtain correct values in parameters **3.26** (encoder 1 input rpm) and **3.27** (encoder 1 position) the number of lines/pulses per revolution must be set up correctly. The rpm and position values are also used in menu 13 for position control and the revolution counter, and these will not operate correctly if this parameter is not set up. The input may come from a quadrature encoder if parameter **3.22** = 0, or non-quadrature encoder if parameter **3.22** = 1. The parameter value is limited to 4096 if **3.22** = 0, or 8192 if **3.22** = 1.

Closed loop

As for the open loop Drive the values in **3.26** and **3.27** will only be correct if the number of line/pulses is set up correctly. Also the position control and revolution counter will only operate correctly if this parameter is set up.

If the Drive encoder is used to derive speed feedback, it is important to set up the encoder lines/pulses per rev so that the machine will run at the correct rpm set via the speed demand.

The parameter value is limited to 4096 if **3.22** = 0, or 8192 if **3.22** = 1. The maximum motor speed that can be defined by **1.06** and **1.07** is limited depending on the value of this parameter as shown below:

3.21 with quadrature encoder	3.21 with frequency and direction input	Allowed speed range (rpm)	
Up to 4096	Up to 8192	0	to 3000
Up to 2048	Up to 4096	3001	to 6000
Up to 1024	Up to 2048	6001	to 12000
Up to 512	Up to 1024	12001	to 24000
Up to 256	Up to 512	24001	to 30000

3.22 Frequency input select

↕	OL> 0 ~ 1	⇒	1		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

Open loop

Normally the encoder input is used for frequency slaving, and so parameter **3.22** should be set to 1 so that F and D mode is active. It is however possible to feed the frequency slaving system with quadrature A and B signals. In this case parameter **3.22** should be set to 0.

Closed loop

Normally the Drive encoder input is used to derive speed feedback from an encoder giving A/B quadrature signals, and so this parameter is normally set to 0. However if required the encoder interface can receive F and D signals (**3.22**=1).

3.23 Encoder supply voltage select

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

The supply voltage from the Drive to the encoder 1 connector can be either +5V (parameter **3.23**=0) or +15V (parameter **3.23**=1). Care should be taken not to change this parameter if a +5V encoder is being used, or else the encoder may be damaged.

3.24 Encoder termination disable

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

If parameter **3.24**=0 the encoder 1 inputs are terminated with 120R. Normally termination is required if the incoming signals are connected to one Drive only. However, if the signals are connected to several Drives the termination should only be present on the furthest Drive from the source of the signals.

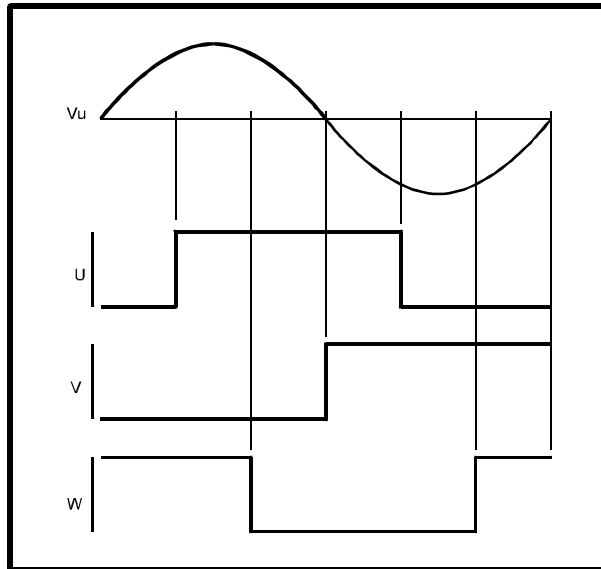
3.25 SV> Encoder phasing test enable

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

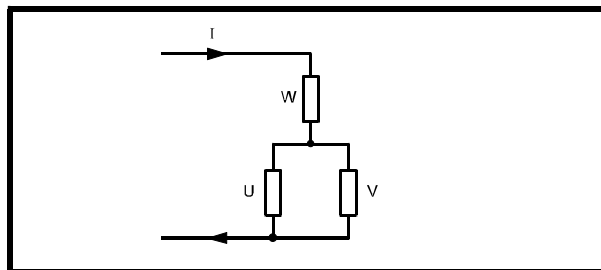
The alignment between the encoder used for feedback from a servo machine supplied by the Drive is important for the control algorithms to work correctly. The required alignment is as follows:

Encoder

If the machine is rotated in the forwards direction (i.e. V_u leads V_v by 120deg and V_v leads V_w by 120deg) the relationship between the commutation signals and V_u should be as shown below.



A static test can also be done to check the alignment by passing a d.c. current through the machine as shown below. The U commutation signal should be toggling from high to low, the V signal should be low and the W signal should be high.



If the encoder is not aligned it is possible for the Drive to check the alignment and to make the necessary compensation. This test can be initiated by setting parameter **3.25** (and is only performed if the enable is active). During the test the Drive will rotate the motor slowly in the forwards direction using half rated motor current (parameter **5.07** defines rated current). Once the test has been completed parameter **3.25** is automatically reset by the Drive. **If any load is applied to the machine during the phasing test the phase measured by the Drive could be incorrect.** It is conventional for a motor to rotate in the clockwise direction (looking from the motor shaft end, i.e. opposite end to the encoder) when the forwards direction is selected. The direction of rotation could be opposite depending on the encoder type, and connections. A motor fitted with a RENCO RCH20 encoder or Stegmann CDD50 DiCoder should rotate in the correct direction if the connections are made correctly.

The phasing test only requires the Drive to be enabled, it will be carried out even if the RUN input to the Drive sequencer is not active. If the run input is active during the phasing test the Drive could start immediately at the end of the test (depending on the sequencing mode). If the RUN is not active the Drive will enter the RDY state at the end of the test.

3.26 Encoder 1 speed

⇅	OL> ±30,000	⇒		RPM	RO	Bi			P
⇅	CL> ±30,000	⇒		RPM					

This parameter will show the rpm of the machine connected to the encoder 1 input provided parameters **3.21** and **3.22** have been set up correctly.

3.27 Encoder 1 position

⇅	OL> 0 ~ 16383	⇒		rev/16384	RO	Uni			P
⇅	CL> 0 ~ 16383	⇒		rev/16384					

This parameter gives the encoder position counted from the point when the Drive was powered up, or if an index marker is detected the position relative to the point where the marker is detected.

3.28 Phase position

↕	OL> 0 ~ 6143	⇒		rev/6143	RW	Uni	S		P
↕	CL> 0 ~ 6143	⇒		rev/6143					

The result of the encoder phasing test (see parameter **3.25**) is the phase offset required to allow the servo algorithms to operate correctly. This parameter shows the offset value in electrical units which vary from 0 to 6143 (unlike the normal mechanical units which vary from 0 to 16383). As this is saved at power-down the offset applies from the point when the test is done until the test is repeated. Loading of default parameters does not affect this value, and so this will not reset the phase position. Care should be taken when putting values directly into this parameter, because incorrect phasing can cause torque to be produced in the wrong direction. Under speed control this causes the motor to accelerate rapidly until it trips when overspeed is detected.

3.29 OL> Overspeed threshold mode select

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

When this parameter is set to zero then the overspeed threshold in both forward and reverse directions is equal to the full scale frequency +20%. (Full scale frequency is defined by parameter **1.06** or the modulus of parameter **1.07** which ever is the greater.) If the speed exceeds this value the Drive will trip on overspeed. This allows the Drive to operate up to full scale with some margin for slip compensation. Note that there is an upper limit on Drive output frequency of 1000.0Hz and so if the rated frequency is any value above 800Hz then the trip frequency will be 1000Hz. Thus above 800Hz there is a progressively reducing overspeed margin.

When this parameter is set to one the overspeed trip level is defined by the overspeed threshold parameter **3.08**. If the Drive exceeds this value in either forward or reverse direction the Drive will trip on overspeed. The default value for parameter **3.08** in open loop is 1000Hz.

If parameter **3.29** = 1 and parameter **3.08** = 1001 then all overspeed trips are effectively disabled as the actual output frequency can never reach the trip threshold.

3.30	CL>	Speed feedback filter
-------------	---------------	------------------------------

⇅	0-10.0	⇒	0	ms	RW				
---	--------	---	---	----	----	--	--	--	--

A window filter is provided on the speed feedback. The feedback is taken over a sliding window of the length specified by this parameter. This is useful in applications where the load inertia is high and a very high proportional gain is required for the speed controller. If the speed feedback is not filtered, the current demand can include a very high level of ripple. Although this has little effect of the load it can affect the integral hold function of the speed loop because the current limits can become active.

3.31	SV>	Servo phasing fail (ENCPH9) detection disable
-------------	---------------	--

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

If this bit is left at zero the Drive will attempt to detect incorrect servo phasing giving ENCPH9 trip if this is detected. This trip may be disabled if required by setting this bit parameter to 1.

Open-loop

In open-loop mode a current controller is provided to give current limiting in frequency control mode and a torque controller in torque control mode. The active current is controlled by modification of the Drive output frequency. Menu 4 provides parameters to set-up the current controller. Additional voltage based current control is provided to limit transients (peak-limit), but there are no user settable parameters to control this.

Closed-loop

In closed-loop modes the output of the speed controller is a torque demand, which is translated into a torque producing current demand. The output of the flux controller for a closed-loop vector Drive is a flux producing current demand. These current demands form the reference values for two current controllers operating in a rotating reference frame that provide voltage demands for the Drive inverter. Menu 4 provides all the parameters to operate the current controllers.

Current limits

Within the Drive there are two over-riding current limits; maximum drive current and maximum current limit defined as:

Maximum drive current is the r.m.s phase current which would just cause an over current trip.

For sizes 1 to 4 this is the drive rated current x 2.2.

For size 5 this is module rated current x 1.7 x no. of modules.

Maximum current limit is equivalent to the maximum active current allowed by the Drive for a given power factor setting.

For sizes 1 to 4:

Open-loop maximum active current = drive rated current x 150% x power factor

Closed-loop maximum active current = drive rated current x 175% x power factor

For size 5:

Maximum active current = module rated current x 120% x power factor x no. of modules

Size 5 module rated current is given as the level for HVAC applications. Therefore 120% overload is possible if the motor rated current is equal to the drive rated current. For industrial applications the maximum drive rated current is stated lower to allow for 150% overload.

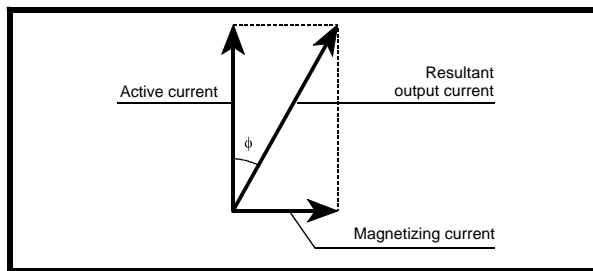
Then maximum current limit = maximum active current / **5.07**, where **5.07** is the motor rated current.

4.1 Parameter descriptions

4.01 Motor current magnitude

⇅	OL> 0 ~ maximum drive current	⇒		Amps	RO	Uni			P
⇅	CL> 0 ~ maximum drive current	⇒		Amps					

This parameter is the rms current from each output phase of the drive. The phase currents consist of an active component and a magnetising component. The three phase currents can be combined to form a resultant current vector as shown below:



The magnitude given in parameter **4.01** is proportional to the length of the resultant output current vector.

The magnetic flux in an induction motor, whether operating under open loop or closed loop vector control, must come from the drive and is produced by the magnetising current. This means that the power factor ($\cos \phi$) will not be unity, but generally in the range from 0.8 to 0.9 for a machine operating with rated load.

The magnetic flux in a servo motor comes from the magnets on the rotor, and so the drive does not have to supply a current to generate flux. The drive will attempt to hold the power factor as close to unity as possible.

4.02 Motor active current

⇅	OL> ± maximum drive current	⇒		Amps	RO	Bi			P
⇅	CL> ± maximum drive current	⇒		Amps					

The diagram above shows the magnetising and active current vectors. These are represented in x and y axes of a reference frame. Parameter **4.02** gives the active current which is proportional to the length of the vector in the y axis and equivalent to the active phase current value in amps.

Open loop

If the drive operates with fixed boost the y axis is aligned with the output voltage. Therefore the magnetising current represents the reactive component of current leaving the drive and the active current represents the real component of current leaving the drive. Therefore the active current produces torque and supplies the losses in the motor.

If the drive operates in vector mode (see parameter **5.14**) the x axis is aligned with the stator flux in the steady state, and so the active current should be proportional to the torque produced by the machine. The active current will give a good indication of the machine torque over most of the frequency range, however, the accuracy is reduced below 10Hz. This method of control gives only moderate transient performance and the active current does not necessarily give a good indication of motor torque under transient conditions.

In both cases the relationship between the active current and motor torque will change once the maximum drive output voltage or the rated voltage of the motor set by parameter **5.09** is reached, whichever is the lowest. (Generally the maximum drive output voltage will be just below the r.m.s. line supply voltage.) Once one of these limits is reached the voltage is held constant and the motor flux reduces with frequency. This is referred to as field weakening or constant power operation. In this region the relationship between torque and active current is approximately as follows, where K is a constant related to the motor:

$$\text{Torque} = K \times \text{active current} \times \text{frequency at voltage limit/actual frequency}$$

Normally the point at which the voltage limit is reached is close to the rated frequency of the motor.

Closed loop Vector

The x axis of the reference frame is aligned with the rotor flux of the motor. The active current is the torque producing current and will give a good indication of the torque being produced by the machine at all speeds up to a level just below base speed. Above this speed the motor flux is reduced with increasing speed (field weakening or constant power operation). Field weakening must be applied, either because the drive cannot produce any more voltage, or because the rated voltage of the motor has been reached (as set by parameter **5.09**). In the field weakening range the relationship between torque and active current is approximately as follows, where K is a constant related to the motor:

$$\text{Torque} = K \times \text{active current} \times \text{speed at voltage limit/actual speed}$$

Normally the point at which the voltage limit is reached is close to the rated speed of the motor (see parameter **5.20**).

Servo

The x axis of the reference frame is aligned with the rotor flux of the motor. The active current is the torque producing current and will give a good indication of the torque being produced by the motor. The drive does not field weaken a servo motor, and so the motor cannot operate at a voltage above the point where the drive cannot produce anymore voltage.

4.03 Torque demand

⇅	OL> ± maximum drive current	⇒		% torque	RO	Bi			P
⇅	CL> ± maximum drive current	⇒		% torque					

Open-loop

The torque demand is the sum of the torque reference (parameter **4.08**) and the torque offset (parameter **4.09**), if enabled. The units of the torque demand are % of rated torque. 100% rated torque is defined by the settings of the drive parameters as shown in the following example:

Motor rated current (parameter **5.07**) = 50A

Motor rated power factor (parameter **5.10**) = 0.85

Assuming frequency is below the point where the voltage limit is reached

Rated active current = 50 x 0.85 = 42.5A

At 100% torque, active current = 42.5A

A positive value of torque demand indicates motoring torque in the positive direction, or regenerating torque in the reverse direction. A negative value indicates regenerative torque in the positive direction and motoring torque in the reverse direction.

Closed-loop

The torque demand can be derived either from the speed loop output or programmed separately depending on the value of parameter **4.11**. The units of the torque demand are % of rated torque, where 100% rated torque is defined by the user in the same way as for the open loop drive. A positive value of torque demand indicates motoring torque in the positive direction, or regenerating torque in the reverse direction. A negative value indicates regenerative torque in the positive direction and motoring torque in the reverse direction.

4.04 Current demand

⇅	OL> ± maximum drive current	⇒		% of rated active current	RO	Bi			P
⇅	CL> ± maximum drive current	⇒							

Open-loop

The current demand is derived from the torque demand. Provided the motor is not field weakened the torque and current demands are the same. In field weakening the current demand is increased with reduced flux:

$$4.04 = 4.03 \times \text{frequency} / \text{rated frequency}$$

The current demand is subject to the current limits.

Closed-loop vector

The current demand is derived from the torque demand. Provided the motor is not field weakened the torque and current demands are the same. In the field weakening range the current demand is increased with reduced flux unless parameter **5.28**=1. The level of flux is derived from the motor model within the drive controllers.

$$4.04 = 4.03 \times \text{flux/rated flux}$$

Closed-loop servo

The current demand and torque demand are the same because field weakening is not possible.

4.05	Motoring current limit
4.06	Regenerating current limit
4.07	Symmetrical current limit

⇕	OL> 0 ~ 400%*	⇒	150	% of rated active current	RW	Uni				
⇕	VT> 0 ~ 400%*	⇒	150	% of rated active current						
⇕	SV> 0 ~ 400%*	⇒	175	% of rated active current						

* This is the maximum range for further restrictions see below.

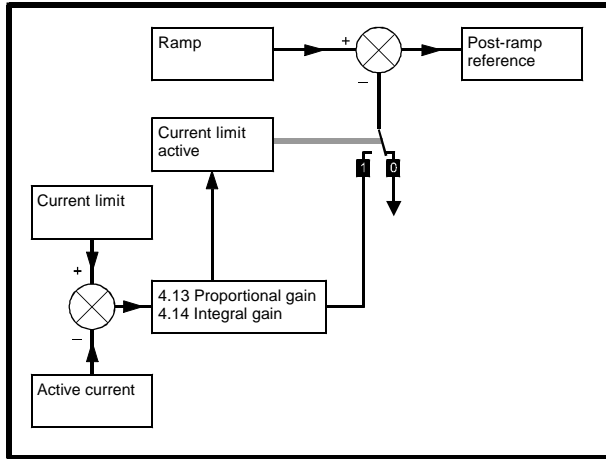
The motoring current limit applies in either direction when the machine is producing motoring torque. Similarly the regenerating current limit applies in either direction when the machine is producing regenerating torque. The symmetrical current limit can override either motoring or regenerating current limit if it is set at a lower value than either limit. The maximum current limit value depends on the level set for the motor rated current (parameter **5.07**).

The maximum range of 400% overload is only possible if the motor rated current is significantly less than the Drive rated current. In other words the Drive must be oversized in order to provide this much current overload. The Drive default values are approximately the maximum overloads available if the motor rated current equals Drive rated current.

The maximum value allowed for the motor rated current is the drive rated current. The drive uses the following methods to try to maintain the currents within the specified limits:

Open loop

In frequency control mode (parameter **4.11=0**), the drive output frequency is modified if necessary to keep the active current within the current limits as shown below:



The current limits are compared with the active current and if the current exceeds a limit the error value passes through the PI controller to give a frequency component which is used to modify the ramp output. The direction of the modification is always to reduce the frequency to zero if the active current is over the motoring limit, or to increase the frequency towards the maximum if the current is over the regenerating limit. Even when the current limit is active the ramp still operates, therefore the proportional and integral gains (parameters **4.13** and **4.14**) must be high enough to counter the effects of the ramp. For a method of setting the gains see parameters **4.13** and **4.14**.

In torque control mode the current demand is limited by the current limits. For operation of this mode see parameter **4.11**.

Closed loop

The current demand input to the current controllers is limited by the current limits.

4.08 Torque reference

↕	OL> ±maximum current limit	⇒	0	% rated active current	RW	Bi			
↕	CL> ±maximum current limit	⇒	0						

Parameter for main torque reference. If connected to an analog input on this drive this parameter is updated every 345µs for 3, 6 and 12kHz switching frequency, and every 460µs for 4.5 and 9kHz switching frequency. This does not apply to the analog inputs of the 'Additional I/O Module'.

4.09 Torque reference offset

↕	OL> ±maximum current limit	⇒	0	% rated active current	RW	Bi			
↕	CL> ±maximum current limit	⇒	0						

Parameter for an offset to be added to the main torque reference. If connected to an analog input the value this is updated every 5.5ms for 3, 6 and 12kHz switching frequency, and every 7.4ms for 4.5 and 9kHz switching frequency. Therefore the main torque reference should be used in applications where fast updating is required.

4.10 Torque reference offset *enable*

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

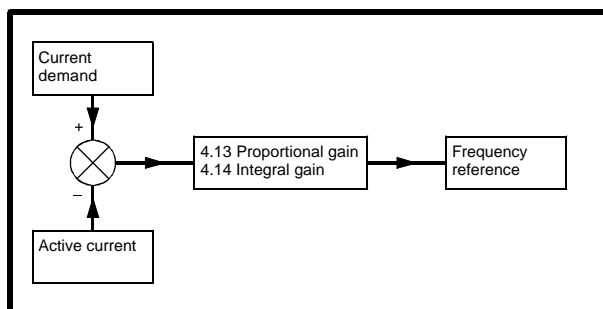
If set the torque offset is added to the torque reference.

4.11 Torque mode *selector*

↕	OL> 0 ~ 1	⇒	0		RW	Uni			
↕	CL> 0 ~ 4	⇒	0						

Open loop

If this parameter is 0 normal frequency control is used. If this parameter is set to 1 the current demand is connected to the current PI controller giving closed loop torque/current demand as shown below. The current error is passed through proportional and integral terms to give a frequency reference which is limited to the range -maximum frequency to +maximum frequency as defined by parameter **1.06**.



Closed loop

The value of this parameter refers to the switches TM0 to TM3 shown on the menu 4 Block diagram. Only one of the switches can be closed at a time.

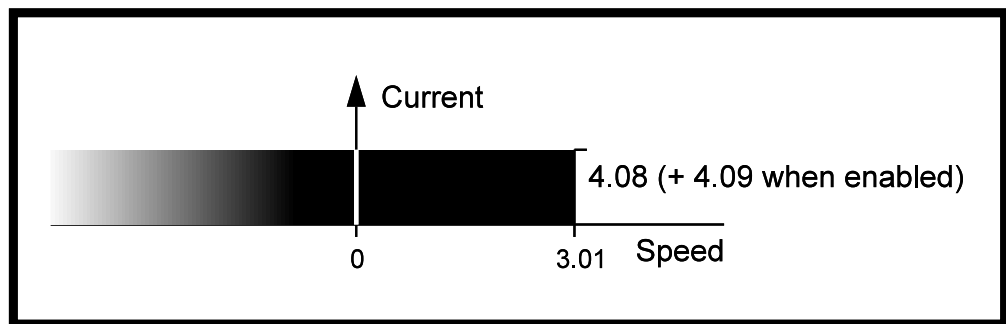
0: Speed control mode

The torque demand is equal to the speed loop output.

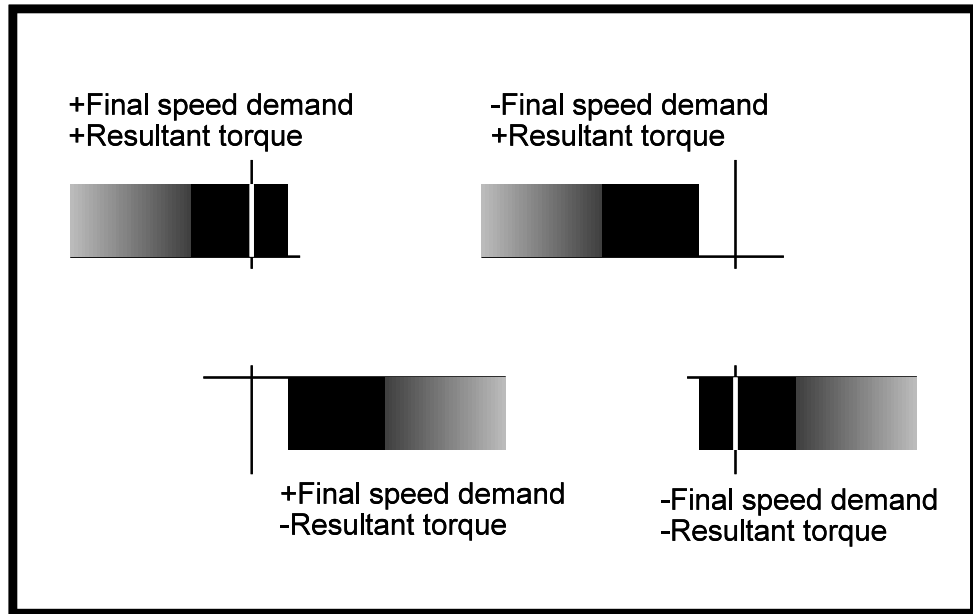
1: Torque control

The torque demand is given by the sum of the torque reference and the torque offset, if enabled. The speed is not limited in any way, however, the drive will trip at the overspeed threshold if runaway occurs.

2: Torque control with speed override



The output of the speed loop defines the torque demand, but is limited between 0 and the resultant torque reference (**4.08 + 4.09** (if enabled)). The effect is to produce an operating area as shown above if the final speed demand and the resultant torque reference are both positive. The speed controller will try and accelerate the machine to the final speed demand level with a torque demand defined by the resultant torque reference. However, the speed cannot exceed the reference because the required torque would be negative, and so it would be clamped to zero.



Depending on the sign of the final speed demand and the resultant torque the four areas of operation shown here are possible.

This mode of operation can be used where torque control is required, but the maximum speed must be limited by the drive. In this mode ramps are not active whilst the drive is in the run state. When the drive is taken out of the run state, but not disabled, the appropriate stopping mode is used. It is recommended that only coast or stopping without ramps is used. If ramp stop mode is used the drive changes to speed control mode to ramp to stop with a reference defined by the user speed demand. This causes the speed to increase towards the reference and then ramp to stop.

3: Coiler/uncoiler mode

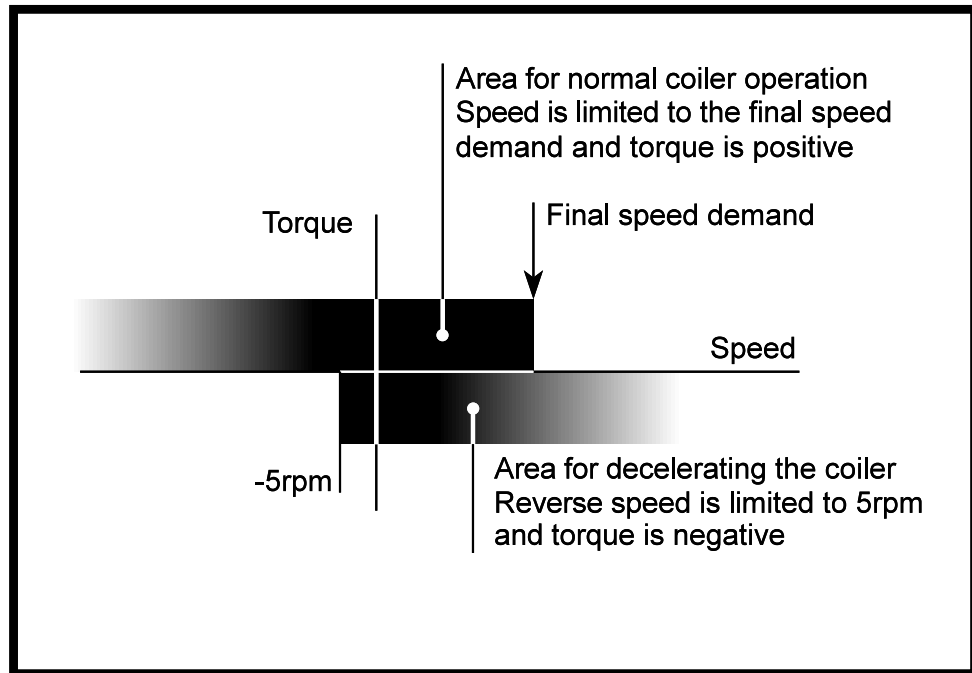
Positive final speed demand: a positive resultant torque will give torque control with a positive speed limit defined by the final speed demand. A negative resultant torque will give torque control with a negative speed limit of -5rpm.

Negative final speed demand: a negative resultant torque will give torque control with a negative speed limit defined by the final speed demand. A positive resultant torque will give torque control with a positive speed limit of +5rpm.

Example of coiler operation

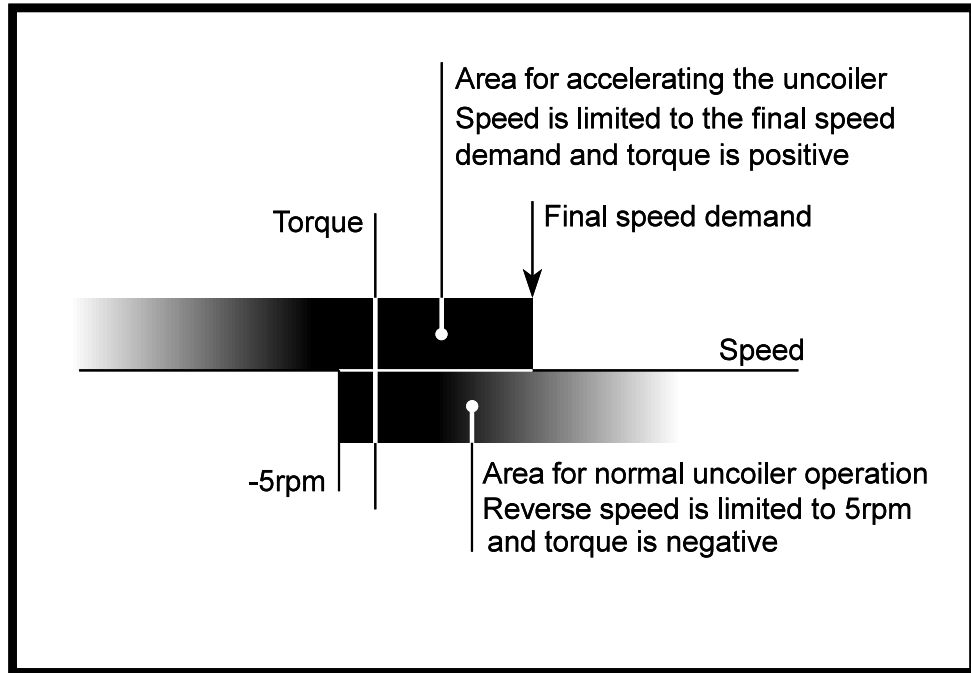
This is an example of a coiler operating in the positive direction. The final speed demand is set to a positive value just above the coiler reference speed. If the resultant torque demand is positive the coiler operates with a limited speed, so that if the material breaks the speed does not exceed a level just above the reference. It is also possible to decelerate the coiler with a negative resultant torque demand. The coiler will decelerate down to -5rpm until a stop is applied.

The operating area is shown below:



Example of uncoiler operation

This is an example for an uncoiler operating in the positive direction. The final speed demand should be set to a level just above the maximum normal speed. When the resultant torque demand is negative the uncoiler will apply tension and try and rotate at 5rpm in reverse, and so take up any slack. The uncoiler can operate at any positive speed applying tension. If it is necessary to accelerate the uncoiler a positive resultant torque demand is used. The speed will be limited to the final speed demand. The operating area is the same as that for the coiler and is shown overleaf:



In this mode ramps are not active whilst the drive is in the run state. When the drive is taken out of the run state, but not disabled, the appropriate stopping mode is used. It is recommended that only coast or stopping without ramps is used. If ramp stop mode is used the drive changes to speed control mode to ramp to stop with a reference defined by the user speed demand. This causes the speed to increase towards the reference and then ramp to stop.

4: Speed control with torque feed-forward

The drive operates under speed control, but a torque value may be added to the output of the speed controller. This can be used to improve the regulation of systems where the speed loop gains need to be low for stability.

4.12 **CL>** Current demand filter time constant

↕	0 ~ 250	⇒	0	ms	RW	Uni			
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It is possible for the output of the speed loop to include some noise due to the digital nature of the speed loop inputs. A first order filter, with a time constant defined by this parameter, is provided on the current demand to reduce acoustic noise and vibration produced as a result of this noise. The filter introduces a lag in the speed loop, and so the speed loop gains may need to be reduced to maintain stability as the filter time constant is increased.

4.13 Current loop proportional gain

⇅	OL> 0 ~ 30000	⇨	20		RW	Uni			
⇅	VT> 0 ~ 30000	⇨	150						
⇅	SV> 0 ~ 30000	⇨	130						

4.14 Current loop integral gain

⇅	OL> 0 ~ 30000	⇨	40		RW	Uni			
⇅	VT> 0 ~ 30000	⇨	2000						
⇅	SV> 0 ~ 30000	⇨	1200						

Open-loop

These parameters control the proportional and integral gains of the current controller used in the open loop drive. As already mentioned the current controller either provides current limits or closed loop torque control by modifying the drive output frequency. The control loop is also used in its torque mode during mains loss, or when the controlled mode standard ramp is active and the drive is decelerating, to regulate the flow of current into the drive. Although the default settings have been chosen to give suitable gains for less demanding applications it may be necessary for the user to adjust the performance of the controller. The following is a guide to setting the gains for different applications.

Current limit operation

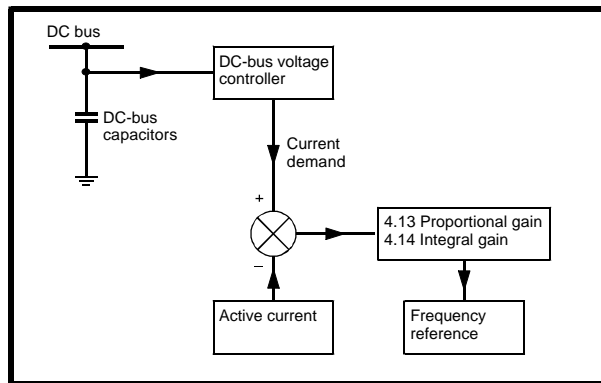
The current limits will normally operate with an integral term only, particularly below the point where field weakening begins. The proportional term is inherent in the loop. The integral term must be increased enough to counter the effect of the ramp which is still active even in current limit. For example, if the drive is operating at constant frequency and is overloaded the current limit system will try to reduce the output frequency to reduce the load. At the same time the ramp will try to increase the frequency back up to the demand level. If the integral gain is increased too far the first signs of instability will occur when operating around the point where field weakening begins. These oscillations can be reduced by increasing the proportional gain. A system has been included to prevent regulation because of the opposite actions of the ramps and the current limit. This can reduce the actual level that the current limit becomes active by 12.5%. This still allows the current to increase up to the current limit set by the user. However the current limit indicator (**10.09**) could become active up to 12.5% below the current limit depending on the ramp rate used.0

Torque control

Again the controller will normally operate with an integral term only, particularly below the point where field weakening begins. The first signs of instability will appear around base speed, and can be reduced by increasing the proportional gain. The controller can be less stable in torque control mode rather than when it is used for current limiting. This is because load helps to stabilise the controller, and under torque control the drive may operate with light load. Under current limit the drive is often under heavy load unless the current limits are set at a low level.

Mains loss and controlled standard ramp

The d.c. Bus voltage controller becomes active if mains loss detection is enabled and the drive supply is lost or controlled standard ramp is being used and the machine is regenerating. The d.c. Bus controller attempts to hold the d.c. Bus voltage at a fixed level by controlling the flow of current from the drive inverter into its d.c. Bus capacitors. The output of the d.c. Bus controller is a current demand which is fed into the current PI controller as shown below:



The d.c. Bus voltage controller cannot be adjusted, but it may be necessary to adjust the current controller gains to obtain the required performance. If the gains are not suitable it is best to set up the drive in torque control first. Set the gains to a value that does not cause instability around the point at which field weakening occurs. Then revert back to open loop speed control in standard ramp mode. To test the controller the supply should be removed whilst the motor is running. It is likely that the gains can be increased further if required because the d.c. Bus voltage controller has a stabilising effect, provided that the drive is not required to operate in torque control mode.

Closed-loop

The P and I gains are used in the voltage based current controller. The default values give satisfactory operation with most motors. However it may be necessary to change the gains especially for low inductance motors. The following procedure should be used:

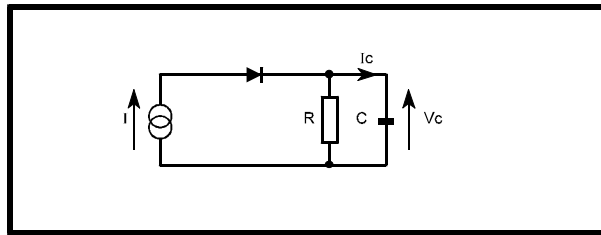
Unless a particularly high bandwidth is required the proportional gain (parameter **4.13**) should be set to a value of $1800 \times L \times \text{Drive rated current}$. Drive rated current is given in parameter **11.32**. L is the motor inductance. For a servo motor this is half the phase to phase inductance that is normally specified by the manufacturer. For an induction motor this is the per phase total leakage inductance (L_s'). This is the inductance value stored in parameter **5.24** after the auto-tune test is carried out. If L_s' cannot be measured it can be calculated (see parameter **5.24**). This will give a response with minimum overshoot after a step change of current reference and a current loop bandwidth of approximately 500Hz. If some overshoot can be tolerated then gain can be increased by a factor of 1.5, giving a bandwidth of 800Hz and 12.5% overshoot after a step change of current reference.

The integral gain (parameter **4.14**) should be set to a value of $0.044 \times (\text{parameter } 4.13) \times R / L$. Where L is the motor inductance as defined previously and R is the per phase stator resistance of the motor. This is half the resistance measured between two phases.

4.15 Motor thermal time constant

⇅	OL> 0 ~ 400.0	⇒	89.0	seconds	RW	Uni			
⇅	VT> 0 ~ 400.0	⇒	89.0	seconds					
⇅	SV> 0 ~ 400.0	⇒	7.0	seconds					

The motor is modelled thermally in a way that is equivalent to the electrical circuit shown below:



$$I_c = C dV_c / dt = I - V_c / R$$

The response of this circuit to a step of I is

$$V_c = RI (1 - e^{-t/\tau})$$

If the voltage is replaced with the temperature of the relevant point in the motor, I with a value proportional to heat input (i.e. I^2) and R with a constant:

$$\text{Temp} = KI^2 (1 - e^{-t/\tau})$$

τ is the thermal time constant of the motor given by parameter **4.15**. The trip threshold is defined by 105% of motor rated current (i.e. parameter **5.07** \times 1.05). The drive will trip if the following is true:

$$(\mathbf{5.07} \times \mathbf{1.05})^2 = I^2 (1 - e^{-t/\tau})$$

Therefore time to trip with 150% rated current = $-\mathbf{4.15} \ln(1 - 105^2/150^2)$. If **4.15** = 89s the time to trip = 60s.

If a different value for the time constant is required it can be calculated as follows:

1. The motor thermal time constant can be used directly.
2. A specific overload time and current level can be used, i.e. 60s at 150%

$$\mathbf{4.15} = -\text{time to trip} / \ln(1 - 105^2 / 150^2) = 89$$

3. If the reset time from an overload is assumed to be the time it takes for the motor to cool to within 1% of the ambient temperature, this can be taken as 5 times the thermal time constant.

There are two alternative modes of operation for motor thermal protection defined by parameter **4.16**.

4.16 Motor protection mode select

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒							

See also parameter **4.15**.

4.16=0: trip when threshold reached

4.16=1: reduction of the current limit to keep the rated current below 100% when the trip level is reached. 5% hysteresis will be included in this case. If the drive is supplying an induction motor, open or closed loop, the level to which the current limit will be reduced will be based on the user parameter defining power factor.

4.17 Motor magnetising current

↕	OL> ±maximum drive current	⇒		Amps	RO	Bi			P
↕	CL> ±maximum drive current	⇒		Amps					

This parameter is proportional to the length of the vector in the x axis of the reference frame and is equivalent to the magnetising current in each output phase in amps.

4.18 Overriding current limit

↕	OL> 0 to +maximum current limit	⇒		% of rated active current	RO	Uni			P
↕	CL> 0 to +maximum current limit	⇒							

The current limit applied at any time depends on whether the drive is motoring or regenerating and also on the level of the symmetrical current limit. Parameter **4.18** gives the limit level that applies at any instant.

4.19 Overload accumulator

↕	OL> 0 to 100.0	⇒		% of trip level	RO	Uni			P
↕	CL> 0 to 100.0	⇒							

When the total current level is above 105% motor rated current (parameter **5.07** x 1.05) the overload accumulator increases, until it reaches 100% when the drive will give an Ixt trip or apply a restriction on the current limit. The level of the accumulator is given by:

$$\text{accumulator} = (I^2 / (5.07 \times 1.05)^2) \times (1 - e^{-t/\tau}) \times 100\%$$

4.20 Percentage torque current

⇅	OL> ±maximum drive current	⇅		% of rated active current	RO	Bi			P
⇅	CL> ±maximum drive current	⇅							

This parameter displays the actual torque producing current (parameter **4.02**) as a percentage of rated torque producing current.

5 Menu 5 Machine Control

5.1 Parameter descriptions

Open loop

Menu 5 includes slip compensation and the main inverter control blocks. The post ramp frequency reference (after current limits) or the slaving frequency demand are the inputs to this stage. The output controls inverter switching.

Closed loop

Menu 5 includes the motor map parameters for closed-loop vector control of an induction motor or servo motor. These are used to locate the motor flux so that the torque producing current (and flux producing current for the induction motor) can be applied correctly. The motor map parameters are also used in flux control of an induction motor in the field weakening range.

5.01	OL>	Motor frequency
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⇅	±1000.0*	⇒		Hz	RO	Bi			P
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The range of this parameter is the maximum magnitude of parameters **1.06** and **1.07** plus whatever is added or subtracted for the slip compensation.

This parameter gives the output frequency of the Drive, i.e. the sum of the post ramp reference and the slip compensation:

$$2.01 + \text{rated slip frequency} \times 4.02 / 100\% \text{ active current}$$

Parameter **2.01** is limited to the maximum frequency defined by parameter **1.06**, but the final frequency can exceed this by the slip compensation frequency.

5.02	Motor voltage
-------------	----------------------

⇅	OL> 0 to 528	⇒		Volts	RO	Bi			P
⇅	CL> 0 to 528	⇒		Volts					

Modulus of the r.m.s. fundamental line voltage at the inverter output. If this parameter is used to produce an analog output via menu 7, the full scale output corresponds to rated motor voltage (except servo which is maximum possible motor voltage, i.e. 480V).

5.03 Total motor power

⇅	OL> ± Max Drive power	⇒		kW	RO	Bi			P
⇅	CL> ± Max Drive power	⇒		kW					

Total output power of the Drive (positive for power flow out of the Drive output terminals). The range of this parameter is $\sqrt{3} \times \text{MAX_I} \times 5.09/1000$ with quasi-square operation not enabled (**5.20=0**). MAX_I is the maximum current that the Drive can produce, i.e. 150% of drive rated current for open loop, 175% of drive rated current for closed-loop and regen, 120% drive rated current for all modes when using size 5. If quasi-square operation is enabled the range is given by $\sqrt{3} \times \text{MAX_I} \times 830\text{V} \times 0.78/1000$. (In servo mode parameter **5.09** is not used, and so the maximum possible value of this parameter is used in the calculations above, i.e. 480V). If this parameter is used to produce an analog output via menu 7, the full scale output corresponds to the maximum value described above.

5.04 OL> Estimated motor speed

⇅	±60,000*	⇒		rpm	RO	Bi			P
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* This is the maximum range for further restrictions see below.

	Pr5.22 = 0	Pr5.22 = 1
Open loop	±6,000	±60,000

The motor rpm is calculated from the post ramp reference (parameter **2.01**) for normal operation, or the slave frequency demand (parameter **3.01**) if frequency slaving is being used. The speed of rotation is calculated as follows:

$$\begin{aligned} \text{rpm} &= 60 \times \text{frequency}/\text{no. of pole pairs} \\ &= 60 \times \mathbf{2.01} / (\mathbf{5.11}/2) \end{aligned}$$

or

$$= 60 \times \mathbf{3.01} / (\mathbf{5.11}/2)$$

If frequency slaving is being used there will be an error due to the slip frequency. However, in normal operation the result will be reasonably accurate provided that the slip compensation has been set up correctly with the rated full load rpm parameter (**5.08**) and the enable parameter set (**5.27**).

For closed loop operation the speed feedback is given in parameter **3.02**.

5.05 D.C. bus voltage

⇅	OL> 0 to 830	⇒		Volts	RO	Uni			P
⇅	CL> 0 to 830	⇒		Volts					

Voltage across the internal d.c. Bus of the Drive.

5.06	OL>	Motor rated frequency
5.06	VT>	Motor rated frequency

EUR >

⇅	0 to 1000.0	⇒	50.0	Hz	RW	Uni			
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USA >

⇅	0 to 1000.0	⇒	60.0	Hz	RW	Uni			
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Open loop

The motor rated frequency and the motor rated voltage (parameter **5.09**) are used to define the voltage to frequency characteristic applied by the Drive to the motor (see parameter **5.09**). The motor rated frequency is also used in conjunction with the motor full load rpm to calculate the rated slip for slip compensation (see parameter **5.08**).

Closed loop vector

The motor rated frequency is used in conjunction with the motor full load rpm to calculate the rated slip of the machine for the vector control algorithm (see parameter **5.08**). It is also used during the magnetising current test in conjunction with the motor rated voltage to set up the Drive to determine the rated magnetising current (see parameter **5.09**).

5.07	Motor rated current	
-------------	----------------------------	--

⇅	OL> 0 to 100% drive rated current	⇒	100%	Amps	RW	Uni			
⇅	CL> 0 to 100% drive rated current	⇒	drive rated current	Amps					

The motor rated current should be set at the machine nameplate value for rated current. See parameter **5.18** for limits on drive switching frequency for different rated current levels.

Open loop

This value is used in the following:

- Current limits, see parameter **4.05** to **4.07**
- Ixt system, see parameter **4.15**
- Vector mode voltage control, see parameter **5.14**
- Slip compensation, see parameters **5.08** and **5.27**
- Dynamic V to f control, see parameter **5.13**

Closed loop vector

This value is used in the following:

- Current limits, see parameter **4.05** to **4.07**
- Ixt system, see parameter **4.15**
- Vector control algorithm, see parameter **5.08**

Servo

This value is used in the following:

- Current limits, see parameter **4.05** to **4.07**
- Ixt system, see parameter **4.15**

5.08	OL>	Motor rated full load RPM
	VT>	Motor rated full load RPM

EUR >

⇕ ⇕	OL> 0 ~ 60,000 *	⇒ 0	rpm	RW	Uni			
	VT> 0 ~ 30,000 *	⇒ 1450	rpm					

USA >

⇕ ⇕	OL> 0 ~ 60,000 *	⇒ 0	rpm	RW	Uni			
	VT> 0 ~ 30,000 *	⇒ 1770	rpm					

* This is the maximum range for further restrictions see below.

	Pr5.22 = 0	Pr5.22 = 1
Open loop	6,000	60,000
Closed loop	30,000	30,000

The rated full load rpm is used with the motor rated frequency to calculate the rated slip of induction machines in Hz. (For fine trim in 0.01rpm units see parameter **5.32**.)

Open loop

The rated full load rpm is used with the motor rated frequency to calculate the rated slip of induction machines in Hz.

$$\begin{aligned} \text{rated slip (Hz)} &= \text{rated motor frequency} - (\text{no. of pole pairs} \times \text{motor full load rpm} / 60) \\ &= \mathbf{5.06} - ((\mathbf{5.11} / 2) \times \mathbf{5.08} / 60) \end{aligned}$$

The rated slip is used to calculate the frequency adjustment required to compensate for slip from the following equation;

$$\begin{aligned} \text{slip compensation} &= \text{rated slip} \times \text{active current} / \text{rated active current} \\ \text{where rated active current} &= \text{motor rated current} \times \text{power factor} \\ &= \mathbf{5.07} \times \mathbf{5.10} \end{aligned}$$

If parameter **5.08** is set to 0 slip compensation is disabled. If slip compensation is required parameter **5.27** should be set to a 1, and parameter **5.08** should be set to the nameplate value, which should give the correct rpm for a hot machine. Sometimes it will be necessary to adjust this when the Drive is commissioned because the nameplate value may be inaccurate. Slip compensation will operate correctly both below base speed and within the field weakening region. Slip compensation is normally used to prevent droop in the motor shaft speed as load is applied. If the motor full load speed is set below the synchronous speed the slip compensation will increase the output frequency with a motoring load and decrease the frequency with a regenerative load both operating in the forward direction. The opposite is true for reverse operation.

The rated full load rpm can also be set higher than synchronous speed to deliberately introduce speed droop. In this case a motoring load in the forward direction will decrease the output frequency. This can be useful to aid load sharing with mechanically coupled motors.

Closed loop vector

Motor full load rpm is used with motor rated frequency to determine the full load slip of the motor which is used by the vector control algorithm. Incorrect setting of this parameter has the following effects:

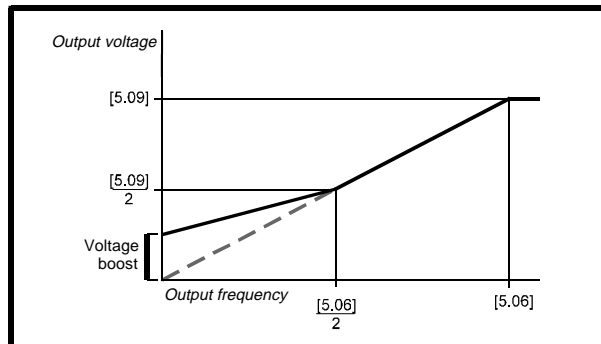
- Reduced efficiency of motor operation
- Reduction of maximum torque available from the motor
- Reduced transient performance
- Inaccurate control of absolute torque in torque control modes

The nameplate value is normally the value for a hot machine, however, some adjustment may be required when the Drive is commissioned if the nameplate value is inaccurate. Either a fixed value can be entered in this parameter or an optimisation system may be used to automatically adjust this parameter (see parameter **5.27**).

5.09	OL>	Motor rated voltage
5.09	VT>	Motor rated voltage
EUR >		
⇅	0 ~ 480	⇒ 400 Volts RW Uni
USA >		
⇅	0 ~ 480	⇒ 460 Volts RW Uni

Open loop

This voltage is used in conjunction with the motor rated frequency (parameter **5.06**) to define the voltage to frequency characteristic applied to the machine. If fixed boost is selected (parameter **5.14** = 3) the following characteristic is used.



If vector mode is selected (parameter **5.14** = 0, 1 or 2) a linear characteristic is used from 0Hz to rated frequency, and a constant voltage above rated frequency. When the Drive operates between rated frequency/50 and rated frequency/4, full vector based stator resistance (R_s) compensation is applied. However there is a delay of 0.5s when the Drive is enabled during which only partial vector based compensation is applied to allow the machine flux to build up. When the Drive operates between rated frequency/4 and rated frequency/2 the R_s compensation is gradually reduced to zero as the frequency increases. For the vector modes to operate correctly the stator resistance (parameter **5.17**), motor rated power factor (parameter **5.10**) and voltage offset (parameter **5.23**) are all required to be set up accurately.

Closed loop vector

The rated voltage is used by the field controller to limit the voltage applied to the machine. Normally this is set to the nameplate value. So that current control can be maintained it is necessary for the Drive to leave some ‘headroom’ between the machine terminal voltage and the maximum available drive output voltage. This headroom is set at 5% of maximum available drive output voltage. Therefore the maximum voltage applied to the motor is the rated voltage or the headroom limit, whichever is the lower.

The rated voltage is also used in conjunction with the motor rated frequency (**5.06**) during the magnetising current test (see parameter **5.12**) and in the calculations required for automatic optimisation of the rated motor slip. It is important, therefore that the correct rated voltage for the motor is used. In some applications it may be necessary to restrict the voltage applied to the motor to a level lower than the rated voltage. The rated frequency (**5.06**) must be adjusted to maintain the ratio of rated voltage and frequency given on the motor nameplate. The rated frequency will then be different to the nameplate value, and so the rated speed must be changed from the nameplate value to maintain the same rated slip.

5.10	OL>	Motor rated power factor
5.10	VT>	Motor rated power factor

⇅	0 ~ 1.000	⇄	0.92		RW	Uni	S	P
---	-----------	---	------	--	----	-----	---	---

Open loop

The power factor is used in conjunction with the motor rated current (parameter **5.07**) to calculate the rated active current and magnetising current of the motor. The rated active current is used extensively to control the Drive and the magnetising current is used in vector mode Rs compensation. It is important that this parameter is set up correctly.

Closed loop vector

The power factor is used in conjunction with the motor rated current (parameter **5.07**) to calculate the rated active current and the magnetising current of the motor. These currents are used in the vector control algorithms, therefore it is important that the rated power factor is set up correctly. It is possible for the Drive to measure the magnetising current of the machine automatically, then provided the motor rated current (parameter **5.07**) has been set to the correct value, this parameter will be set automatically. For details on this test see parameter **5.12**.

The “power factor” measured and used by the Drive is $\cos(i_{\text{torque}} / i_{\text{rated}})$, where i_{torque} is the rated torque producing current and i_{rated} is the rated current. The power factor given by the motor manufacturer is $\cos(i_{\text{real}} / i_{\text{rated}})$, where i_{real} is the current in phase with the supply voltage. The manufacturers’ power factor will tend to be worse than that measured by the Drive because of the motor leakage inductance.

5.11 Motor – number of poles

⇅	OL> 2POLE to 32POLE	⇒	4POLE	poles	RW	Txt			P
⇅	VT> 2POLE to 32POLE	⇒	4POLE	poles					
⇅	SV> 2POLE to 32POLE	⇒	6POLE	poles					

Set to the no. of poles for the machine being used.

Please note when setting this parameter via comms:

- 0 = 2 pole
- 1 = 4 pole
- 2 = 6 pole etc

5.12 OL> Magnetising current test *enable*

5.12 VT> Magnetising current test *enable*

⇅	0 ~ 1	⇒	0		RW	Bit			P
---	-------	---	---	--	----	-----	--	--	---

Note:

It is important that the motor is at standstill before this test is carried out. Also as soon as this parameter is set to 1 and the Drive is enabled the machine will begin to rotate. Pressing the stop/reset button on the front of the Drive can be used to cause the motor to coast to a rest at any point during this test. If the forward limit switch (6.35) becomes active it will also stop the test.

Note:

It is important to note that the motor rated voltage (5.09) and motor rated frequency (5.06) are used in conjunction with the inductance values measured by this test to perform automatic optimisation of the rated full load slip. Therefore the test must be repeated if parameters 5.06 or 5.09 are modified.

If this parameter is set to 1 and the Drive enable is active, the Drive will perform a series of tests on the motor:

- Standstill test to measure total leakage inductance. The motor must be at standstill before this test. (Closed-loop Vector only)
- Accelerate the motor up to 2/3 x rated frequency in the forward direction to measure the rated magnetising current (the frequency is less if sufficient d.c. bus voltage is not available to operate at this level without field weakening). The rated magnetising current is used to set up the motor rated power factor. The motor must be unloaded for this test.
- Run at 2/3 x rated frequency for 30 seconds to measure the saturation characteristic of the motor. The motor must be unloaded for this test. (Closed-loop Vector only)

Open loop

In this mode only the magnetising current test is performed. Once the test is complete parameter **5.12** is reset. If the power factor value set up as a result of this test is not accurate (i.e. because the motor is loaded), the voltage setting and hence the flux level at low frequencies will be incorrect.

Closed loop

In this mode all of the tests described above are carried out as well as the feedback encoder being checked, once the test is complete parameter **5.12** is reset.

The total leakage inductance is used for automatic adjustment of the motor rated speed (see parameter **5.27**). If the value of total leakage inductance is incorrect this will affect the performance of the optimiser. Total leakage inductance is also used for current cross coupling (see parameter **5.26**).

The magnetising current (power factor and rated motor current) is used to set the level of magnetising current and flux in the motor. This should be set correctly for good performance.

The saturation characteristic is used to determine the level of motor flux in the field weakening region. If this parameter is not set correctly the performance of the Drive will be affected in speed control and the torque accuracy will be affected in torque control.

During the test the following trips can occur:

- ENCPH5 - A signal missing
- ENCPH6 - B signal missing
- ENCPH7 - A/B phase reversed
- ENCPH8 - Test stopped before completion

5.13 **OL>** **Dynamic V/f select**

⇅	0 ~ 1	⇒	0		RW	Bit		
---	-------	---	---	--	----	-----	--	--

Setting this bit enables dynamic V to f mode which is intended for applications where power loss should be kept to a minimum under low load conditions. The rated frequency used to derive the voltage to frequency characteristic of the Drive is varied with load:

- if $|\text{active current}| < 0.7 \times \text{rated active current}$
motor rated frequency = **5.06** $\times (2 - (\text{active current}/(0.7 \times \text{rated active current})))$
- else if $|\text{active current}| \geq 0.7 \times \text{rated active current}$
motor rated frequency = **5.06**

Although the rated frequency varies the value shown as parameter **5.06** does not vary from that set by the user.

5.14 OL> Voltage mode selector

↕	0 to 3	⇒	1		RW	Uni			P
---	--------	---	---	--	----	-----	--	--	---

This parameter selects the voltage control mode used by the open loop drive. This falls into two categories: vector mode (0=Ur_S, 1=Ur_I and 2=Ur) and fixed boost (3). The voltage characteristics for these two modes have been covered in the description of parameter **5.09**.

The difference between the three versions of vector mode is the method used to determine the stator resistance and the voltage offset.

Ur_S mode (0):

The stator resistance (**5.17**) and the voltage offset (**5.23**) are measured each time the Drive is enabled. This test can only be done with a stationary machine where the flux has decayed to zero. Therefore this mode should only be used if the machine is guaranteed to be stationary each time the Drive is enabled. To prevent the test from being done before the flux has decayed there is a period of 2 seconds after the Drive has been in the inhibit or ready state during which the test would not be done if the Drive is re-enabled. In this case, previously measured values are used. This is the preferred version of vector mode because the stator resistance varies with temperature.

Ur_I mode (1):

The stator resistance and the voltage offset are measured each time the Drive is powered up only. This test can only be done with a stationary machine where the flux has decayed to zero. Therefore this mode should only be used if the machine is guaranteed to be stationary at power-up. Note: if the Drive is not enabled at power-up this test will not be performed.

Ur mode (2):

The stator resistance and voltage offset are not measured. This version should be used if either of the above versions cannot be used. The resistance of the machine and cabling can be measured, but will not include "resistance" effects within the Drive. The voltage offset (see parameter **5.23**) is a function of the Drive and cannot be measured by the user. Therefore the best method to obtain these parameter is to use mode 0 or 1 during commissioning, and then to switch to mode 2 for normal operation.

Fd mode (3)

Fixed boost mode. Neither the stator resistance or the voltage offset are used, instead the boost voltage is applied as defined by parameters **5.15** and **5.09**.

Note:

It is recommended that this parameter is set to Ur or Ur_S in applications where dips or brown outs are likely. Incorrect values can be stored in this case causing poor or incorrect performance.

5.15	OL>	Boost voltage
5.15	VT>	Boost voltage

⇅	0 to 25.0	⇒	3.0	% of motor rated voltage (parameter 5.09)	RW	Uni				
---	-----------	---	-----	---	----	-----	--	--	--	--

Open loop

The boost level for the fixed boost characteristic is defined by this parameter.

Closed loop vector

Fixed boost is used during the magnetising current test. The level of boost is defined by this parameter.

5.16	OL>	Jog boost voltage
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⇅	0 to 25.0	⇒	3.0	% of motor rated voltage (parameter 5.09)	RW	Uni				
---	-----------	---	-----	---	----	-----	--	--	--	--

If the jog preset speed is active in fixed boost mode, this boost level is used instead of the normal boost level set by parameter **5.15**.

5.17	OL>	Stator resistance
-------------	---------------	--------------------------

⇅	0 to 32.000	⇒	0.0	Ohms	RW	Uni	S			P
---	-------------	---	-----	------	----	-----	---	--	--	---

This parameter stores the stator resistance of the machine for vector mode operation. If the Drive cannot achieve the necessary current levels to measure the stator resistance in Ur_S or Ur_I modes (e.g. there is no motor connected to the Drive), an rS trip will occur and the value in parameter **5.17** remains unchanged. If the necessary current level can be achieved, but the calculated resistance exceeds the maximum values for the particular drive size, an rS trip will occur and parameter **5.17** will contain the maximum allowed value. The maximum value can be calculated from the following formula:

$$R_{s_{max}} = V_{DC_{full_scale}} / I_{full_scale} / 2$$

where

$$V_{DC_{full_scale}} = 830V \text{ for standard drives}$$

$$I_{full_scale} = \text{Drive rated current} \times \sqrt{2} / 0.47$$

5.18 PWM switching frequency selector

⇅	OL> 0 to 4: [3, 4.5, 6, 9, 12kHz]	⇒	0:[3]	kHz	RW	Txt			P
⇅	CL> 0 to 4: [3, 4.5, 6, 9, 12kHz]	⇒	0:[3]	kHz					

The Drive modulator uses space vector modulation with a switching frequency defined by this parameter. The sampling frequency of all control systems within the Drive are based on the switching frequency as follows.

Voltage based current control (peak limits for open loop and current control for closed loop drives)

Switching frequency kHz	Control frequency kHz
3	3
4.5	4.5
6	6
9	4.5
12	6

Open loop drive current control and closed loop drive speed control

Switching frequency kHz	Control frequency kHz
3	3
4.5	2.25
6	3
9	2.25
12	3

The Drive can model the temperature of the junctions of the IGBT's in the inverter (see also parameters **5.33** and **7.32**) and give trip Oh1 if this temperature is too high. If this thermal model protection is enabled any switching frequency can be used up to rated drive current except where a zero is shown in the table below. If a zero is shown then the switching frequency is not available for that drive size.

If thermal model protection is not enabled then the switching frequency is restricted depending on the motor rated current set in parameter **5.07** as shown in the table below. If the switching frequency is limited then the current limits are also derated so that the maximum drive current is restricted to 150% of the value shown in the table for open-loop mode and 175% of the value shown for closed-loop modes (including the regen unit mode).

Drive size	Rated power kW	Current rating 3kHz A	Current rating 4.5kHz A	Current rating 6kHz A	Current rating 9kHz A	Current rating 12kHz A
UNI1401	0.75	2.1	2.1	2.1	2.1	2.1
UNI1402	1.1	2.8	2.8	2.8	2.8	2.8
UNI1403	1.5	3.8	3.8	3.8	3.8	3.8
UNI1404	2.2	5.6	5.6	5.6	5.6	4.5
UNI1405	4	9.5	9.5	8.5	7.0	5.5
UNI2401	5.5	12.0	12.0	12.0	12.0	11.7
UNI2402	7.5	16.0	16.0	16.0	14.2	11.7
UNI2403	11	25.0	21.7	18.2	14.2	11.7
UNI3401	15	34.0	34.0	34.0	28.0	23.0
UNI3402	18.5	40.0	40.0	37.0	28.0	23.0
UNI3403	22	46.0	46.0	40.0	32.0	26.6
UNI3404	30	60.0	47.0	40.0	32.0	26.7
UNI3405	37	70.0	56.0	46.0	35.0	28.0
UNI4401	45	96.0	96.0	88.0	70.0	0
UNI4402	55	124.0	104.0	88.0	70.0	0
UNI4403	75	156.0	124.0	105.0	80.0	0
UNI4404	90	180.0	175.0	145.0	110.0	0
UNI4405	110	202.0	175.0	145.0	110.0	0
Size 5	132 / 160 per module	240 / 300 per module	0	0	0	0

The Drive will thermally protect itself in ambient temperatures up to 40°C. Above this temperature some derating must be applied.

5.19 High stability space vector modulation *enable*

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

Open loop

Normally the Drive will use space vector modulation to produce the IGBT control signals. High stability space vector modulation offers three advantages in an open loop drive, but the acoustic noise produced by the machine may increase slightly.

- It is possible for instability to occur around motor rated frequency/2 on light load. The Drive uses deadtime compensation to reduce this effect, however, it is still possible that some machines will be unstable. To prevent this, high stability space vector modulation should be enabled by setting this parameter.
- As the output voltage approaches the maximum available from the Drive pulse deletion occurs. This can cause unstable operation with a lightly or fully loaded machine. High stability space vector modulation will reduce this effect.
- High stability space vector modulation gives also a small reduction in drive heat loss.

Closed loop

Normally the Drive will use space vector modulation to produce the IGBT control signals. The only advantage of high stability space vector modulation is the small reduction in drive heat loss. The acoustic noise produced by the machine may increase slightly.

5.20 Quasi-square wave enable

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

Open loop

The maximum modulation level of the Drive is normally limited to unity. If the motor rated voltage is set at the same level as the supply voltage some pulse deletion will occur as the Drive output voltage approaches the rated voltage level. If parameter **5.20** is set to 1 the modulator will allow over modulation, so that as the output frequency increases beyond the rated frequency the voltage continues to increase above the rated voltage. The modulation depth will increase beyond unity; first producing trapezoidal and then quasi-square waveforms. This can be used for example to obtain high output frequencies (up to 1kHz) with a low switching frequency (i.e. 3kHz), which would not be possible with space vector modulation limited to unity modulation depth. The disadvantage is that the machine current will be distorted as the modulation depth increases above unity, and will contain a significant amount of low order harmonics of the fundamental output frequency.

Closed loop

This feature can also be enabled with closed loop drives to obtain a higher output voltage. The maximum voltage possible with a closed-loop vector drive, still allowing for headroom for current control to operate, is higher with quasi-square operation.

When closed-loop vector control is used with this parameter set at 0, the output voltage of the converter is theoretically limited to 90% of the supply voltage. In practice various voltage drops within the Drive will reduce this further. This margin is to allow the current controllers to operate correctly in the field weakening range. As the speed approaches the rated value the Drive begins field weakening. The torque produced by the motor may be limited below the expected value at rated speed, because the voltage is first clamped to its maximum limit at a speed below rated speed. To overcome this limitation parameter **5.20** can be set to 1, however odd multiple harmonics of the fundamental may be increased above the level produced with **5.20** equal to 0.

5.21 **VT>** **Field gain reduction enable**

↕	0 ~ 1	⇒	1		RW	Bit			
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The closed loop vector drive field controller has a gain defined by the Drive from the rated current and voltage of the machine. However it is possible by setting this parameter to a 1 to reduce this gain by a factor of 2 if instability problems occur in the field weakening range.

5.22 **OL>** **Maximum speed x 10 select**

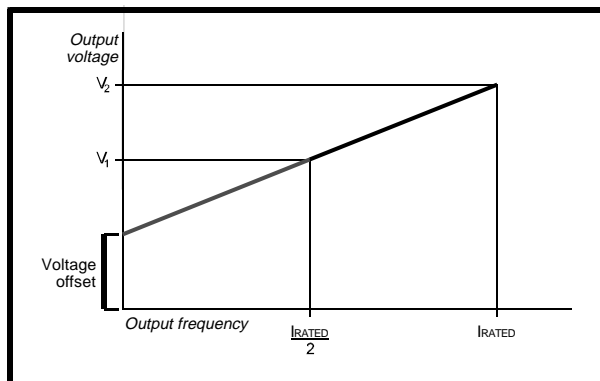
↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

This bit affects the way the Drive holds parameters **5.04** and **5.08** in memory. If **5.22** = 0, values up to 6,000rpm can be used with a resolution of 1rpm. If parameter **5.22** = 1, values up to 60,000rpm can be used with a resolution of 10rpm. This only applies to the open loop drive. All speed parameters for the closed loop drive are held with a resolution of 1rpm.

5.23 **OL>** **Voltage offset**

↕	0 to 25.5	⇒		Volts	RO	Uni			P
---	-----------	---	--	-------	----	-----	--	--	---

The stator resistance test is carried out at half and full rated motor current. A current is applied in the y axis of the reference frame with zero frequency, and so d.c. current flows in all three phases of the machine. The results are as shown below.



The gradient of the line gives the stator resistance, cabling resistance and resistance effects within the Drive. The units are converted to ohms before being stored in parameter **5.17**.

The Drive must produce a voltage before any current flows, shown as V_{offset} . This includes IGBT voltage drops etc. To obtain good performance at low frequencies where the machine terminal voltage is small this offset must be taken into account. The value shown in parameter **5.23** is given in volts, representing the voltage that would be applied on the U phase output as a d.c. level. The voltages on the other two phases would be $-V_{\text{offset}}/2$. It is not possible for the user to measure this voltage easily, and so the automatic measurement procedure should be used, see parameter **5.14**.

5.24 **CL> Motor leakage inductance**

↕	0.000 to 320.00	⇒	0.0	mH	RW	Uni	S		P
---	-----------------	---	-----	----	----	-----	---	--	---

Closed-loop vector

The value of inductance stored in this parameter should be the total leakage inductance (L_s') of the motor. The value can be measured at the start of the magnetising current test and stored in this parameter. Alternatively the user can modify the value. The range of this parameter will change with the size of the Drive. For standard voltage drives the range is 0.01 to 320.00 for 11kW and below, and 0.001 to 32.000 for 15kW and above.

The total leakage inductance can be calculated from the steady state per phase equivalent circuit of the motor:

$$L_s' = L_1 + (L_2 L_m / (L_2 + L_m))$$

L_s' is used for automatic optimisation of the rated speed (see parameter **5.27**) and for current cross coupling compensation (see parameter **5.26**).

Servo

The value of inductance stored in this parameter should be the total phase inductance (half the phase to phase inductance). The inductance is used for cross coupling compensation (see parameter **5.26**). The value is not automatically measured, and so the correct value must be entered by the user if cross coupling compensation is required.

5.25 **OL> Output frequency doubling select**

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

If this bit is set the change of reference frame angle per sample is doubled. This will result in the motor output frequency being twice the displayed value. If this bit is set the maximum open loop output frequency will go up from 1000Hz to 2000Hz. No other changes are made, and so slip comp, ramps etc. will need to be re-scaled.

For example:

The real machine is 4 pole, 2000Hz, 400V, 60000 rpm, full load speed 58000 rpm, and the desired maximum speed is 40000 rpm with a trip at 50000 rpm. Acceleration is to be 500Hz / sec.

Menu 1:

maximum frequency (parameter **1.06**) should be set to

$$0.5 \times 2000 \times 40000 / 60000 = 667\text{Hz}$$

Menu 2:

the ramp times (parameters **2.11** to **2.29**) need to be set at

$$0.5 \times 0.2 \text{ sec per } 100\text{Hz} = 0.1$$

Menu 3:

the over-speed trip threshold (parameter **3.08**) should be set at

$$0.5 \times 2000 \times 50000 / 60000 = 833\text{Hz}$$

Menu 5:

the rated motor voltage (parameter **5.09**) 400V

the rated frequency (parameter **5.06**) $0.5 * 2000 = 1000\text{Hz}$

the full load speed is (parameter **5.08**) $0.5 * 58000 = 29000\text{rpm}$

the motor poles (parameter **5.11**) 4 POLE

Extreme caution should be exercised when setting this bit as the actual machine speed will be double that indicated.

5.26	CL>	Cross-coupling compensation enable
-------------	---------------	---

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

Closed-loop vector

When an induction motor is operated in closed-loop vector mode the flux and torque are controlled by two separate currents similar to the field and armature currents of a d.c. machine. Under all conditions these currents independently control the flux and torque. Under transient conditions there is cross-coupling between the axes that represent flux and torque. The main effect will be that the flux controlling current will change with torque demand. This effect is most significant when using a 3kHz switching frequency, at higher switching frequencies the current controllers are fast to eliminate this effect. Thus this parameter is only available with a 3kHz switching frequency.

Servo

Cross coupling also occurs in servo motors. This effect is worse with high speed (6000rpm) motors and could in some cases cause over current trips. If cross coupling compensation is required, the user must enter the phase inductance in parameter **5.24** and set parameter **5.26** to 1.

5.27	OL>	Slip compensation enable
-------------	---------------	---------------------------------

↕	0 ~ 1	⇒	1		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

The level of slip compensation is set by the rated frequency and rated speed parameters. Slip compensation is not automatically enabled, but is only active when this parameter is set to 1.

5.27 VT> **Auto-optimize rated speed enable**

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

The motor rated full load rpm parameter (**5.08**) in conjunction with the motor rated frequency parameter (**5.06**) defines the full load slip of the motor. The slip is used in the motor model for closed-loop vector control. The full load slip of the motor varies with rotor resistance which can vary significantly with motor temperature. When this parameter is set the Drive can automatically sense if the value of slip defined by parameters **5.06** and **5.08** has been set incorrectly or has varied with motor temperature. If the value is incorrect parameter **5.08** is automatically adjusted. Parameter **5.08** is not saved at power-down, and so when the Drive is powered-down and up again it will return to the last value saved by the user. If the new value is required at the next power-up it must be saved by the user. Automatic optimisation is not carried out below rated speed / 8. Automatic optimisation requires some load on the machine to operate (not operational below rated load / 8), and so if the motor full load slip is unknown and the auto-tuning method is being used to determine this value the motor should be run under a significant load. For automatic optimisation to operate the correct value of motor total leakage inductance must be stored in parameter **5.24**.

At high output frequencies the voltages measured by the Drive can be displaced from the real motor voltages. The Drive compensates for this displacement, but as the frequency increases it becomes difficult for this to be done accurately. If the voltages are displaced from the real voltages the optimisation of the motor rated rpm can become inaccurate or even diverge from the real value. If this occurs it is suggested that a threshold detector from menu 12 is used to disable the optimiser at higher speeds.

5.28 VT> **Field weakening gain compensation disable**

↕	0 ~ 1	⇒	0		RW	Bit			
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When the flux in the motor is reduced below its rated level the level of torque producing current required for a given amount of shaft torque is higher than the rated level. This same effect occurs in a d.c. machine where the armature current needs to be increased for a given amount of torque if the field current is reduced. Normally the Drive automatically provides the necessary increase in torque producing current as the motor flux reduces in the field weakened (constant power range). In speed control the compensation prevents gain reduction at higher speeds. In torque control the compensation maintains the torque at the correct level for a given torque demand. In some applications using speed control it may be desirable to have a reduction of gain as the motor flux is reduced to maintain stability. If this is required parameter **5.28** should be set.

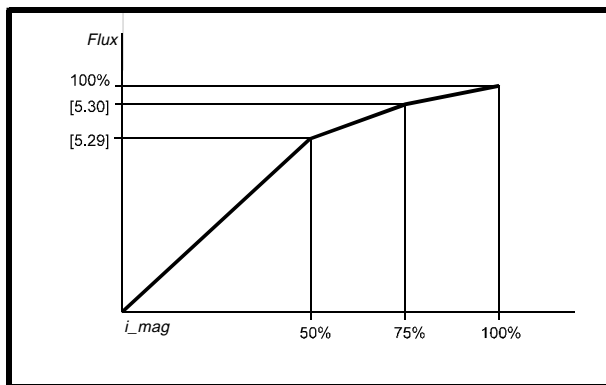
5.29 VT> **Motor saturation breakpoint 1**

⇅	0 to 100	⇄	50	% of rated flux	RW	Uni			P
---	----------	---	----	-----------------	----	-----	--	--	---

5.30 VT> **Motor saturation breakpoint 2**

⇅	0 to 100	⇄	75	% of rated flux	RW	Uni			P
---	----------	---	----	-----------------	----	-----	--	--	---

The rated level of flux in most induction motors causes saturation. Therefore the flux against flux producing current characteristic is non-linear. The effects of saturation are to cause a step increase in torque when operating in torque mode as the speed increases into the field weakening region. The Drive can include the effects of saturation by representing the flux producing current to flux characteristic as a series of three lines as shown below:



If parameters **5.29** and **5.30** have their default values of 50 and 75, the characteristic becomes one line and there will be a linear relationship between the Drive estimate of flux and the flux producing current. If **5.29** and **5.30** are increased above 50 and 75 the Drive estimate of flux can include the effect of saturation. It is unlikely that information will be available to set up these parameters, and so the values are determined during the mag current test. These parameters are not saved at power-down, and so if the new values are required the user must save parameters before power-down.

5.31 Voltage controller gain

⇅	OL> 0 to 30	⇒	1		RW	Uni			P
⇅	CL> 0 to 30	⇒	1						

This parameter controls the gain of the voltage controller used for mains loss and standard ramp control. If the parameter is set to 1 the gain used is suitable for applications where the Drive is used alone. Higher values are intended for applications where the d.c. bus of each drive is connected in parallel and the Drive is used as a master for mains loss control. This is intended for use in applications where each drive is locked together using open-loop frequency slaving. (If motors are locked together using digital-locking, using a master for mains loss control, it is unlikely that the system will be stable during mains loss unless the power rating of the master is much higher than the combined rating of the slaves. This is due to the lag created by the master motor inertia.)

5.32 OL> Motor full load speed fine trim

5.32 VT> Motor full load speed fine trim

⇅	0.0 to 0.99	⇒	0.0	0.01rpm	RW	Uni			P
---	-------------	---	-----	---------	----	-----	--	--	---

This parameter provides a fine trim for the full load rated speed in 0.01rpm units. The full load rated speed is given by **5.08** + **5.32**. The trim allows more accurate setting of the rated speed for larger motors where the full load slip may be quite small. The rated speed optimiser changes this parameter as well as parameter **5.08**.

5.33 Thermal model protection enable

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

If this bit is set the Drive will protect itself using a thermal model. The protection system assumes that the ambient temperature is 40°C. An estimate of the maximum IGBT case temperature is made using the Drive output current and switching frequency. This calculation includes the thermal time constant of the Drive heatsink. An estimate of the IGBT junction temperature is made based on the calculated case temperature and an instantaneous temperature drop using the Drive output current and switching frequency. The estimated IGBT junction temperature is displayed in parameter **7.32**. If the temperature exceeds 145°C the switching frequency is reduced if this is possible. The allowed changes are 12kHz to 6kHz, 6kHz to 3kHz, and 9kHz to 4.5kHz. The switching frequency parameter **5.18** will not change. Reducing the switching frequency reduces the Drive losses and the junction temperature displayed in parameter **7.32** will also reduce. If the load condition persists the junction temperature will continue to rise. If it again rises above 145°C the Drive will initiate an Oh1 trip. Every second the Drive will attempt to restore the switching frequency to the level set in parameter **5.18**. The switching frequency will remain at the level in parameter **5.18** until the junction temperature again rises above 145°C again. Thermal model protection is the only option for the standalone regen unit.

The Drive sequencer has a number of states which are indicated in the four digit window on the display in status mode. The various states are:

inh	Inhibit	The output bridge is inactive because the Drive is disabled, a coast stop is in progress, or the Drive is inhibited following a trip reset.
rdy	Ready	The Drive is enabled and ready for a start command, output bridge is inactive.
StoP		The Drive is enabled and ready for a start command, output bridge is active holding zero speed.
SCAN		The Drive is trying to synchronise its output frequency with rotational speed of the motor (open loop only).
run		The Drive is running.
ACUU		An AC Under voltage has been detected and the Drive is trying to ride through the condition by absorbing power from the load.
dEC		The Drive is decelerating following a stop command.
dc		Injection braking current is being applied to the machine .
POS		Orientation stop is taking place.
triP		The Drive has tripped, the fault code is present in the upper six digit window.
act		Regen mode input converter active.

If the Drive is in regen mode some of the strings have different meanings.

inh	Drive is not enabled, or is enabled, but the soft-start contactor is not closed when it should be
StoP	Drive is waiting for the dc bus voltage to stabilise or the AC supply voltage is too low
SCAN	Drive is synchronising to the AC supply

6.1 Parameter descriptions

6.01 Stop mode selector

⇕	OL> 0 to 4	⇒	1		RW	Txt			
⇕	VT> 0 to 3	⇒	1						
⇕	SV> 0 to 3	⇒	2						

Open Loop

0	COASt	Coast stop
1	rP	Ramp stop
2	rP-dcl	Ramp stop + 1 second dc injection
3	dcl	Injection braking stop with detection of zero speed
4	td.dcl	Timed injection braking stop

Stopping is in two distinct phases: decelerating to stop, and stopped.

Stopping Mode	Phase 1	Phase 2	Comments
0: Coast	Inverter disabled	Drive cannot be re-enabled for 2s	Delay in phase 2 allows rotor flux to decay in induction motors
1: Ramp	Ramp down to zero frequency	Wait for 1s with inverter enabled	
2: Ramp + 1s d.c.	Ramp down to zero frequency	Inject d.c at level specified by parameter 6.06 for 1s	
3: D.C with zero speed detection	Low frequency current injection with detection of low speed before next phase.	Inject d.c at level specified by parameter 6.06 for 1s	The Drive automatically senses low speed and therefore it adjusts the injection time to suit the application. If the injection current level is too small the Drive will not sense low speed (normally a minimum of 50-60% is required).
4: Timed injection braking stop	Inject d.c. at level specified by parameter 6.06 for time specified by 6.07 - 1s.	Inject d.c at level specified by parameter 6.06 for 1s	The minimum total injection time is 1s for phase 1 and 1s for phase 2, i.e. 2s in total.

Once modes 3 or 4 have begun the Drive must go through the ready state before being restarted either by stopping, tripping, or being disabled.

Closed loop

- 0 COASt Coast stop
- 1 rP Ramp stop
- 2 no.rP Stop without ramps
- 3 rP-POS Stop and orientate

In the closed loop mode the two stopping phases do not exist and the ready state is entered as soon as the single stopping action is complete.

Stopping Mode	Action	Comments
0: Coast	Inhibits the inverter	
1: Ramp	Stop with ramp	
2: No ramp	Stop with no ramp	
3: Stop and orientate	Stops with ramp and then rotates to a preset position.	The position system controlled by menu 13 is used to orientate the motor. Parameter 13.08 must be set up correctly for use, and the hard speed reference enabled, parameter 3.19 .

6.02 Auto start mode selector

⇅	OL> 0 to 2	⇅	0		RW	Txt			
⇅	CL> 0 to 2	⇅	0						

- 0 diS Disabled
- 1 ALYS Always
- 2 Pd.dP Power Down dependant

This parameter has no effect in sequencing modes 2 to 4 because they are not latching modes and require the run input to be closed for the Drive to run.

0: disabled

The Drive will never automatically start at power up, or after auto-reset of a trip.

1: always

The Drive will always start at power up, or after a trip reset providing the Drive is enabled and the stop terminal is not open.

2: power down dependant

The Drive remembers its state when the power is removed. If the Drive was running when the power went off then it will restart when power is re-applied (subject to the Drive being enabled and the stop terminal being closed). Also if the Drive is tripped then it will restart after a trip reset (again subject to the Drive being enabled and the stop terminal being closed).

Notes:

Auto-start does not operate after a trip reset from the keypad stop/reset key.

6.03 AC supply loss mode selector

⇅	OL> 0 to 2	⇅	0		RW	Txt			P
⇅	CL> 0 to 2	⇅	0						

0	diS	Disabled
1	StoP	Stop
2	ridE.th	Ride through

0: Disabled

There is no mains loss detection and the Drive operates normally only as long as the DC Bus voltage remains within specification (above 320V).

1: Stop open-loop

The action taken by the Drive is the same as for ride through mode, except the ramp down rate is at least as fast as the deceleration ramp setting and the Drive will continue to decelerate and stop even if the mains is re-applied. If normal or timed injection braking is selected the Drive will use ramp mode to stop on loss of the supply. For injection braking or ramp with d.c. injection modes, d.c. current will be applied to the motor for 1s after it has stopped. (Unless the mains has been reapplied the Drive is likely trip UU before or during the 1s injection period.)

1: Stop Closed Loop

The speed reference is set to zero and the ramps are disabled allowing the Drive to decelerate the motor to a stop under current limit. If the mains is re-applied whilst the motor is stopping any run signal is ignored until the motor has stopped. If the current limit value is set very low the Drive may trip UU before the motor has stopped.

2: Ride through

The Drive detects mains loss when the d.c. Bus voltage falls below a specific level (420V). The Drive then enters a mode where a closed-loop controller attempts to hold the d.c. Bus level at a specific level (400V). This causes the motor to decelerate at a rate that increases as the speed falls. If the mains is re-applied it will force the d.c. Bus voltage above the detection threshold and the Drive will continue to operate normally.

In open-loop mode the output of the mains loss controller is a current demand that is fed to the frequency changing current controller and therefore the gain parameters **4.13** and **4.14** must be set up for optimum control. See parameters **4.13** and **4.14** for set-up details.

In closed-loop mode the output of the mains controller is also a current demand that is fed directly to the current loop. If the settings of **4.13** and **4.14** are suitable for normal operation, they should need no adjustment. See parameter **4.13** and **4.14** for set-up details.

6.04 Sequencing mode selector

↕	OL> 0 ~ 4	↕	4		RW	Uni			P
↕	CL> 0 ~ 4	↕	4						

There are four sequencing modes available as shown below. Any terminal can be used for any of the functions provided in each mode (see sequencing bits below).

Note:

By default the Unidrive uses sequencing mode 4(Wire Proof PLC mode), where the necessary terminals are assigned as required. If any other sequencing mode is enabled the corresponding sequencing bits (parameters 6.30 to 6.34) must also be programmed for particular use (see menu 8).

- 0 CD type interface
- 1 Mentor type interface
- 2 Wire proof mode
- 3 PLC mode
- 4 Wire proof PLC mode

Sequencing mode 0: CD type

Run permit or /Stop	(parameter 6.34)	Run permit or 'not stop' input
Sequencing bit 0	(parameter 6.30)	Run (Latching)
Sequencing bit 1	(parameter 6.31)	Jog
Sequencing bit 2	(parameter 6.32)	Reverse
Sequencing bit 3	(parameter 6.33)	Not used

In this mode it also possible to enable the keypad switches, see parameters **6.11** to **6.13**. If any are enabled the corresponding sequence bit controlled from one of the terminal inputs is ignored. Any jog command received will only be accepted in the ready or Stop states. Run commands override jog commands.

Sequencing mode 1: Mentor type

Run permit or /Stop	(parameter 6.34)	Run permit or 'not stop' input
Sequencing bit 0	(parameter 6.30)	Run forward (latching)
Sequencing bit 1	(parameter 6.31)	Jog forward
Sequencing bit 2	(parameter 6.32)	Run reverse (latching)
Sequencing bit 3	(parameter 6.33)	Jog reverse

The Drive run key can also latch a run state if it is enabled and the fwd/rev key can change direction if it is enabled (unless one of the sequencing bits is being held in which case they have priority). The stop key can also stop the Drive if it is enabled and a run condition is not being forced by the sequencing bits. Any jog command received will only be accepted in the ready or Stop states. Run commands override jog commands.

Sequencing mode 2: Wire Proof Mode

Run permit or /Stop	(parameter 6.34)	Run permit or 'not stop' input
Sequencing bit 0	(parameter 6.30)	Run forward
Sequencing bit 1	(parameter 6.31)	Jog
Sequencing bit 2	(parameter 6.32)	Run reverse
Sequencing bit 3	(parameter 6.33)	Not used

In this mode the run permit bit, and either sequencing bit 0 or 2 (but not both) must be at 1 before the Drive will run. This requires that at least 3 terminals must be made active on the Drive, the Drive enable input and 2 others programmed to control the run permit bit and one of the sequencing bits. If forward and reverse are selected at the same time the Drive will stop after a delay of 60ms.

To jog forward or reverse the jog sequencing bit must be active together with the appropriate direction sequencing bit. Any jog command received will only be accepted in the ready or Stop states. (i.e. the jog input must be active before the run input). Because this mode requires terminals to be held in an active state at all times, the run, stop, and fwd/rev keys on the Drive are not responded to even if they are enabled.

Sequencing mode 3: PLC Mode

Run permit or /Stop	(parameter 6.34)	Not used
Sequencing bit 0	(parameter 6.30)	Run
Sequencing bit 1	(parameter 6.31)	Jog
Sequencing bit 2	(parameter 6.32)	Forward/Reverse
Sequencing bit 3	(parameter 6.33)	Not used

The Drive will respond to the sequencing bits as it finds them in this mode.

To jog forward or reverse the jog sequencing bit must be active together with the run bit and the appropriate direction selected. Any jog command received will only be accepted in the ready or Stop states (i.e. the jog input must be active before the run input). As with mode 2 this mode requires terminals to be held active and therefore the run, stop, and fwd/rev keys on the Drive are not responded to even if they are enabled.

Sequencing mode 4: Wire Proof PLC Mode

Run permit or /Stop	(parameter 6.34)	Not used
Sequencing bit 0	(parameter 6.30)	Run forward
Sequencing bit 1	(parameter 6.31)	Jog
Sequencing bit 2	(parameter 6.32)	Run Reverse
Sequencing bit 3	(parameter 6.33)	Not used

In this mode either sequencing bit 0 or 2 must be at 1 before the Drive will run. All inputs are non latching and when not asserted the Drive will stop immediately using the mode defined by the stopping mode. If both forward and reverse are active then the Drive will stop. If the Drive is operating in open-loop mode there is a 60ms delay after both forwards and reverse are closed before a stop is initiated.

To jog forward or reverse the jog sequencing bit must be active together with the appropriate direction sequencing bit. Any jog command received will only be accepted in the ready or Stop states. Because this mode requires terminals to be held in an active state at all times, the run, stop, and fwd/rev keys on the Drive are not responded to even if they are enabled.

6.05 Minimum jog time

⇅	OL> 0.0 to 25.0	⇨	0.0	seconds	RW	Uni			
⇅	CL> 0.0 to 25.0	⇨	0.0	seconds					

This parameter can be used to define a minimum jog period such that a machine will move by a fixed amount when a jog pulse is received. It is not operational in sequencing modes 2 and 3 because removing the jog input and leaving the run active causes the Drive to select its normal run reference.

6.06 OL> Injection braking level

⇅	0.0 to Maximum current limit	⇨	100.0	%	RW	Uni			
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In open loop drives this parameter defines the current level used for injection braking.

(For definition of maximum current limit see menu 4.)

6.07 OL> Injection braking time

⇅	0.0 to 25.0	⇨	5.0	seconds	RW	Uni			
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This parameter defines the low frequency braking time for phase 1 of stopping during a stop using stopping mode 4 in open loop drives (see parameter **6.01**).

6.08 Hold zero speed enable

⇅	OL> 0 ~ 1	⇨	0		RW	Bit			
⇅	VT> 0 ~ 1	⇨	0						
⇅	SV> 0 ~ 1	⇨	1						

When this bit is set the Drive will hold torque at standstill when not in the running state rather than disabling the output bridge. The Drive status will be 'StoP' when the Drive is at standstill rather than 'rdy'.

6.09 Synchronize to a spinning motor

↕	OL> 0 ~ 1	↔	0		RW	Bit			
↕	CL> 0 ~ 1	↔	1						

Open Loop

The Drive performs a sequence of operations to determine the motor frequency before attempting to run the motor with full voltage applied. These tests are carried out with a voltage defined by parameter **6.37**. The frequency is first set to maximum frequency in the direction in which the Drive last ran. The frequency is ramped to zero at a rate defined by parameter **6.10**. If the machine frequency is not detected, the frequency is set to maximum in the other direction and the test is repeated. If the frequency is detected at any point the test is stopped, the voltage is ramped up at a rate defined by parameter **6.37** and then the Drive runs normally. If the frequency is not detected the Drive starts from 0Hz. If the Drive is powered down the previous direction of operation is not stored, and so the test begins in the forward direction.

It is important that if spinning start is selected then the Voltage Mode, parameter **5.14**, must be set to 'Fd' and not left in the default value of 'Ur_I' (value 1).

Closed Loop

The ramp output is set to the actual motor speed when the Drive is commanded to start.

6.10 OL> Spinning motor ramp rate

↕	0 to 25.0	↔	5.0	s/100Hz (seconds per 100Hz)	RW	Uni			
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This parameter defines the rate at which the frequency is changed when trying to synchronize the motor speed. Motors and loads with very low inertias will require this parameter to be set low to ensure the speed is detected, while motors and loads with large inertias may require the parameter to be increased to prevent over voltage trips.

6.11 Keypad RUN key enable

↕	OL> 0 to 1	↔	0		RW	Bit			
↕	CL> 0 to 1	↔	0						

This parameter enables the Run switch on the Drive. In keypad mode this parameter has no effect because this key is automatically enabled.

6.12 Keypad STOP key enable

⇅	OL> 0 to 1	⇒	0		RW	Bit			
⇅	CL> 0 to 1	⇒	0						

This parameter enables the Stop switch on the Drive. In keypad mode this parameter has no effect because this key is automatically enabled.

6.13 Keypad Fwd/Rev key enable

⇅	OL> 0 to 1	⇒	0		RW	Bit			
⇅	CL> 0 to 1	⇒	0						

This parameter enables the Fwd/Rev switch on the Drive. In keypad mode the forward/reverse key is not active unless this parameter is set.

6.15 Drive enable

⇅	OL> 0 to 1	⇒	1		RW	Bit			
⇅	CL> 0 to 1	⇒	1						

Setting this parameter to 0 will disable the Drive. It must be at 1 for the Drive to run.

6.16 Electricity cost per kWh.

⇅	OL> 0.0 to 600.0	⇒	0	Currency/ kWh	RW	Uni			
⇅	CL> 0.0 to 600.0	⇒	0						

When this parameter is set up correctly for the local currency, parameter **6.26** will give an instantaneous read out of running cost.

6.17 Power consumption meter reset

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

Used to reset parameters **6.24** and **6.25** back to zero.

6.18 Time interval between filter changes

⇅	OL> 0 to 30,000	⇒	0	Hours	RW	Uni			
⇅	CL> 0 to 30,000	⇒	0						

If the user wishes the Drive to measure the running time between filter changes on a machine and indicate to the user when a change is due, this parameter should be set up to define the running time interval between the changes.

6.19 Filter change required/done

⇅	OL> 0 ~ 1	⇒	1		RW	Bit			
⇅	CL> 0 ~ 1	⇒	1						

During the running of the Drive, parameter **6.27** is reduced until such a time that it reaches 0, at which point this parameter will be set to 1 to inform the user that a filter change is required. When the user has changed the filter, resetting this parameter to 0 will indicate to the Drive that the change has been done at which time it will reload parameter **6.27** with the value of parameter **6.18**.

Parameter **6.27** can be updated with the value of parameter **6.18** at any time by setting and clearing this parameter manually.

6.20 Time interval between lubrication

⇅	OL> 0 to 30,000	⇒	0	Hours	RW	Uni			
⇅	CL> 0 to 30,000	⇒	0						

If the user wishes the Drive to measure the running time between lubrication requirements on a machine and indicate to the user when lubrication is due, this parameter should be set up to define the running time interval between lubrication.

6.21 Lubrication required/done

⇅	OL> 0 ~ 1	⇒	1		RW	Bit			
⇅	CL> 0 ~ 1	⇒	1						

During the running of the Drive, parameter **6.28** is reduced until such a time that it reaches 0 at which point this parameter will be set to 1 to inform the user that lubrication is required. When the user has lubricated the machine, resetting this parameter to 0 will indicate to the Drive that the lubrication has been done at which time it will reload parameter **6.28** with the value of parameter **6.20**.

Parameter **6.28** can be updated with the value of parameter **6.20** at any time by setting and clearing this parameter manually.

6.22 Run time log

⇅	OL> 0.000 to 30.365	⇒	0	Years.days	RO	Uni		S	P
⇅	CL> 0.000 to 30.365	⇒	0	Years.days					

Together with the next parameter the Drive records the amount of time the Drive has been running since it left the manufacturing plant.

6.23 Run time log

⇅	OL> 0.00 to 23.59	⇅	0	Hours.Minutes	RO	Uni		S	P
⇅	CL> 0.00 to 23.59	⇅	0	Hours.Minutes					

Together with the previous parameter the Drive records the amount of time the Drive has been running since it left the manufacturing plant.

6.24 Power meter

⇅	OL> 0 to 30,000	⇅		Mwh	RO	Uni		S	P
⇅	CL> 0 to 30,000	⇅		MWh					

Drive power consumption meter. The meter increments when the Drive is monitoring and decrements when the Drive is regenerating. This can be reset to zero by setting parameter **6.17**.

6.25 Power meter

⇅	OL> 0.0 to 999.9	⇅		kWh	RO	Uni		S	P
⇅	CL> 0.0 to 999.9	⇅		kWh					

Drive power consumption meter. The meter increments when the Drive is monitoring and decrements when the Drive is regenerating. This can be reset to zero by setting parameter **6.17**.

6.26 Running cost

⇅	OL> 0 to 32000	⇅		Currency/	RO	Uni		S	P
⇅	CL> 0 to 32000	⇅		Hour					

Instantaneous read out of the cost/hour of running the Drive. This requires parameter **6.16** to be set up correctly. The displayed cost needs to be scaled depending on the Drive size as follows:

- Size 1 and 2 Multiply display by 1.
- Size 3 and 4 Multiply display by 10.
- Size 5 Multiply display by 100.

For example if the cost/kWh = 123.4 and a Size 3 drive is giving 10kW the running cost display (**6.26**) will show 123, this must be then multiplied by ten to give the actual running cost of 1230/hour.

6.27 Time before filter change due

⇅	OL> 0 to 30,000	⇅		Hours	RO	Uni		S	P
⇅	CL> 0 to 30,000	⇅		Hours					

This parameter indicates the running time remaining before the Drive will indicate to the user to change a filter on the machine. See parameter **6.19**.

6.28 Time before lubrication due

⇅	OL> 0 to 30,000	⇒		Hours	RO	Uni		S	P
⇅	CL> 0 to 30,000	⇒		Hours					

This parameter indicates the running time remaining before the Drive will indicate to the user to lubricate the machine. See parameter **6.21**.

6.29 Hardware enable

⇅	OL> 0 ~ 1	⇒			RO	Bit			P
⇅	CL> 0 ~ 1	⇒							

If parameter **8.09** is set to 1, terminal 30 becomes a drive enable input and this parameter will be set to 1 when the terminal is active. If parameter **8.09** is set to 0 then this parameter is always at 1.

6.30 Sequencing bit 0

6.31 Sequencing bit 1

6.32 Sequencing bit 2

6.33 Sequencing bit 3

6.34 Run permit or/Stop

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

The Drive sequencer uses these bits as inputs rather than looking at terminals directly. This allows the customer to define the use of each drive terminal according to each applications needs.

Although these parameters are R/W, they are volatile and are not stored on power down. Every time the Drive powers up they will be reset to 0.

parameter 6.30	Sequencing bit 0
parameter 6.31	Sequencing bit 1
parameter 6.32	Sequencing bit 2
parameter 6.33	Sequencing bit 3
parameter 6.34	Run permit or /Stop

6.35	Limit switch 1
6.36	Limit switch 2

⇅	OL> 0 ~ 1	⇒				RO	Bit			
⇅	CL> 0 ~ 1	⇒								

These parameters should be used for stopping drives at each end of a traverse of some kind.

- parameter **6.35** Limit switch 1 (Forward only)
- parameter **6.36** Limit switch 2 (Reverse only)

Parameter **6.35** if set to 1 will stop the Drive when it is operating in forward direction and **6.36** will stop the Drive when it is operating in the reverse direction. Input terminals should be routed to control these parameters if the feature is required. In open-loop mode the stop will be initiated within 5.5ms [7.4ms] of the terminal being made active. In closed-loop modes the maximum software delay is only 345us [460us]. The input hardware also includes a delay of approximately 500us, therefore the total delay from a change at the input to initiating a stop is less than 1ms. (To achieve a fast response and allow full programmability the Drive must monitor the limit switch inputs in the speed controller task as well as the slow user task. If the limit switch for the opposite direction of rotation to the actual direction of rotation is activated it will cause a momentary reduction of speed, but the motor will not stop. This should never happen in practice anyway.)

6.37	OL>	Spinning motor start-voltage
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⇅	0 to 100%	⇒	25.0	% of normal voltage	RW	Uni			
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Defines the voltage applied during a spin start as the % of voltage that would be applied in normal operation. Setting this value too high causes the Drive to current limit, setting it too low will give problems detecting low motor speeds.

6.38	OL>	Spinning motor voltage ramp
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⇅	0 to 2.5	⇒	0.25	seconds	RW	Uni			
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When the software has detected the motor speed it ramps the Drives output voltage from the level programmed in parameter **6.37** to its normal operating voltage. This parameter determines the time interval for this change in voltage. Setting the time too short will cause excessive current transients in the machine as the voltage rises, while setting it too long may cause the Drive to lose synchronisation if the motor is decelerating quite quickly.

Unidrive has three analog inputs and two analog outputs. All inputs and outputs can be configured for voltage mode operation over $\pm 10V$, or current loop mode with a maximum current of 20mA. In addition analog input three can be configured as a motor thermistor input. Both the analog inputs and outputs have a normal sample rate of 5.5ms for 3, 6 and 12kHz, and 7.4ms for 4.5 and 9kHz, (abbreviated as a sample rate of 5.5ms [7.4ms]).

For information on obtaining faster update rates see the following:

Frequency control - menu 1

Speed control - menu 1

Torque control - parameter **4.08**

Frequency/speed/torque outputs - parameter **7.30**

Analog input 1 uses a v to f converter to convert from analog to digital values. This input has a resolution of 12 bits plus sign, except for speed control via parameters **1.36** and **1.37** where the long term resolution is effectively infinite. This is because the integral term within the speed loop holds the difference in the pulse count from the v to f converter and the motor encoder.

Analog inputs 2 and 3 use A to D converters to convert from analog to digital values. These inputs have a resolution of 10 bits plus sign.

Name	Terminal Number	Direction	Mode
Ain 1	5 positive, 6 negative	Input	Voltage / Current
Ain 2	7	Input	Voltage / Current
Ain 3	8	Input	Voltage / Current or Thermistor
Aout 1	9	Output	Voltage / Current
Aout 2	10	Output	Voltage / Current

7.1 Parameter descriptions

7.01	Analog input 1
7.02	Analog input 2
7.03	Analog input 3

⇅	OL> ±100.0	⇅		%	RO	Bi			P
⇅	CL> ±100.0	⇅		%					

These parameters display the level of the analog signal present at their respective terminals. Parameter range is $\pm 100.0\%$ for voltage inputs or 0 - 100.0% for any of the current input modes.

7.04	Heatsink temperature
-------------	-----------------------------

⇅	OL> 0 to 100	⇅		°C	RO	Uni			P
⇅	CL> 0 to 100	⇅							

This parameter displays the temperature currently being measured on the heat sink. If this level reaches 94°C the Drive will trip and will not allow a reset until the temperature falls below 90°C. This parameter is updated even when the Drive is tripped.

7.05	Control board temperature
-------------	----------------------------------

⇅	OL> 0 to 100	⇅		°C	RO	Uni			P
⇅	CL> 0 to 100	⇅							

The ambient temperature around the control board is displayed here. If this measurement reaches 95°C the Drive will trip and will not allow a reset until the temperature falls below 90°C. This parameter is updated even when the Drive is tripped.

7.06 Analog input 1 mode selector

⇅	OL> 0 to 8	⇒	VOLt		RW	Txt			
⇅	CL> 0 to 8	⇒	VOLt						

This analog input can be set up for different types of control signals via this input mode parameter. The available modes are shown below:

- 0 VOLt Voltage input
- 1 0 - 20 0 - 20 mA
- 2 20 - 0 20 - 0 mA
- 3 4 - 20.tr 4 - 20 mA, Trip on loss
- 4 20 - 4.tr 20 - 4 mA, Trip on loss
- 5 4 - 20.Lo 4 - 20 mA, Min (or low) speed on loss
- 6 20 - 4.Lo 20 - 4 mA, Min (or low) speed on loss
- 7 4 - 20.Pr 4 - 20 mA, Previous speed on loss
- 8 20 - 4.Pr 20 - 4 mA, Previous speed on loss

In 4-20mA or 20-4mA modes the threshold for current loop loss is 3mA.

7.07 Analog input 1 offset trim

⇅	OL> ±10.000	⇒	0	%	RW	Bi			P
⇅	CL> ±10.000	⇒	0	%					

This parameter can be used to trim out any offset in the users reference signal.

7.08 Analog input 1 scaling

⇅	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

This parameter can be used to scale analog input 1 if so desired. However in most cases it is not necessary as each input is automatically scaled such that for 100.0% input the destination parameter will be at maximum.

7.09 Analog input 1 invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This parameter can be used to invert analog input 1 reference if so desired.

7.10 Analog input 1 destination parameter

⇅	OL> 0.00 to 20.50	⇒	01.36	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	01.36						

The parameter which analog input 1 is required to control is programmed here. Only a non-bit parameter which is not protected can be controlled by an analog input. If a non-valid parameter is programmed then the input is not routed anywhere. After modification of this parameter the destination is only changed when a reset is performed (or the drive is powered down and then up again)

7.11 Analog input 2 mode selector

⇅	OL> 0 to 8	⇒	VOLt		RW	Txt			
⇅	CL> 0 to 8	⇒	VOLt						

This analog input can be set up for different types of control signals via this input mode parameter. The available modes are shown below:

0	VOLt	Voltage input
1	0 - 20	0 - 20 mA
2	20 - 0	20 - 0 mA
3	4 - 20.tr	4 - 20 mA, Trip on loss
4	20 - 4.tr	20 - 4 mA, Trip on loss
5	4 - 20.Lo	4 - 20 mA, Min (or low) speed on loss
6	20 - 4.Lo	20 - 4 mA, Min (or low) speed on loss
7	4 - 20.Pr	4 - 20 mA, Previous speed on loss
8	20 - 4.Pr	20 - 4 mA, Previous speed on loss

In 4-20mA or 20-4mA modes the threshold for current loop loss is 3mA.

7.12 Analog input 2 scaling

⇅	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

This parameter can be used to scale analog input 2 if so desired. However in most cases it is not necessary as each input is automatically scaled such that for 100.0% input the destination parameter will be at maximum.

7.13 Analog input 2 invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This parameter can be used to invert analog input 2 reference if so desired.

7.14 Analog input 2 destination parameter

⇅	OL> 0.00 to 20.50	⇒	01.37	Menu. Parameter	RW	Uni	R	P
⇅	CL> 0.00 to 20.50	⇒	01.37					

The parameter which analog input 2 is required to control is programmed here. Only a non-bit parameter which is not protected can be controlled by an analog input. If a non-valid parameter is programmed then the input is not routed anywhere. After modification of this parameter the destination is only changed when a reset is performed (or the drive is powered down and then up again)

7.15 Analog input 3 mode selector

EUR >

⇅	OL> 0 ~ 10	⇒	th		RW	Txt		
⇅	CL> 0 ~ 10	⇒	th					

USA >

⇅	OL> 0 ~ 10	⇒	Volt		RW	Txt		
⇅	CL> 0 ~ 10	⇒	Volt					

This analog input can be set up for different types of control signals via this input mode parameter. The available modes are shown below:

0	VOLt	Voltage input
1	0 - 20	0 - 20 mA
2	20 - 0	20 - 0 mA
3	4 - 20.tr	4 - 20 mA, Trip on loss
4	20 - 4.tr	20 - 4 mA, Trip on loss
5	4 - 20.Lo	4 - 20 mA, Min (or low) speed on loss
6	20 - 4.Lo	20 - 4 mA, Min (or low) speed on loss
7	4 - 20.Pr	4 - 20 mA, Previous speed on loss
8	20 - 4.Pr	20 - 4 mA, Previous speed on loss
9	th.SC	Thermistor with trip on short circuit detection (Ain 3 only)
10	th	Thermistor without short circuit detection (Ain 3 only)

Note:

Modes 9 and 10 are only available on analog input 3.

In 4-20mA or 20-4mA modes the threshold for current loop loss is 3mA.

7.16 Analog input 3 scaling

⇅	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

This parameter can be used to scale analog input 3 if so desired. However in most cases it is not necessary as each input is automatically scaled such that for 100.0% input the destination parameter will be at maximum.

7.17 Analog input 3 invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This parameter can be used to invert analog input 3 reference if so desired.

7.18 Analog input 3 destination parameter

⇅	OL> 0.00 to 20.50	⇒	00.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	00.00						

The parameter which analog input 3 is required to control is programmed here. Only a non-bit parameter which is not protected can be controlled by an analog input. If a non-valid parameter is programmed then the input is not routed anywhere. After modification of this parameter the destination is only changed when a reset is performed (or the drive is powered down and then up again)

7.19 Analog output 1 source parameter

⇅	OL> 0.00 to 20.50	⇒	5.01	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	3.02						

The parameter which is desired to be read via the analog output should be programmed here. Only a non bit parameter can be programmed. If a non valid parameter is programmed the output will remain at the minimum level. After modification of this parameter the source is only changed when a reset is performed (or the drive is powered down and then up again).

7.20 Analog output 1 scaling

⇅	OL> 0.000 to 4.000	⇒	1.000	Menu. Parameter	RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

This parameter is used to scale an output if so desired. Automatic scaling is provided such that when the source parameter is at its maximum value the analog output will be at a maximum.

7.21 Analog output 1 mode selector

⇅	OL> 0 to 2	⇒	VOLt		RW	Txt			P
⇅	CL> 0 to 2	⇒	VOLt						

This parameter can configure the analog output in three different ways.

- 0 VOLt Output range $\pm 10V$.
- 1 0 - 20 Output range 0 - 20 mA.
- 2 4 - 20 Output range 4 - 20 mA.

In modes 1 and 2 negative values in a source parameter will be treated as zero.

7.22 Analog output 2 source parameter

⇅	OL> 0.00 to 20.50	⇒	4.02	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	4.02						

The parameter which is desired to be read via the analog output should be programmed here. Only a non bit parameter can be programmed. If a non valid parameter is programmed the output will remain at the minimum level. After modification of this parameter the source is only changed when a reset is performed (or the drive is powered down and then up again).

7.23 Analog output 2 scaling

⇅	OL> 0.000 to 4.000	⇒	1.000	Menu. Parameter	RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

This parameter is used to scale an output if so desired. Automatic scaling is provided such that when the source parameter is at its maximum value the analog output will be at a maximum.

7.24 Analog output 2 mode selector

⇅	OL> 0 to 2	⇒	VOLt		RW	Txt			P
⇅	CL> 0 to 2	⇒	VOLt						

This parameter can configure the analog output in three different ways.

- 0 VOLt Output range $\pm 10V$.
- 1 0 - 20 Output range 0 - 20 mA.
- 2 4 - 20 Output range 4 - 20 mA.

In modes 1 and 2 negative values in a source parameter will be treated as zero.

7.25 Calibrate analog input1 full scale *enable*

⇅	OL> 0 to 1	⇒	0		RW	Bit			
⇅	CL> 0 to 1	⇒	0						

Setting this bit will cause the Drive to adjust its own scale factor such that the required maximum is reached at the input level at the time calibration takes place. This parameter is cleared by the software when the calibration is complete.

The input voltage or current when calibration is called for must be greater than 25% of the Drives normal full scale input (2.5V or 5mA). Once a calibration has been done the result will be used until the calibration is redone or cancelled (the calibration result is stored on power down). To cancel a previously set-up calibration such that the Drive has the standard full scale value, a calibration should be called for with less than 15% of the Drives normal full scale input applied.

7.26 CL> V/F sample time

⇅	0 to 5.0	⇒	4.0	ms	RW	Uni			
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This parameter affects the low speed performance and the speed of response to a changing speed demand. Low values give good dynamic response but noisy operation at low speeds and high values give smooth low speed operation but a poorer dynamic response. A compromise must be made between low speed operation and good dynamic response. This parameter is only used in the special case described under analog input modes where the destination is parameter **1.36**, **1.37**, or **3.19**.

7.27 Analog input 1 current loss *indicator*

7.28 Analog input 2 current loss *indicator*

7.29 Analog input 3 current loss *indicator*

⇅	OL> 0 to 1	⇒			RO	Bit			
⇅	CL> 0 to 1	⇒							

If analog input 1, 2, or 3 is programmed for 4-20mA or 20-4mA current loop, with any of the hold, trip, or min on loss modes, then if the current is less than 3mA the current loss bit will be set. In any other input mode, or if the current is greater than 3mA then the bit will be cleared.

7.30 Analog output short cut enable

↕	OL> 0 to 1	⇒	0		RW	Bit			
↕	CL> 0 to 1	⇒	0						

The analog outputs are controlled with a 5.5 or 7ms sample rate. To allow the Drive speed and current loops to be set-up, speed (closed-loop) or frequency (open-loop), and the torque producing current can be accessed via the analog outputs at a sample rate of 345µs or 460µs. This function is enabled by setting parameter **7.30**. The scalings are as follows:

Frequency: If the maximum frequency is between -100Hz and +100Hz then ±10V corresponds to ±125Hz, otherwise ±10V corresponds to ±1000Hz.

Speed: The speed signal is derived directly from the encoder/resolver feedback.

For speeds up to 3,000rpm 5.5V = 3,000rpm

For 3,000rpm < speed < 6,000rpm 5.5V = 6,000rpm

For 6,000rpm < speed < 12,000rpm 5.5V = 12,000rpm

For 12,000rpm < speed < 24,000rpm 5.5V = 24,000rpm

For 24,000rpm < speed < 30,000rpm 5.5V = 30,000rpm

(Sincos at high speeds may overflow)

Torque producing current: ±10V corresponds to ±full scale current for the Drive. Full scale current ≅ 225% Drive rated continuous current (Pr**11.32**).

7.31 UD78 large option module fitted indicator

↕	OL> 0 to 1	⇒			RO	Bit			P
↕	CL> 0 to 1	⇒							

If a UD78 large option module is fitted to the Drive this bit is set to 1, if not it is 0. The UD78 has the following features:

High precision analog input

If the UD78 is fitted AN1 on the Drive no longer functions, but is replaced by the input on this module. It will function in the same way as AN1 on the Drive. It has a fixed calibration level, such that 9.8V gives full scale, or may be calibrated with a user defined voltage by setting parameter **7.25**. The UD78 should not be removed whilst the Drive is powered-up. However if it is removed, either the Drive processor will detect a bus error giving a hardware trip, or if the processor is able to continue running, an AN1.DIS trip will be given. This can only be reset after the Drive has been powered-down and up again.

Auxiliary power supply

The Drive control electronics can be supplied from a 24V power supply via the UD78. The auxiliary supply is only used when the main drive supply voltage falls below approximately 230V a.c. (320V on the d.c. bus). The auxiliary supply is then used until the main supply voltage rises to approximately 320V (450V on the DC bus), at which point the Drive will return to using its own switch mode power supply. When the auxiliary supply becomes the active supply all power-down parameters are saved. Until the main supply rises again to the point where the main switch mode power supply is used parameters cannot be saved and the Drive cannot be enabled. When the auxiliary supply is being used the alarm code LO.PS is displayed. There is a 5s delay when the Drive is initially powered-up via a UD78 to allow all the electronics to stabilise. There is also a 5s delay when the mains power is applied to a drive running off a UD78 supply before the Drive can be enabled.

ANSI comms

An ANSI comms interface is provided with RS485 hardware only.

7.32 IGBT Junction temperature

⇅	OL> 0 to 150	⇒		°C	RO	Uni			P
⇅	CL> 0 to 150	⇒		°C					

This parameter displays the calculated junction temperature IGBT's within the Drive. The temperature is calculated based on an ambient of 40°C. Therefore the minimum value of this parameter is 40°C when thermal modelling is enabled. When thermal modelling is disabled this parameter is held at 0.

Unidrive has seven digital input / output terminals, of which three are bi-directional, and four input only. Terminals F1 to F6 are fully programmable for source, destination and polarity. When in output mode F1 to F3 can have open collector, or active pull-up outputs. The Enable/Trip input is a dedicated input which can be used either as an enable input or as an external trip input. If both features are required then terminal 30 should be used as the Drive enable and one of the other inputs should be programmed to control the External trip bit 10.32 (an inversion on the input logic will be required to prevent a trip when the input terminal is active). Note that in Regen mode the functions of terminals F1, F2 and F5 are fixed and can not be changed by the user. Digital inputs and outputs are updated every 8ms. If any changes of source or destination are made no action is taken by the Drive until the stop/reset key is pressed or the Drive is powered-down and up again.

Name	'F' Number	Terminal Number	Direction
Dio 1	F1	24	Input / Output
Dio 2	F2	25	Input / Output
Dio 3	F3	26	Input / Output
Din 1	F4	27	Input
Din 2	F5	28	Input
Din 3	F6	29	Input
Enable / Trip	F7	30	Input

The Drive logic sense can be changed from Negative logic (default) to Positive logic using parameter **8.27**.

Please note only the logic sense of digital inputs change. The sense of digital outputs must be changed independantly using the invert parameters if required. Please see the table below for detail:

Logic sense	Input		Output	
	0	1	0	1
Negative	24V	0V	24V	0V
Positive	0V	24V	24V	0V

8.1 Parameter descriptions

8.01	Digital input/output F1 state indicator
8.02	Digital input/output F2 state indicator
8.03	Digital input/output F3 state indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

These parameters indicate the input state of the terminals if they are set up as inputs, or the output state if they are set up as outputs. For inputs 0 = in-active, 1 = active; and for outputs a 1 will cause the terminal to sink current, and a 0 will cause the terminal to drive current.

8.04	Digital input F4 state indicator
8.05	Digital input F5 state indicator
8.06	Digital input F6 state indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

These parameters indicate the state of inputs F4 to F6, 0 = in-active, 1 = active.

8.07	External trip/inhibit input F7 state indicator
-------------	---

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter indicates the state of the Enable/Trip input terminal, 0 = open, 1 = closed.

8.08	Status relay indicator
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⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter indicates the state of the Drive relay, 0 = de-energised, 1 = energised.

8.09 External trip/inhibit input F7 mode select

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	1						

Terminal 30 can be configured as either a drive enable input (inhibit = 1) or an external trip (Et = 0) input via this parameter.

This parameter should be set up for the required input function. When the terminal is being used as an external trip, the Hardware enable parameter **6.29** is set to 1.

8.10 F1 destination or source parameter

⇕	OL> 0.00 to 20.50	⇒	10.06	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	10.03						

This parameter should be programmed with either:

1. The destination parameter for when terminal 24 is an input
2. The source parameter for when terminal 24 is an output.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed:

1. An input is not routed anywhere
2. An output will drive current

After modification of this parameter the source / destination is only changed when a reset is performed (or the drive is powered down and then up again).

8.11 F1 invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 24.

Setting this parameter to a 1 causes the input sense to the destination parameter to be inverted or the output sense from the source parameter to be inverted.

8.12 F1 output enable

⇕	OL> 0 ~ 1	⇒	1		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	1						

This parameter is for enabling terminal 24 as an output.

A setting of 1 is for an output and a setting of 0 is for an input.

8.13 F2 destination or source parameter

⇕	OL> 0.00 to 20.50	⇒	10.33	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	10.33						

This parameter should be programmed with either:

1. The destination parameter for when terminal 25 is an input
2. The source parameter for when terminal 25 is an output.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed:

1. An input is not routed anywhere
2. An output will drive current

After modification of this parameter the source / destination is only changed when a reset is performed (or the drive is powered down and then up again).

8.14 F2 invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 25.

Setting this parameter to a 1 causes the input sense to the destination parameter to be inverted or the output sense from the source parameter to be inverted.

8.15 F2 output enable

⇕	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	0						

This parameter is for enabling terminal 25 as an output.

A setting of 1 is for an output and a setting of 0 is for an input.

8.16 F3 destination or source parameter

⇕	OL> 0.00 to 20.50	⇒	6.31	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	6.31						

This parameter should be programmed with either:

1. The destination parameter for when terminal 26 is an input
2. The source parameter for when terminal 26 is an output.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed:

1. An input is not routed anywhere
2. An output will drive current

After modification of this parameter the source / destination is only changed when a reset is performed (or the drive is powered down and then up again).

8.17 F3 invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 26.

Setting this parameter to a 1 causes the input sense to the destination parameter to be inverted or the output sense from the source parameter to be inverted.

8.18 F3 output enable

⇕	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	0						

This parameter is for enabling terminal 26 as an output.

A setting of 1 is for an output and a setting of 0 is for an input.

8.19 F4 destination parameter

⇕	OL> 0.00 to 20.50	⇒	6.30	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	6.30						

This parameter should be programmed with the destination parameter for terminal 27.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the input is not routed anywhere

After modification of this parameter the destination is only changed when a reset is performed (or the drive is powered down and then up again).

8.20 F4 invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 27.

Setting this parameter to a 1 causes the input sense to the destination to be inverted.

8.21 F5 destination parameter

⇕	OL> 0.00 to 20.50	⇒	6.32	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	6.32						

This parameter should be programmed with the destination parameter for terminal 28.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the input is not routed anywhere

After modification of this parameter the destination is only changed when a reset is performed (or the drive is powered down and then up again).

8.22 F5 invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 28.

Setting this parameter to a 1 causes the input sense to the destination to be inverted.

8.23 F6 destination parameter

⇕	OL> 0.00 to 20.50	⇒	1.41	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	1.41						

This parameter should be programmed with the destination parameter for terminal 29.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the input is not routed anywhere

After modification of this parameter the destination is only changed when a reset is performed (or the drive is powered down and then up again).

8.24 F6 invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 29.

Setting this parameter to a 1 causes the input sense to the destination to be inverted.

8.25 Relay source

⇅	OL> 0.00 to 20.50	⇒	10.01	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	10.01						

This parameter should be programmed with the source parameter for the status relay on terminals 1 and 2.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the output will be open.

After modification of this parameter the source is only changed when a reset is performed (or the drive is powered down and then up again).

8.26 Status relay invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminals 1 and 2.

Setting this parameter to a 1 causes the output sense from the source parameter to be inverted.

8.27 Positive logic select

⇅	OL> 0 ~ 1	⇒	0		RW	Bit		R	P
⇅	CL> 0 ~ 1	⇒	0						

This parameter changes the logic polarity on digital inputs. In its default state the input polarity is negative logic which requires digital inputs to be pulled low (< 5V) to activate the input. When this parameter is set to 1 the input polarity is positive logic and digital inputs must be driven high (> 15V) to activate the input. Note that the Drive must be disabled and then reset before changing this parameter will take effect.

Please see note at the beginning of this menu.

Warning

If positive logic is selected and the +24v from the Drive supply is overloaded causing the Drive status to display 'OP.OULd', use of the same +24v for the external trip control may cause inconsistent results. The Drive may trip on either 'OP.OULd' or 'Et' dependant upon which condition is detected first.

8.28 Open collector outputs select

⇅	OL> 0 ~ 1	⇅	0		RW	Bit		R	P
⇅	CL> 0 ~ 1	⇅	0						

The high side driving on the three digital outputs can be disabled by setting this parameter. This allows outputs of a number of drives to be connected together in a wired OR configuration.

Note

The wired OR configuration is only possible if Negative logic is being used.

9

Menu 9 Programmable logic

This menu contains two programmable logic functions which can each be used to generate a signal or action which cannot be achieved with the Drives standard parameter set. An example of such a case might be in an application where a stall signal is required. The inputs could be parameters **10.03** (Zero speed) and **10.09** (Current limit) with an appropriate delay programmed to ensure that the output signal does not change through momentary impulses on the input signals. Menu 9 also contains a programmable motorised pot which can be used to control any unprotected non-bit variable within the Drive. There is also a binary sum block which calculates the binary weighted sum of three bits. This block is useful for applications such as changing torque mode from digital inputs. Viewing the block diagram of Menu 9 will help in understanding the functions of the following parameters.

9.1 Parameter descriptions

9.01	Prog. logic function 1 output <i>indicator</i>						
9.02	Prog. logic function 2 output <i>indicator</i>						

⇅	OL> 0 ~ 1	⇒			RO	Bit			P
⇅	CL> 0 ~ 1	⇒							

These parameters indicate the output state of the two programmable logic functions. The output of a logic function can be routed to a terminal, if required, by setting the appropriate digital output source in menu 8 to output one of these parameters.

9.03	Motorized pot output <i>indicator</i>						
-------------	--	--	--	--	--	--	--

⇅	OL> ±100.0	⇒	±100.0	%	RO		S		P
⇅	CL> ±100.0	⇒	±100.0	%					

Indicates the level of the motorised pot prior to scaling. If parameter **9.21** is set to 1 this parameter is set to 0 at power up.

9.04	Prog. logic function 1 input 1 source parameter						
-------------	--	--	--	--	--	--	--

⇅	OL> 0.00 to 20.50	⇒	00.00	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	00.00						

This source parameter defines the parameter to be sourced into logic input 1 of programmable logic function 1.

Only a bit parameter can be programmed as an input.

If both inputs to a logic function are non valid then the logic output will always be a 0. If only one of the inputs is non valid then the input is taken as a 1 so that the valid input passes through the function.

9.05 Prog. logic function 1 input 1 invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of input 1 of logic function 1. Setting this parameter to a 1 causes the input sense from the source parameter to be inverted.

9.06 Prog. logic function 1 input 2 source parameter

⇅	OL> 0.00 to 20.50	⇒	00.00	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	00.00						

This source parameter defines the parameter to be sourced into logic input 2 of programmable logic function 1.

Only a bit parameter can be programmed as an input.

If both inputs to a logic function are non valid then the logic output will always be a 0. If only one of the inputs is non valid then the input is taken as a 1 so that the valid input passes through the function.

9.07 Prog. logic function 1 input 2 invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of input 2 of logic function 1. Setting this parameter to a 1 causes the input sense from the source parameter to be inverted.

9.08 Prog. logic function 1 output invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of the logic output from logic function 1. Setting this parameter to a 1 causes the the output from the logic to be inverted.

9.09 Prog. logic function 1 delay

⇅	OL> 0 ~ 25.0	⇒	0	seconds	RW	Uni			
⇅	CL> 0 ~ 25.0	⇒	0						

This parameter introduces a delay into the switching of the logic output of logic function 1. The delay is on an output transition from a 0 to a 1 **only**, such that there is a delay on the output becoming active but not on the output becoming inactive. The delay parameters are primarily there to ensure that the output condition is a genuine condition (by being present for a period of time) and not just a temporary one.

9.10 Prog. logic function 1 destination parameter

⇕	OL> 0.00 to 20.50	⇒	00.00	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	00.00						

This destination parameter defines the parameter to be controlled by logic function 1. Only a bit parameter can be programmed as the destination.

If a non valid parameter is programmed the output is not routed anywhere.

9.14 Prog. logic function 2 input 1 source parameter

⇕	OL> 0.00 to 20.50	⇒	00.00	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	00.00						

This source parameter defines the parameter to be sourced into logic input 1 of programmable logic function 2.

Only a bit parameter can be programmed as an input.

If both inputs to a logic function are non valid then the logic output will always be a 0. If only one of the inputs is non valid then the input is taken as a 1 so that the valid input passes through the function.

9.15 Prog. logic function 2 input 1 invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of input 1 of logic function 2. Setting this parameter to a 1 causes the input sense from the source parameter to be inverted.

9.16 Prog. logic function 2 input 2 source parameter

⇕	OL> 0.00 to 20.50	⇒	00.00	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	00.00						

This source parameter defines the parameter to be sourced into logic input 2 of programmable logic function 2.

Only a bit parameter can be programmed as an input.

If both inputs to a logic function are non valid then the logic output will always be a 0. If only one of the inputs is non valid then the input is taken as a 1 so that the valid input passes through the function.

9.17 Prog. logic function 2 input 2 invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of input 2 of logic function 2. Setting this parameter to a 1 causes the input sense from the source parameter to be inverted.

9.18 Prog. logic function 2 output invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of input 2 of logic function 2. Setting this parameter to a 1 causes the input sense from the source parameter to be inverted.

9.19 Prog. logic function 2 delay

⇕	OL> 0.0 to 25.0	⇒	0.0	seconds	RW	Uni			
⇕	CL> 0.0 to 25.0	⇒	0.0						

This parameter introduces a delay into the switching of the logic output of logic function 2. The delay is on an output transition from a 0 to a 1 only, such that there is a delay on the output becoming active but not on the output becoming inactive. The delay parameters are primarily there to ensure that the output condition is a genuine condition (by being present for a period of time) and not just a temporary one.

9.20 Prog. logic function 2 destination parameter

⇕	OL> 0.00 to 20.50	⇒	00.00	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	00.00						

This destination parameter defines the parameter to be controlled by logic function 2. Only a bit parameter can be programmed as the destination.

If a non valid parameter is programmed the output is not routed anywhere

9.21 Motorized pot zero start select

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

If this parameter is set then the motorised pot output will be set to zero each time the Drive powers up. Otherwise the motorised pot output will be at the same level at power up as it was when power was removed.

9.22 Motorized pot bipolar select

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

When this bit is set to 0 the motorised pot output is limited to positive values only (0 to 100.0%). Setting it to 1 allows negative outputs also (-100.0% to +100.0%).

9.23 Motorized pot rate

⇅	OL> 0 - 250	⇒	20	seconds	RW	Uni			
⇅	CL> 0 - 250	⇒	20						

This parameter defines the time taken for the motorised pot function to ramp from 0 to 100.0 %. Twice this time will be taken to adjust the output from -100.0% to +100.0%.

9.24 Motorized pot output scale factor

⇅	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

This parameter can be used to restrict the output of the motorised pot to operate over a reduced range so that it can be used as a trim, for example. There is an automatic scaling such that when this parameter is set to 1.000, a 100% level on the motorised pot will cause the programmed destination parameter to be at its maximum value.

9.25 Motorized pot destination

⇅	OL> 00.00 to 20.50	⇒	00.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 00.00 to 20.50	⇒	00.00						

This needs to be set up with the parameter that the motorised pot is to control. Only non-bit parameters which are not protected can be controlled by the motorised pot function. If a non valid parameter is programmed the output is not routed anywhere. If the motorised pot is to control speed then it is suggested that one of the preset speed parameters is entered here. If the motorised pot is to trim speed then it is suggested that the offset parameter (**1.04**) is entered here.

9.26 Motorized pot up

9.27 Motorized pot down

⇅	OL> 0 ~ 1	⇒			RO	Bit			
⇅	CL> 0 ~ 1	⇒							

Two digital inputs or logic functions must be programmed to control these parameters to implement the motorised potentiometer.

9.28 Motorized pot reset

⇅	OL> 0 ~ 1	⇒			RO	Bit			
⇅	CL> 0 ~ 1	⇒							

When this bit is active (= 1) the motorised potentiometer output is set to 0 %

9.29 Binary sum logic ones (LSB)

9.30 Binary sum logic twos

9.31 Binary sum logic fours (MSB)

⇅	OL> 0 ~ 1	⇒			RO	Bit			
⇅	CL> 0 ~ 1	⇒							

Digital inputs or logic functions must be programmed to control these parameters to implement the binary sum function.

9.32 Binary sum logic output value

⇅	OL> 0 ~ 7	⇒			RO	Uni			P
⇅	CL> 0 ~ 7	⇒							

Indicates the binary sum calculated from the three input bits. The value is calculated as follows:

Fours	Twos	Ones	Binary Sum
9.31	9.30	9.29	9.32
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

9.33 Binary sum logic destination parameter

⇅	OL> 0.00 to 20.50	⇒	00.00	Menu.	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	00.00	Parameter					

This destination parameter defines the parameter to be controlled by the binary sum logic. The binary sum function is typically used to change the mode of operation of a 'select' parameter 'on the fly' via one or more digital inputs. Only a non bit parameter which is not protected can be controlled by the binary sum function. If a non valid parameter is programmed the output is not routed anywhere. If the parameter programmed has a value less than 7 then the destination parameter will be limited to the correct value independently of 9.32.

10

Menu 10 Status and trips

This menu contains bit parameters that indicate the status of the Drive, the trip log which holds the last ten trips and the dynamic brake parameters.

10.1 Parameter descriptions

10.01 Drive normal indicator

↕	OL> 0 ~ 1	⇒			RO	Bit			P
↕	CL> 0 ~ 1	⇒							

This parameter indicates whether the Drive has tripped or not. A logic 0 indicates a trip state is present. If parameter **10.36** is set to 1, this bit will be at 1 in a tripped state if an auto reset is going to occur. Once the programmed number of auto resets have occurred the next trip will cause this bit to be cleared.

10.02 Drive running indicator

↕	OL> 0 ~ 1	⇒			RO	Bit			P
↕	CL> 0 ~ 1	⇒							

This parameter is set if the inverter output is active.

10.03 At zero speed indicator

↕	OL> 0 ~ 1	⇒			RO	Bit			P
↕	CL> 0 ~ 1	⇒							

On the open loop drive this bit is set to 1 when the absolute value of the ramp output is at or below the zero speed threshold as defined by parameter **3.05**. On closed loop drives the speed feedback is monitored rather than the ramp output.

10.04 At or below min. speed indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

In bipolar mode (**1.10** = 1) this parameter is the same as zero speed (**10.03**).

In unipolar mode this parameter is set if the absolute value of the ramp output or speed feedback is at or below (minimum speed + 0.5Hz), or (minimum speed + 5rpm). Minimum speed is defined by parameter **1.07**.

Parameter is only set if drive is running.

10.05 Below at speed window indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set when the absolute value of the ramp output or speed feedback is below the 'At speed' window as defined by parameters **3.06** and **3.09**. Parameter is only set if drive is running.

10.06 At speed indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set when the absolute value of the ramp output or speed feedback is within the 'At speed' window as defined by parameters **3.06**, **3.07** and **3.09**. Parameter is only set if drive is running.

10.07 Above at speed window indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set when the absolute value of the ramp output or speed feedback is above the 'At speed' window as defined by parameters **3.07**, and **3.09**. Parameter is only set if drive is running.

10.08 100% load reached indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set if active current is greater or equal to rated active current.

$$\text{rated active current} = \mathbf{5.07} \times \mathbf{5.10}$$

10.09 Current limit active *indicator*

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set if the normal current limit is active.

10.10 Motor regenerating *indicator*

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set if the output bridge is transferring power from the motor to the DC Bus.

10.11 Dynamic brake active *indicator*

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set when power is being transferred from the motor to the optional braking resistor, if fitted.

10.12 Dynamic brake alarm *indicator*

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set when the dynamic brake is active and the braking energy accumulator is greater than 75%.

10.13 Direction demanded *indicator*

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is a 1 if the pre-ramp reference is negative (reverse), and is a 0 if the pre-ramp reference is positive (forward).

10.14 Direction running *indicator*

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

On the open loop drive this bit is a 1 if the post-ramp reference is negative (reverse), or a 0 if post-ramp reference is positive (forward). On the closed loop drive the speed feedback is monitored rather than the post-ramp reference.

10.15 AC supply loss indicator

⇅	OL> 0 ~ 1	⇅			RO	Bit			P
⇅	CL> 0 ~ 1	⇅							

This parameter is set to indicate a loss of input supply to the Drive

10.16 Motor thermistor over temperature indicator

⇅	OL> 0 ~ 1	⇅			RO	Bit			P
⇅	CL> 0 ~ 1	⇅							

The parameter is set to indicate that the motor operating temperature has been exceeded.

10.17 Motor current overload alarm indicator

⇅	OL> 0 ~ 1	⇅			RO	Bit			P
⇅	CL> 0 ~ 1	⇅							

This parameter is set if the motor current is larger than 105% of the programmed motor rated current and the overload accumulator is greater than 75% to warn that if the motor current is not reduced the Drive will trip on an Ixt overload.

10.18 Heatsink temperature alarm indicator

⇅	OL> 0 ~ 1	⇅			RO	Bit			P
⇅	CL> 0 ~ 1	⇅							

This parameter is set if the heatsink temperature is greater than 90°C.

10.19 Ambient temperature alarm indicator

⇅	OL> 0 ~ 1	⇅			RO	Bit			P
⇅	CL> 0 ~ 1	⇅							

This parameter is set if the ambient temperature is greater than 90°C.

10.20	Last trip
10.21	Second last trip
10.22	Third last trip
10.23	Fourth last trip
10.24	Fifth last trip
10.25	Sixth last trip
10.26	Seventh last trip
10.27	Eighth last trip
10.28	Ninth last trip
10.29	Tenth last trip

⇅	OL> 0 to 200	⇒			RO	Txt			P
⇅	CL> 0 to 200	⇒							

Parameter **10.20** is the most recent trip and **10.29** the oldest. When a new trip occurs all the parameters move down one, the current trip is put in **10.20** and the oldest trip is lost off the bottom of the log. Possible trips are:

1	UU	DC Bus Under Voltage
2	OU	DC Bus Over Voltage
3	OI.AC	AC instantaneous current trip
4	OI.br	Braking resistor instantaneous current trip
5	PS	Power supply trip
6	Et	External trip
7	OV.SPd	Overspeed
8	Prc2	Processor 2 trip
9	SEP	Small Option Module
10	ENC.OVL	Encoder supply overload *
11	ENC.PH1	U phase missing*
12	ENC.PH2	V phase missing*
13	ENC.PH3	W phase missing*
14	ENC.PH4	UVW connected incorrectly*
15	ENC.PH5	A channel missing*
16	ENC.PH6	B channel missing*
17	ENC.PH7	A/B connected incorrectly*
18	ENC.PH8	Autotune fail (wrong test for mode, limit switch, trip etc)*
19	It.br	Ixt on braking resistor
20	It.AC	Ixt on output current (Motor overload)
21	Oh1	Overheat (Drive thermal model protection)
22	Oh2	Overheat (Heat sink thermistor protection)
23	OA	Over ambient
24	th	Thermistor trip
25	thS	Thermistor short circuit
26	OP.OVLd	Overload on digital output
27	cL1	Current loop 1 loss
28	cL2	Current loop 2 loss
29	cL3	Current loop 3 loss
30	SCL	Serial comms loss
31	EEF	EEPROM failure
32	Ph	Phase loss - always stops before tripping
33	rS	Resistance measurement failure
34	ST GL	Size 5 spurious trip
35	SEP EC	SOM encoder communications failure
36	SEP EF	SOM encoder fault
37	ANI.diS	UD78 Option module removed
38	OI.LINE	(reserved for use on Four Quadrant Version of Unidrive)
39	LI.SYNC	Regen sinusoidal rectifier failed to synchronise to line voltage
40-99	tr xx	User trips where xx is user trip number
100	tr 100	This is not a trip. See parameter 10.38
101	Ot inP	Size 5 - Input over-temperature
102-109	Ot Hsn	Size 5 - Heatsink over-temperature on module n
110-117	PS n	Size 5 - Power supply failure on module n
118-125	OI.AC n	Size 5 - AC instantaneous current trip on module n
126-133	OU n	Size 5 - Over voltage on module n

134-141	Ol.dc n	Size 5 - DC instantaneous current trip on module n
142-149	UFLt n	Size 5 - Unidentified fault on module n
150-158	Conf n	Size 5 - Number of modules has changed, there are now n modules
159-179	tr xx	User trips where xx is the trip number
180	SEP.diS	Small option module not present, but EEPROM values show it should.
181	ENCPH9	Servo phasing is incorrect and reverse torque is produced*
182	FSH.Err	Cloning module memory is corrupt, all information will be erased.
183	FSH.Dat	No data in the cloning module parameter set.
184	FSH.TyP	Current drive type does not match drive type stored in cloning module.
185	FSH.ACC	Write access to the cloning module is not enabled.
186	FSH.LO	Data transfer to drive: menu20 data available but no LOM fitted.
187	FSH.20	Data transfer to drive: LOM fitted but no menu20 data available.
188-200	tr xx	User trips where xx is the trip number

Note:

If an SEP.diS trip is produced this is because the small option module is not fitted, but the value for the module type stored in parameter 16.01 indicates that a module should be fitted. This trip can only be cleared by saving parameters. Once this is done the trip will be cleared and not re-occur after the next power-up unless a small option module is fitted, parameters are saved and then the option module is removed again.

Note:

Trips marked with * apply to position feedback devices. Trip 10 only applies to the encoder power supply for the main drive encoder from the 15 way D-type on the Drive. Trips 11-16 only apply to the main encoder feedback on the Drive. Trip 17 indicates that the direction of rotation of the motor is incorrect during drive auto-tuning and can apply whatever type of feedback device is used. Trip 181 indicates incorrect phasing and can also apply whatever type of feedback device is used. Small option modules with position feedback devices can also produce trips (SEP, SEP_DiS, SEP_EC, SEP_EF). The manual for each small option module includes details of the trips related to the particular module.

10.30 Max. full power braking time

⇅	OL> 0.0 to 400.0	⇒	0.0	seconds	RW	Uni			
⇅	CL> 0.0 to 400.0	⇒	0.0	seconds					

This parameter defines the time period that the braking resistor fitted can stand full braking volts (780V) without damage. The setting of this parameter is used in determining the braking overload trip time.

10.31 Max. full power braking interval

⇅	OL> 0.0 to 25.0	⇒	0.0	minutes	RW	Uni			
⇅	CL> 0.0 to 25.0	⇒	0.0	minutes					

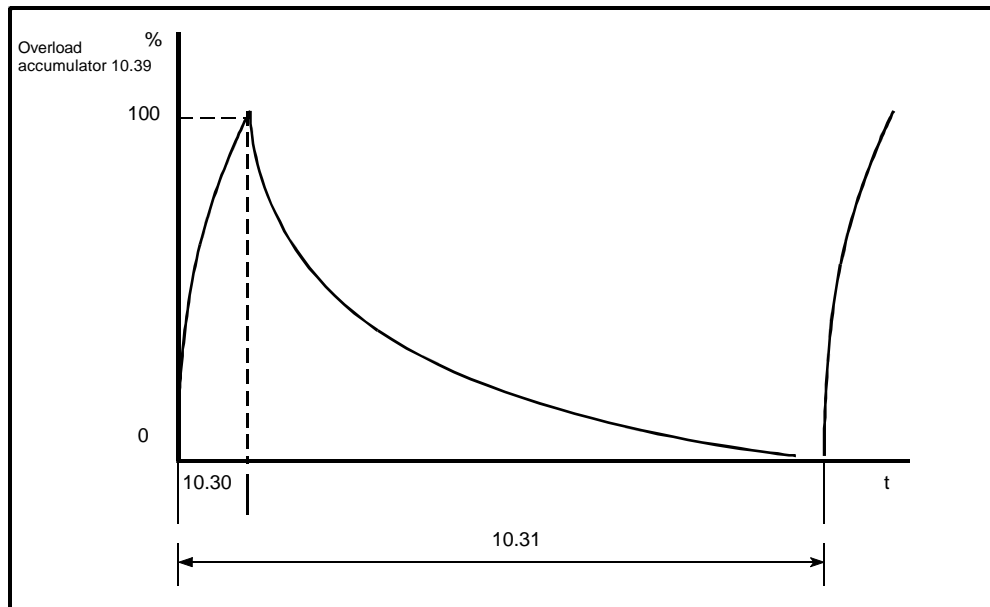
This parameter defines the time period which must elapse between consecutive braking periods of maximum braking power as defined by parameter **10.30**. The setting of this parameter is used in determining the thermal time constant of the resistor fitted. If this parameter is set to 0 then no braking resistor protection is implemented.

Braking resistor protection

The characteristics of a braking resistor are that its temperature rises in proportion to the amount of power being put into it, and falls in proportion to the temperature difference between itself and ambient. This is an exponential characteristic which the Drive models to protect the resistor against overload, two parameters being provided for the user to enter the resistor data. Once a resistor has been chosen for the requirement of a particular application, parameters **10.30** and **10.31** should be set up according to the resistor data.

Parameter **10.30** should be set up with the time that the resistor can stand 780V across it (short time overload). This is the time for the resistor to reach maximum operating temperature from the expected maximum ambient given the power input that 780V will provide.

Parameter **10.31** should be entered with the time period required before a second short time overload can be applied without damage.



Parameter **10.31** defines the time for the resistor to fall to ambient temperature but this does not mean that this amount of time is required between braking. The actual period between braking will depend on the amount of energy put into the resistor during a braking period, since the braking resistor accumulator must remain below 100% to prevent a trip (dotted line).

10.32 External trip

↕	OL> 0 ~ 1	⇒			RO	Bit		
↕	CL> 0 ~ 1	⇒						

If this indicator is set to 1 then the Drive will trip (Et). If parameter **8.09** is set to 0 this indicator will be set when ever the Enable/Trip terminal is inactive. If the Enable/Trip terminal is required for an enable input and an external trip input is required, another terminal must be programmed to control this indicator with an inversion such that the terminal must be active to prevent a trip.

10.33 Drive reset

↕	OL> 0 ~ 1	⇒	0		RW	Bit		
↕	CL> 0 ~ 1	⇒	0					

A 0 to 1 change on this parameter will cause a drive reset. If a drive reset terminal is required on the Drive the required terminal must be programmed to control this bit. If a drive trips on an IGBT over-current trip, either output bridge or braking resistor, the Drive cannot be reset for 10 seconds to allow the IGBT to fully recover.

10.34 Number of auto reset attempts

⇅	OL>	0 ~ 5	⇒	0		RW	Uni			
⇅	CL>	0 ~ 5	⇒	0						

If this parameter is set to zero then no auto reset attempts are made. Any other value will cause the Drive to automatically reset following a trip for the number of times programmed. Parameter **10.35** defines the time between the trip and the auto reset. The reset count is only incremented when the trip is the same as the previous trip, otherwise it is reset to 0. When the reset count reaches the programmed value, any further trip of the same value will not cause an auto-reset.

If there has been no trip for 5 minutes then the reset count is cleared.

Auto reset will not occur on an External trip (Et).

10.35 Auto reset delay

⇅	OL>	0.0 to 25.0	⇒	1.0	seconds	RW	Uni			
⇅	CL>	0.0 to 25.0	⇒	1.0						

This parameter defines the time between a trip and an auto reset subject to the minimum trip time for IGBT over-current trips.

10.36 Hold Drive normal (10.01) until last auto reset attempt

⇅	OL>	0 ~ 1	⇒	0		RW	Bit			
⇅	CL>	0 ~ 1	⇒	0						

If this parameter is 0 then parameter **10.01** (Drive healthy) is cleared every time the Drive trips regardless of any auto-reset that may occur. When this parameter is set the 'Drive healthy' indication is not cleared on a trip if an auto-reset is going to occur.

10.37 Stop Drive on non-important trips

⇅	OL>	0 ~ 1	⇒	0		RW	Bit			
⇅	CL>	0 ~ 1	⇒	0						

If this parameter is set, the drive will stop before tripping on non important trips. Phase loss (Ph) always stops the motor before tripping the drive whatever the setting of this parameter. Non important trips are : th, ths, OP.Ovld, cL1, cL2,cL3 and SCL.

10.38 User trip

⇅	OL> 0 to 200	↔	0		RW	Uni			P
⇅	CL> 0 to 200	↔	0						

This parameter is used to generate user trips, either from the large option module or over the serial comms, or to reset the Drive. Codes are as shown below:

1 to 39

General drive trips that give trip strings.

40 to 99

User trips that give string trXX, where XX is the trip number. These are used by some predefined UD70 large option module applications. They may also be used for user UD70 applications or to trip the Drive via serial communications.

100

If the parameter is set to 100 the Drive is reset.

101 to 151

General drive trips related to size 5 Unidrive.

All trips are described in the text accompanying **Pr10.29**.

10.39 Braking-energy overload accumulator

⇅	OL> 0.0 to 100.0	↔		%	RO	Uni			P
⇅	CL> 0.0 to 100.0	↔							

This parameter gives an indication of braking resistor temperature based on a simple thermal model, see parameters **10.30** and **10.31**. Zero indicates the resistor is close to ambient and 100% is the maximum temperature (trip level).

10.40 Status word

⇕	OL> 0 to 32767	⇒			RO	Uni			P
⇕	CL> 0 to 32767	⇒							

This parameter is for use by a serial comms interface. The value of this parameter is the addition of the Drive read only bits with binary weighting as follows:

10.01	2^0	1
10.02	2^1	2
10.03	2^2	4
10.04	2^3	8
10.05	2^4	16
10.06	2^5	32
10.07	2^6	64
10.08	2^7	128
10.09	2^8	256
10.10	2^9	512
10.11	2^{10}	1024
10.12	2^{11}	2048
10.13	2^{12}	4096
10.14	2^{13}	8192
10.15	2^{14}	16384

10.41 UD78 auxilliary power supply active indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set if the UD78 large option module is fitted and the Drive is powered via the UD78 power supply. If the Drive is powered from its internally derived supplies this parameter is 0.

10.42 IGBT junction temperature above 135°C indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

This parameter is set if the IGBT junction temperature calculated from the Drive thermal model is above 135°C. See paramters **5.18**, **5.33** and **7.32**.

11 Menu 11

Drive setup

This menu contains parameters for the Drive setup including:

The contents of menu zero, drive type, serial communications and security.

11.1 Parameter descriptions

11.01 Parameter 0.11 assignment

⇕	OL> 0.00 to 20.50	⇒	1.03	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	1.03						
⇕	RG> 0.00 to 20.50	⇒	15.01						

11.02 Parameter 0.12 assignment

⇕	OL> 0.00 to 20.50	⇒	2.01	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	2.01						
⇕	RG> 0.00 to 20.50	⇒	15.02						

11.03 Parameter 0.13 assignment

⇕	OL> 0.00 to 20.50	⇒	4.02	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	4.02						
⇕	RG> 0.00 to 20.50	⇒	15.03						

11.04 Parameter 0.14 assignment

⇕	OL> 0.00 to 20.50	⇒	1.05	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	1.05						
⇕	RG> 0.00 to 20.50	⇒	15.04						

11.05 Parameter 0.15 assignment

⇕	OL> 0.00 to 20.50	⇒	2.04	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	2.04						
⇕	RG> 0.00 to 20.50	⇒	15.05						

11.06 Parameter 0.16 assignment

⇕	OL> 0.00 to 20.50	⇒	6.01	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	6.01						
⇕	RG> 0.00 to 20.50	⇒	15.06						

11.07 Parameter 0.17 assignment

⇕	OL> 0.00 to 20.50	⇒	4.11	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	4.11						
⇕	RG> 0.00 to 20.50	⇒	15.07						

11.08 Parameter 0.18 assignment

⇕	OL> 0.00 to 20.50	⇒	2.06	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	2.06						
⇕	RG> 0.00 to 20.50	⇒	15.08						

11.09 Parameter 0.19 assignment

⇕	OL> 0.00 to 20.50	⇒	2.07	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	2.07						
⇕	RG> 0.00 to 20.50	⇒	15.09						

11.10 Parameter 0.20 assignment

⇅	OL> 0.00 to 20.50	⇒	1.29	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	1.29						
⇅	RG> 0.00 to 20.50	⇒	15.10						

11.11 Parameter 0.21 assignment

⇅	OL> 0.00 to 20.50	⇒	1.30	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	1.30						
⇅	RG> 0.00 to 20.50	⇒	15.11						

11.12 Parameter 0.22 assignment

⇅	OL> 0.00 to 20.50	⇒	1.31	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	1.31						
⇅	RG> 0.00 to 20.50	⇒	15.12						

11.13 Parameter 0.23 assignment

⇅	OL> 0.00 to 20.50	⇒	1.32	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	1.32						
⇅	RG> 0.00 to 20.50	⇒	15.13						

11.14 Parameter 0.24 assignment

⇅	OL> 0.00 to 20.50	⇒	7.06	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	7.06						
⇅	RG> 0.00 to 20.50	⇒	15.14						

11.15 Parameter 0.25 assignment

⇅	OL> 0.00 to 20.50	⇒	7.11	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	7.11						
⇅	RG> 0.00 to 20.50	⇒	15.15						

11.16 Parameter 0.26 assignment

⇅	OL> 0.00 to 20.50	⇒	7.14	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	7.14						
⇅	RG> 0.00 to 20.50	⇒	15.16						

11.17 Parameter 0.27 assignment**EUR >**

⇅	OL> 0.00 to 20.50	⇒	8.27	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	8.27						
⇅	RG> 0.00 to 20.50	⇒	15.17						

USA >

⇅	OL> 0.00 to 20.50	⇒	6.04	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	6.04						
⇅	RG> 0.00 to 20.50	⇒	6.04						

11.18 Parameter 0.28 assignment**EUR >**

⇅	OL> 0.00 to 20.50	⇒	4.13	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	4.13						
⇅	RG> 0.00 to 20.50	⇒	15.18						

USA >

⇅	OL> 0.00 to 20.50	⇒	1.01	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	1.01						
⇅	RG> 0.00 to 20.50	⇒	1.01						

11.19 Parameter 0.29 assignment

EUR >

⇕	OL> 0.00 to 20.50	⇒	4.14	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	4.14						
⇕	RG> 0.00 to 20.50	⇒	0.00						

USA >

⇕	OL> 0.00 to 20.50	⇒	8.23	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	8.23						
⇕	RG> 0.00 to 20.50	⇒	8.23						

11.20 Parameter 0.30 assignment

EUR >

⇕	OL> 0.00 to 20.50	⇒	6.13	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	6.13						
⇕	RG> 0.00 to 20.50	⇒	0.00						

USA >

⇕	OL> 0.00 to 20.50	⇒	6.13	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	6.13						
⇕	RG> 0.00 to 20.50	⇒	0.00						

11.21 Parameter 0.30 scaling

⇕	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇕	CL> 0.000 to 4.000	⇒	1.000						

If the parameter programmed into position 30 of menu 0 is R/O then a scale factor can be applied to it such that they may indicate some meaningful unit such as cans/hour.

11.22 Power-up Parameter displayed select

⇕	OL> 0.00 to 0.50	⇒	0.10	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 0.50	⇒	0.10						

This parameter defines which menu 0 parameter is the power up default.

11.23 Serial comms. address

⇕	OL> 0.0 to 9.9	⇒	1.1	Group.Unit	RW	Uni			P
⇕	CL> 0.0 to 9.9	⇒	1.1						

Used in ANSI comms to define the unique address for the Drive. Any number in the permitted range 0.0 to 9.9 which has a zero in it should not be used as these are used in addressing groups of drives.

This parameter and all other serial interface parameters (**11.24** to **11.28**) that follow are only effective when the 'Serial Communications' Large option module is fitted.

11.24 Serial comms. mode selector

⇅	OL> 0 to 2	⇨	1		RW	Txt		R	P
⇅	CL> 0 to 2	⇨	1						

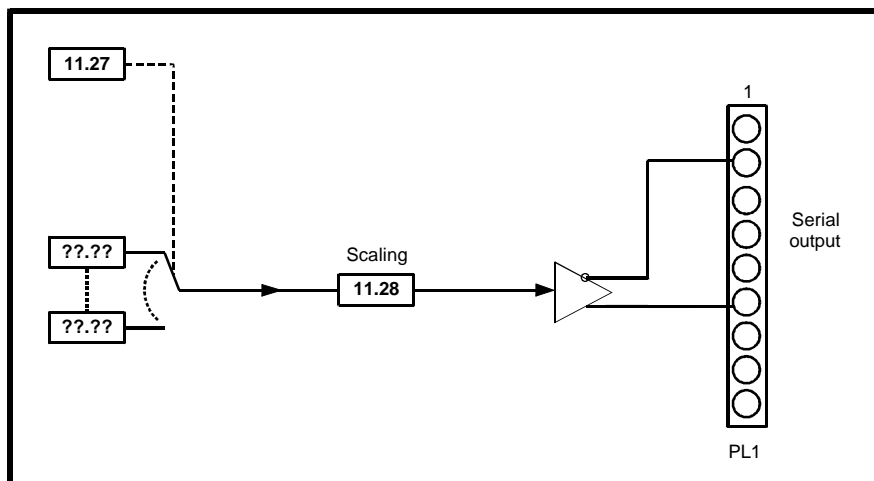
This is the mode of operation of the serial port.

- | | | |
|---|--------|---|
| 0 | ANSI 2 | ANSI protocol, two wire, half duplex serial communications. |
| 1 | ANSI 4 | ANSI protocol, four wire, half duplex serial communications. |
| 2 | OUtPUt | Output variable defined by 11.27 (CT protocol) |
| 3 | INPUt | Input variable to parameter defined by 11.27 (CT protocol) |

In mode 0, ANSI 2 wire, parameter **11.26** can be set to provide a delay in changing from receive to transmit to allow the host time to change to receive. **It should be noted that 5ms should be allowed by the host between receiving data from the Drive to transmitting data back to the Drive to allow the Drive to change from transmit to receive mode.**

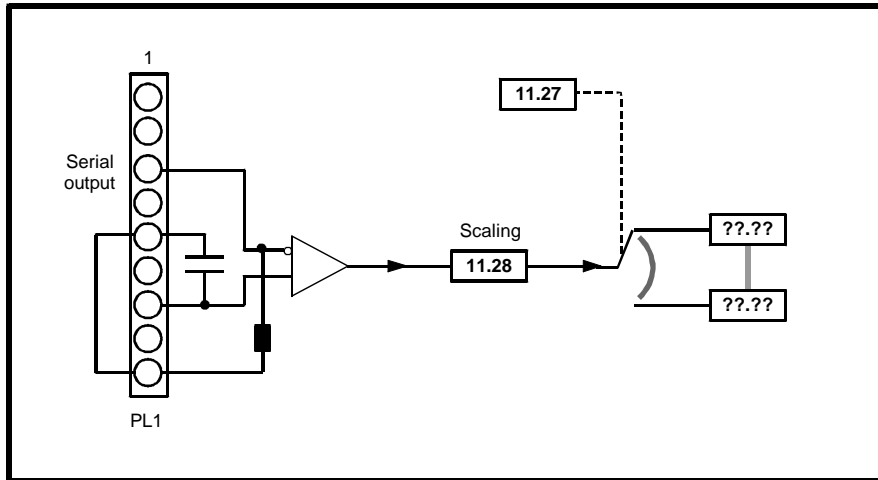
Modes 2 and 3 are for transfer of a variable from one drive to another. In both cases data is transferred at a rate of at least 140Hz. Although the data rate is slightly slower than that of Mentor II and CDE, the protocol and baud rate are identical and it is possible to connect a Unidrive to a Mentor II or CDE for data transfer in either direction.

Mode 2 output variable to another drive.



In the event of the Drive tripping a value of zero is transmitted.

Mode 3 input variable from another drive.



Once data has been received in this mode, a comms loss trip will occur if the comms link is lost and the last data received is non zero.

11.25 Serial comms. baud rate selector

⇅	OL> 0 to 2	⇒	0		RW	Txt			P
⇅	CL> 0 to 2	⇒	0						

Used in ANSI comms mode (2 or 4 wire) to select the comms port baud rate. Three available options are:

- 0 4800 4,800 baud.
- 1 9600 9,600 baud.
- 2 19200 19,200 baud.

11.26 Serial comms. two wire mode delay selector

⇅	OL> 0 to 255	⇒	0	ms	RW	Uni			
⇅	CL> 0 to 255	⇒	0	ms					

The ANSI protocol is half duplex, and so it is possible to connect the RX and TX together and the /RX and /TX together and operate the comms with only 2 data connections. If parameter **11.24** is set to "ANSI 2" two wire standard comms is active. Problems can occur with 2 wire mode comms if the Drive replies to a request before the device that sent the request has been able to change its buffers from transmit to receive. To avoid this problem a delay, defined by parameter **11.26**, can be introduced between the Drive receiving data and then responding. The delay is always at least as long as the value programmed in parameter **11.26**, but may be longer. Although the parameter resolution is 1ms, the actual timing resolution is 5ms: 1ms in the parameter will give a delay of at least 5ms, 4ms gives at least 5ms, 5ms gives at least 5ms, 6ms gives at least 10ms, etc.

11.27 Serial comms. source/destination selector

⇅	OL> 0.00 to 20.50	⇒	0	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0						

This parameter is used in serial comms modes 1 and 2 to define the parameter being output or input respectively. In comms mode 2 any new value programmed will only be implemented after a drive reset. Only non-bit parameters can be input or output and for inputs the parameter must not be protected. If a non valid parameter is programmed the Drive will not input or output data.

11.28 Serial comms. parameter scaling

⇅	OL> 0.000 to 4.000	⇒	1.000	Menu. Parameter	RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

Can be used to scale the data being output or input in serial modes 1 or 2. However in most cases it is not necessary as the input or output is automatically scaled such that for a full scale input or output the destination or source parameter will be at its maximum.

11.29 Drive software version

⇅	OL> 1.00 to 99.99	⇒			RO	Uni			P
⇅	CL> 1.00 to 99.99	⇒							

Indicates the version of drive software fitted. The last digit indicates the version of the mask software within the Drive processor.

11.30 User security code

⇅	OL> 0 to 255	⇒	149		RW	Uni	S		P
⇅	CL> 0 to 255	⇒	149						

If any number other than 149 is programmed in this parameter a user security will be applied. The parameter value can only be seen while it is being edited, otherwise the value displayed is 149 so that the actual security code cannot be seen. Setting this security code protects all parameters from being adjusted until the correct code has been entered in parameter xx.00. Do not use a code of 0, as 0 is the default value for parameter xx.00, the parameter used for unlocking security.

11.31 Drive operating mode selector

⇅	0 to 3	⇒			RW	Txt		R	P
	0	OPEn.LP	Open loop inverter						
	1	CL.VECT	Closed loop vector						
	2	SErVO	Servo						
	3	REGE _n	Regen input converter						

This parameter defines the Drive type as indicated in the default settings. Parameter **XX.00** must be set to 1253, the Drive type change security value, before this parameter can be changed. When the Drive is reset to implement any change in this parameter, the default settings of all parameters will be set according to drive type. The Drive type will not be changed if it is currently running a motor.

11.32 Drive rated continuous current

⇅	OL> *	⇒		Amps	RO	Uni			P
⇅	CL> *	⇒							

This parameter indicates the maximum continuous current rating of the Drive in Amps.

* It is Drive dependant and therefore does not have a range.

11.33 Drive voltage rating

⇅	OL> 480	⇒		Volts	RO	Uni			P
⇅	CL> 480	⇒							

This parameter indicates the voltage rating of the Drive.

11.34 Drive software build number

⇅	OL> 0 to 99	⇒			RO	Uni			P
⇅	CL> 0 to 99	⇒							

This parameter indicates the sub-version of user software stored in the memory external to the processor.

11.35 Number of size 5 modules connected

⇅	OL> 0 to 255	⇒	0		RO	Uni			P
⇅	CL> 0 to 255	⇒	0						

When a size 5 drive system is connected the control system checks the configuration switches to determine how many and which units are operating in parallel. The result of this is stored in parameter **11.35** after a trip reset. If the new arrangement of modules is different from the previously saved value of parameter **11.35** a “Conf” trip is given. Resetting the trip will cause the new configuration to be loaded into parameter **11.35** and the system will run. To prevent a repeat of the trip at the next power-up parameters must be saved to save the new value of parameter **11.35**. Each bit in this parameter corresponds to a module, i.e. bit0 = module 1, bit1 = module2 etc.

11.36 Drive with slow speed fans

⇅	STD> 0	⇒			RO	Bit			P
⇅	LFT> 1	⇒							
⇅	VTC> 0	⇒							

If this parameter is set to 1 the Drive has slow speed fans. This parameter cannot be changed by the user.

11.37 Macro loaded number

⇅	0 to 9	⇒	0		RO	Uni			P
---	--------	---	---	--	----	-----	--	--	---

Parameter macros are a series of parameter values that can be loaded from drive ROM to produce a drive set up for a particular application. When a parameter macro is loaded, by setting parameter **XX.00** to a value between 2001 and 2009 and then resetting the Drive, the macro number is written to this parameter. If 2001 is used to load a macro then this parameter is set to 1, etc. When default parameters are loaded this parameter is set to zero, indicating that a macro has not been loaded.

With no macro loaded scrolling completely round menu 0 is possible. Unused parameters are not displayed and the display jumps to the next parameter that exists. If a macro is loaded and this parameter has a non-zero value it is not possible to scroll completely round menu 0. Normally a contiguous block of parameters will exist at the bottom of the menu, i.e. **0.00** to **0.10**, and a contiguous block will exist at the top of the menu, i.e. **0.35** to **0.50**. If a macro is selected with the parameters given as an example, it will not be possible to move above parameter **0.10** with the up key, or down below parameter **0.35** with the down key. This restriction also applies to the use of ACK and BS with ANSI serial communications when scrolling through menu 0.

11.38 Cloning module parameter set

⇅	OL> 0 to 8	⇒	0		RW	Uni			
⇅	CL> 0 to 8	⇒	0						

Used to select parameter set information from the cloning small option module if fitted, otherwise it cannot be modified. See also parameters **11.39** and **11.40**.

11.39 Cloning module parameter set Drive type

⇅	OL> OPEn.LP Open loop inverter	⇒	0		RO	Uni			
⇅	VT> CL.VECt Closed loop vector	⇒	1						
⇅	SV> SErVO Servo	⇒	2						
⇅	RG> REGEEn Regen input converter	⇒	3						
⇅	FrEE Parameter set is free	⇒	4						

Displays the stored drive type saved in the cloning module for the parameter set given by parameter **11.38**. To restore a particular parameter set the current drive type must match the Drive type stored in the cloning module.

11.40 Cloning module parameter checksum

⇅	OL> 0 to 16383	⇒			RO	Uni			
⇅	CL> 0 to 16383	⇒							

Displays the parameter checksum stored in the cloning module for the parameter set given by parameter **11.38**.

This menu contains two threshold detectors. The threshold detectors allow a parameter to be compared against a threshold value to produce a digital output which has a programmable destination. This function may be used for example for detecting when speed reaches a particular value and switching the ramp rate at that point.

12.1 Parameter descriptions

12.01 Threshold detector 1 output *indicator*

12.02 Threshold detector 2 output *indicator*

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

These parameters indicate whether the input variables are above (1) or below (0) the programmed thresholds.

12.03 Threshold detector 1 input source parameter

⇕	OL> 0.00 to 20.50	⇒	0.00	Menu.	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	0.00	Parameter					

This source parameter defines the variable which is to be used as the input to programmable threshold 1. The absolute value of the source variable is taken as input to the threshold comparator. Only non-bit parameters can be programmed as a source. If a non valid parameter is programmed the input value is taken as 0.

12.04 Threshold detector 1 threshold level

⇕	OL> 0.0 to 100.0	⇒	0.0	%	RW	Uni			
⇕	CL> 0.0 to 100.0	⇒	0.0	%					

This parameter defines the threshold level at which comparator output 1 will switch. The parameter is scaled as a percentage of the source maximum.

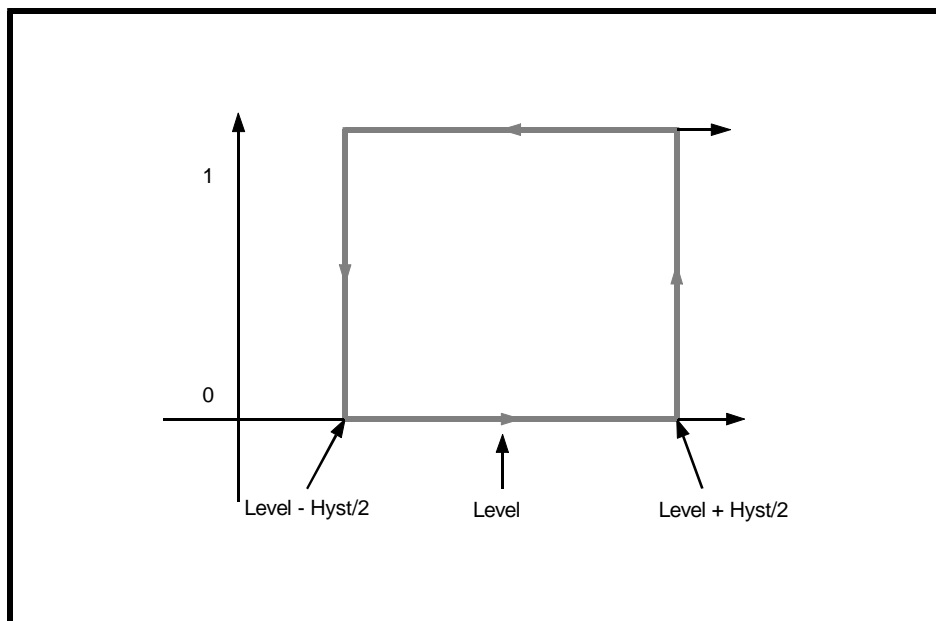
12.05 Threshold detector 1 hysteresis

⇕	OL> 0.0 to 25.0	⇒	0.0	%	RW	Uni			
⇕	CL> 0.0 to 25.0	⇒	0.0	%					

This parameter defines the band in which no change will occur on the output of threshold detector 1. The upper limit for switching is therefore $(Level + Hyst/2)$ and the lower level will be $(Level - Hyst/2)$.

Note

It is up to the user to ensure that the lower level is greater than zero otherwise the comparator output will never return to zero.



12.06 Threshold detector 1 output *invert*

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of the output from threshold detector 1. Setting this parameter to a 1 causes the output of the comparator to be inverted.

12.07 Threshold detector 1 output destination *parameter*

⇕	OL> 0.00 - 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 - 20.50	⇒	0.00						

This parameter defines the parameter which is to be controlled by the output of threshold detector 1. Only a bit parameter which is not protected can be programmed. If a non valid parameter is programmed then the output is not routed anywhere.

12.13 Threshold detector 2 input source parameter

⇕	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	0.00						

This source parameter defines the variable which is to be used as the input to programmable threshold 2. The absolute value of the source variable is taken as input to the threshold comparator. Only non-bit parameters can be programmed as a source. If a non valid parameter is programmed the input value is taken as 0.

12.14 Threshold detector 2 threshold level

⇕	OL> 0.0 to 100.0	⇒	0.0	%	RW	Uni			
⇕	CL> 0.0 to 100.0	⇒	0.0	%					

This parameter defines the threshold level at which comparator output 2 will switch. The parameter is scaled as a percentage of the source maximum.

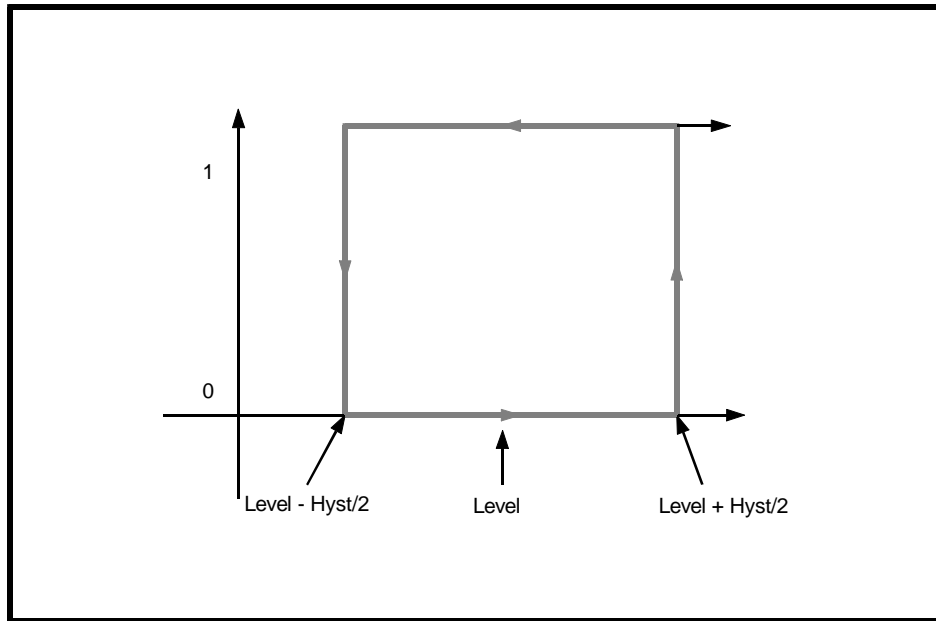
12.15 Threshold detector 2 hysteresis

⇕	OL> 0.0 to 25.0	⇒	0.0	%	RW	Uni			
⇕	CL> 0.0 to 25.0	⇒	0.0	%					

This parameter defines the band in which no change will occur on the output or threshold detector 2. The upper limit for switching is therefore $(Level + Hyst/2)$ and the lower level will be $(Level - Hyst/2)$.

Note

It is up to the user to ensure that the lower level is greater than zero otherwise the comparator output will never return to zero.



12.16 Threshold detector 2 output *invert*

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of the output from threshold detector 2. Setting this parameter to a 1 causes the output of the comparator to be inverted.

12.17 Threshold detector 2 output destination *parameter*

⇕	OL> 0.00 - 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 - 20.50	⇒	0.00						

This parameter defines the parameter which is to be controlled by the output of threshold detector 2. Only a bit parameter which is not protected can be programmed. If a non valid parameter is programmed then the output is not routed anywhere.

13

Menu 13 Position control

Menu 13 includes position control for open and closed-loop drives: either digital lock using two position feedback devices or orientation control for a closed-loop drive. When using digital lock position control it is sometimes necessary to move the master and slave relative to each other to change the lock position. This can be done using relative jogging. If the position loop is running in a digital lock mode, the sequencer calls for a normal jog, if a jog command is received in the Ready or Stop states, or a relative jog if a jog command is received while the drive is running. Relative jogging is implemented by the jog reference either being added or subtracted to the digital lock reference.

13.1 Parameter descriptions

13.01 Position loop error

⇅	OL> ±16384	⇒		1/16384 Rev	RO	Bi			P
⇅	CL> ±16384	⇒		1/16384 Rev					

This parameter monitors the position error when position control is being used. The range of the parameter is ± 1 Revolution (± 16384). If the position error is greater than one revolution, the parameter will show a 1 revolution error in the appropriate direction.

13.02 Reference encoder input

⇅	OL> ±100.0	⇒		%	RO	Bi			P
⇅	CL> ±100.0	⇒		%					

Open loop

This parameter indicates the speed of the encoder 1 input as a percentage of the maximum reference speed programmed in parameter **13.03**.

Closed loop

This parameter indicates the speed of the reference encoder as a percentage of the maximum reference speed programmed in parameter **13.03**.

13.03 Maximum reference speed

⇅	OL> 0 to 30000	⇒	1500	rpm	RW	Uni			
⇅	VT> 0 to 30000	⇒	1500	rpm					
⇅	SV> 0 to 30000	⇒	3000	rpm					

Open loop

This parameter should be set up by the user to the maximum rpm expected on the encoder 1 input if the encoder signal is to be used as a reference. When the encoder speed is equal to this value parameter **13.02** will indicate 100% input.

Closed loop

This parameter should be set up by the user to the maximum rpm expected on the reference encoder input if the encoder signal is to be used as a reference. When the encoder speed is equal to this value parameter **13.02** will indicate 100% input.

13.04 Reference encoder scaling

⇅	OL> 0 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0 to 4.000	⇒	1.000						

Open loop

Can be used to scale the encoder 1 input when it is being used as a reference alone.

Closed loop

Can be used to scale the reference encoder input when it is being used as a reference alone.

13.05 CL> Percentage input select

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

When the reference encoder input is being used as a reference only, the value routed through to the destination can be a percentage of maximum input or actual rpm, this selection is made by setting this parameter.

13.06 Reference input destination parameter

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This parameter is used to define the destination parameter for an encoder reference. Only non-bit parameters which are not protected can be programmed as destinations. If a non valid parameter is programmed the input is not routed anywhere.

13.07 Reference encoder ratio

⇅	OL> 0 to 4.000	⇨	1.000		RW	Uni			
⇅	CL> 0 to 4.000	⇨	1.000						

Can be used to scale the reference encoder input to the position loop such that the feedback can run at some ratioed speed to the reference encoder.

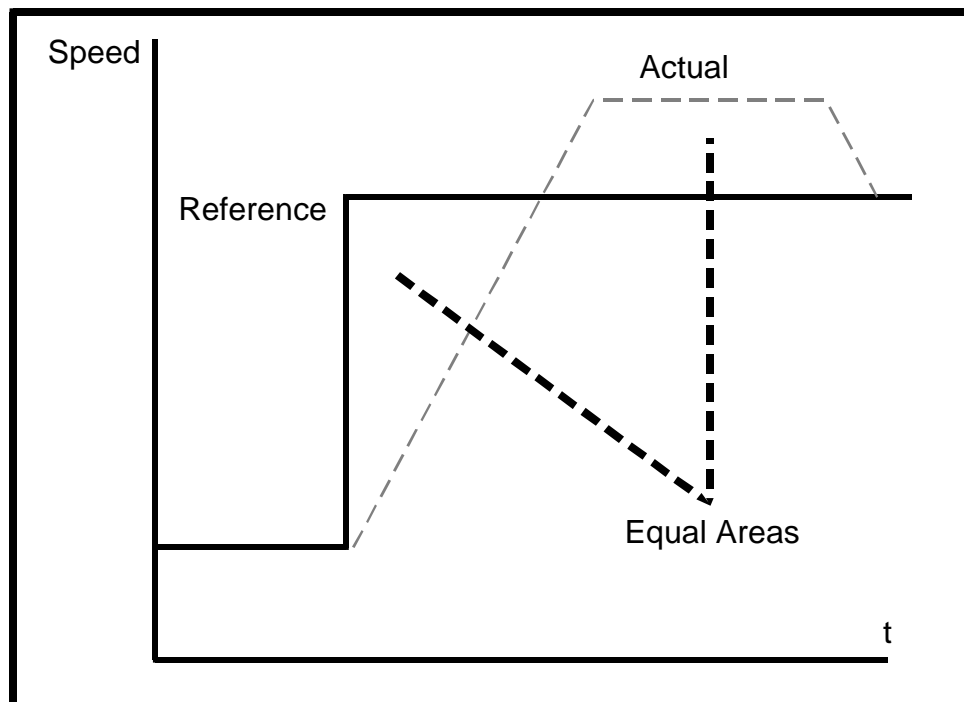
13.08 Position loop mode selector

⇅	OL> 0 to 2	⇨	0		RW	Uni			
⇅	CL> 0 to 6	⇨	0						

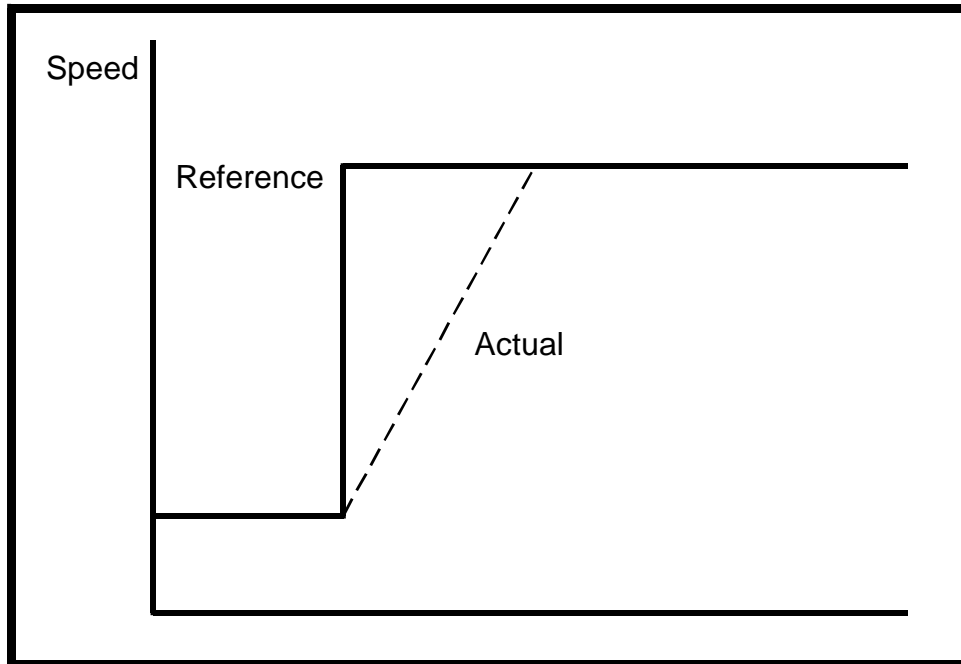
- 0 Position loop disabled
- 1 Rigid digital lock with digital Feed Forward
- 2 Rigid digital lock without digital Feed Forward
- 3 Non rigid digital lock with digital Feed Forward
- 4 Non rigid digital lock without digital Feed Forward
- 5 Orientate on stop command only
- 6 Orientate on stop command and when enabled

Sets the mode of operation of the position loop.

In rigid lock mode the position error is absolute relative to the time the position loop is closed. This means that if the slave shaft is slowed down due to excessive load, the target position will eventually be recovered by running at a higher speed when the load is removed.



In non rigid lock mode the position loop is only closed when the 'At Speed' condition is met. This allows slippage to occur while the speed loop is not satisfied.



Digital lock can be implemented without digital feed forward, where the input frequency of the encoder being followed is too low to obtain a smooth feed forward term from it. In this case the user can provide an alternative speed reference to be used as the feed forward term and the position loop will provide the velocity correction only. It should be noted that if the alternative feed forward is not correct, the position loop will run with a constant error to provide the difference between the feed forward and the actual speed of the reference encoder. During relative jogging, digital feed forward is always used because the feed forward term has to be adjusted.

In order for the digital feed forward term to function in modes 1 and 3 the hard speed reference must be enabled (**3.20** = 1). The correction term used in the feed forward modes is fed into the speed loop via the hard speed reference in menu 3 (see block diagrams). If a non rigid mode is used and an independant correction term is required then this must be routed to the hard speed reference (**3.19**) by the user.

Two orientation modes are selectable. In mode 5, the drive orientates following a stop command with orientation stop enabled (see parameter **6.01** Stop mode). Mode 6 operates the same as mode 5 but in addition the drive always orientates when it is enabled providing that the 'Hold zero speed' parameter is set (**6.08**). This ensures that the spindle is always in the same position following the drive being enabled.

When orientating from a stop command the drive goes through the following sequence:

1. Ramps are enabled and the motor is decelerated or accelerated to the speed limit programmed in parameter **13.10** in the direction the motor was previously running.
2. When the speed set in parameter **13.10** is reached, ramps are disabled and the motor continues to rotate until the position is found to be close to the target position. At this point the speed demand is set to 0 and the position loop is closed.
3. When the absolute value of speed is less than 2 rpm and the position is within the window defined by parameter **13.12**, the orientation complete signal is given.

13.09 Position loop gain

⇅	OL> 0 to 4.000	⇒	0.100		RW	Uni			
⇅	CL> 0 to 4.000	⇒	0.100						

The gain applied to the position error to generate the velocity correction term.

13.10 Positioning speed limit

⇅	OL> 0 to 250	⇒	150	rpm	RW	Uni			
⇅	CL> 0 to 250	⇒	150						

This parameter limits the velocity correction applied by the position loop such that high position loop gains can be used without getting large corrections. On closed loop drives it is also used as a reference during the orientation process.

13.11 CL> Orientation position reference

⇅	0 to 4095	⇒	0	1/4096 Rev	RW	Uni			
---	-----------	---	---	------------	----	-----	--	--	--

Defines the encoder position required for orientation.

13.12 CL> Orientation acceptance window

⇅	0 to 200	⇒	20	1/4096 Rev	RW	Uni			
---	----------	---	----	------------	----	-----	--	--	--

During the orientation process, the orientation complete flag is set when the absolute value of speed is less than 2 rpm and the encoder position is between **13.11 + 13.12** and **13.11 - 13.12**.

13.13	CL>	Encoder sample time
--------------	---------------	----------------------------

⇅	0 to 5.0	⇒	4.0	ms	RW	Uni			
---	----------	---	-----	----	----	-----	--	--	--

The resolution of speed measurement from an encoder depends on the sampling time the measurement is made over. Increasing the sampling time increases the resolution but also increases the time that a change in input frequency filters through the measurement. A compromise must be made between resolution and good dynamic response.

For a quadrature encoder the resolution of speed measurement is given by:

$$\frac{\text{No. of Enc. lines} \times 4 \times \text{Maximum speed (rpm)} \times \text{Pr13.13}}{1000 \times 60}$$

13.14	Reference revolution counter reset
--------------	---

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

When this parameter is set parameter **13.16** is reset to 0.

13.15	Feedback revolution counter reset
--------------	--

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

When this parameter is set parameter **13.17** is reset to 0.

13.16	Reference encoder revolution counter
--------------	---

⇅	OL> 0 to 16384	⇒		Revolutions	RO	Bi			P
⇅	CL> 0 to 16384	⇒		Revolutions					

This variable is incremented for every revolution in the forward direction and decremented for every revolution in the reverse direction. The counter is modulo 16384.

13.17	Feedback encoder revolution counter
--------------	--

⇅	OL> 0 to 16384	⇒		Revolutions	RO	Bi			P
⇅	CL> 0 to 16384	⇒		Revolutions					

This variable is incremented for every revolution in the forward direction and decremented for every revolution in the reverse direction. The counter is modulo 16384.

13.18	CL>	Orientation complete <i>indicator</i>					
--------------	---------------	--	--	--	--	--	--

↕	0 ~ 1	⇒			RO	Bit			P
---	-------	---	--	--	----	-----	--	--	---

Indicates that the orientation process is complete. Set when the absolute value of speed is less than 2 rpm and the position is within the window defined by parameter **13.12**.

13.19	Reference feedback invert <i>select</i>						
--------------	--	--	--	--	--	--	--

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

If one of the digital lock modes is being used the reference feedback may be inverted by setting this bit.

This menu contains a PID controller which has programmable reference and feedback inputs, programmable enable bit, reference slew rate limiting, variable clamp levels and programmable destination. If the PID integral and differential gains are made zero, then menu 14 can be used to sum up to three parameters together and route this to a destination parameter. The sample rate of the PID controller is the same as for the digital inputs, that is 5.5ms when using a switching frequency of 3,6 and 12kHz, and 7.4ms when using a switching frequency of 4.5kHz or 9kHz.

14.1 Parameter descriptions

14.01 PID controller output

⇅	OL> ±100.0	⇨		%	RO	Bi			P
⇅	CL> ±100.0	⇨		%					

This parameter monitors the output of the PID controller before scaling is applied. Subject to the PID output limits the PID output is given by:

$$P.e + \frac{I.e}{s} + D.e.s$$

where

P, I & D are the programmed gains
e is the input error to the PID (reference - feedback)

and

s is the Laplace operator

Therefore:

With an error of 100%, if P=1.000 the output produced by the proportional term is 100%.

With an error of 100%, if I=1.000 the output produced by the integral term will increase linearly by 100% every second.

With an error that is increasing by 100% per second, if D=1.000 the output produced by the D term will be 100%.

14.02	Main reference source parameter
14.03	PID reference source parameter
14.04	PID feedback source parameter

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	0.00						

These parameters define the variables which are to be used as input variables to the PID controller. Only non-bit parameters can be programmed as a source. If a non valid parameter is programmed the input value is taken as 0. All variable inputs to the PID are automatically scaled to variables having the range $\pm 100.0\%$, or 0 - 100.0% if they are unipolar.

Please see the Menu 14 Block Diagram.

14.05	PID reference <i>invert</i>
14.06	PID feedback source <i>invert</i>

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

These invert parameters are used to change the sense of the PID reference and PID feedback signals respectively. Setting one of these parameters to a 1 causes the respective signal seen by the PID controller to be inverted.

14.07	PID reference slew rate limit
--------------	--------------------------------------

⇅	OL> 0 - 3200.0	⇒	0	seconds	RW	Uni			
⇅	CL> 0 - 3200.0	⇒	0						

This parameter defines the time taken for the reference input to ramp from 0 to 100.0% following a 0 to 100% step change in input. Changes from -100.0% to +100.0% will take twice this time.

14.08	PID <i>enable</i>
--------------	--------------------------

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This parameter must be set at 1 for the PID controller to operate, if it is 0 the PID output will be 0.

14.09 Optional PID enable source parameter

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This parameter can be used to control when the PID function is enabled via a bit parameter. This bit parameter is ANDed with the PID enable parameter (**Pr14.08**) to enable the PID function.

If a non valid parameter is programmed the input to the PID controller is taken as a 1. Any valid optional enable programmed must be a 1 for the PID controller to operate, if it is a 0 then the PID output will be 0.

14.10 PID proportional gain

⇅	OL> 0 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0 to 4.000	⇒	1.000						

This is the proportional gain applied to the PID error.

14.11 PID Integral gain

⇅	OL> 0 to 4.000	⇒	0.500		RW	Uni			
⇅	CL> 0 to 4.000	⇒	0.500						

This is the integral gain applied to the PID error before being integrated.

14.12 PID derivative gain

⇅	OL> 0 to 4.000	⇒	0.000		RW	Uni			
⇅	CL> 0 to 4.000	⇒	0.000						

This is the derivative gain applied to the PID error before being differentiated.

14.13 PID output high limit

⇅	OL> 0 to 100.0	⇒	100.0	%	RW	Uni			
⇅	CL> 0 to 100.0	⇒	100.0	%					

The maximum positive PID output is limited by this parameter. If parameter **4.18** (symmetrical limits enabled) is set to 1 then the magnitude of this parameter also defines a negative low limit.

14.14 PID output low limit

⇅	OL> ±100.0	⇒	-100.0	%	RW	Bi			
⇅	CL> ±100.0	⇒	-100.0	%					

The maximum negative or minimum positive PID output is limited by this parameter if parameter **4.18** is zero. If **4.18** is 1 this parameter has no effect.

14.15 PID output scale factor

⇅	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

The PID output is scaled by this parameter before being added to the main reference. After the addition to the main reference, the output is automatically scaled again to match the range of the destination parameter.

14.16 PID output destination parameter

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This destination parameter defines the parameter to be controlled by the PID function. Only a non bit parameter which is not protected can be controlled. If a non valid parameter is programmed the output is not routed anywhere. If the PID is to control speed then it is suggested that one of the preset speed parameters is entered here. If the PID is to trim speed then it is suggested that the offset parameter (**1.04**) is entered

14.17 PID hold integrator enable

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

When this parameter is set to 0 the integrator operates normally. Setting this parameter to 1 will cause the integrator value to be held.

14.18 PID Symmetrical limits enable

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

If this parameter is 0, then parameters **14.13** and **14.14** define the maximum and minimum limits for the PID output. If this parameter is 1, then **14.13** defines the magnitude of a symmetrical positive/negative limit.

14.19	PID Main reference
--------------	---------------------------

⇅	OL> ±100.0	⇅		%	RO	Bi			P
⇅	CL> ±100.0	⇅		%					

This parameter monitors the PID controller main reference.

14.20	PID reference
--------------	----------------------

⇅	OL> ±100.0	⇅		%	RO	Bi			P
⇅	CL> ±100.0	⇅		%					

This parameter monitors the PID controller reference

14.21	PID feedback
--------------	---------------------

⇅	OL> ±100.0	⇅		%	RO	Bi			P
⇅	CL> ±100.0	⇅		%					

This parameter monitors the PID controller feedback

14.22	PID error
--------------	------------------

⇅	OL> ±100.0	⇅		%	RO	Bi			P
⇅	CL> ±100.0	⇅		%					

This parameter monitors the PID controller error.

15

Menu 15 Regen

A Unidrive can be used as a sinusoidal input current power unit to supply one or more Unidrives via their dc buses. When this mode is selected as a drive type in menu 11, menu 15 will appear and is used to setup the Unidrive.

15.1 Parameter descriptions

15.01	RG>	Supply current magnitude
--------------	---------------	---------------------------------

⇅	±maximum drive current	⇒		amps	RO	Bi			P
---	------------------------	---	--	------	----	----	--	--	---

This parameter gives the rms phase current from the supply. The sinusoidal rectifier controls the current so that the fundamental current and voltage are in phase at the power terminals of the unit. There is a small phase shift across the input inductors, and so the current magnitude and the real component of current are approximately equal. If power is flowing into the sinusoidal rectifier the current magnitude is negative, and if power is flowing out (back into the supply) the current magnitude is positive.

15.02	RG>	Supply voltage
--------------	---------------	-----------------------

⇅	0 to 600	⇒		volts	RO	Uni			P
---	----------	---	--	-------	----	-----	--	--	---

When the sinusoidal rectifier unit is active the supply voltage is given by this parameter. If the unit is not active this parameter shows zero.

15.03	RG>	Supply power
--------------	---------------	---------------------

⇅	±drive max current x 647V x $\sqrt{3}$	⇒		kW	RO	Bit			
---	--	---	--	----	----	-----	--	--	--

Total supply power of the Drive is calculated from the product of the line voltage and current which is equivalent to **15.01** x **15.02** x $\sqrt{3}$. Note that as the power factor is approximately unity the power is equal to the volt-amperes. The power shown is that flowing out of the Drive, hence when power is flowing from the supply to the regen drive **15.03** is negative, and when power is flowing from the regen drive back into the supply **15.03** is positive.

15.04	RG>	D.C. bus voltage
--------------	---------------	-------------------------

⇅	0 to 830	⇒		Volts		RO		Uni				P
---	----------	---	--	-------	--	----	--	-----	--	--	--	---

Voltage at the dc output of the unit.

15.05	RG>	Supply frequency
--------------	---------------	-------------------------

⇅	±100	⇒		Hz		RO		Bi				P
---	------	---	--	----	--	----	--	----	--	--	--	---

When the sinusoidal rectifier unit is active this parameter gives the supply frequency. Positive values indicate positive phase sequence and negative values indicate negative phase sequence. If the unit is not active this parameter shows zero.

15.06	RG>	Input inductance
--------------	---------------	-------------------------

⇅	0.001 to 100	⇒		mH		RO		Uni				P
---	--------------	---	--	----	--	----	--	-----	--	--	--	---

At power-up this parameter is zero. Each time the unit is enabled the supply inductance is measured and displayed by this parameter. The value given includes the supply inductance and the inductors inserted at the supply to the sinusoidal rectifier unit. The value given is only approximate, but will give an indication as to whether the input inductance is correct for the sinusoidal rectifier unit size.

15.07	RG>	D.C. bus voltage set-point
--------------	---------------	-----------------------------------

⇅	0 to 800	⇒	700	Volts		RW		Uni				
---	----------	---	-----	-------	--	----	--	-----	--	--	--	--

The sinusoidal rectifier unit will attempt to hold the dc bus at the level specified by this parameter. The higher the bus voltage the better the performance of the unit as there will be more voltage available to control the input current. The bus voltage must always be higher than the peak of the line to line supply voltage if the unit is to operate correctly. The voltage can be set to a level up to 800V, but this only leaves 30V headroom below the over-voltage trip level. Therefore it is best to use the default value of 700V unless the supply voltage is such that it must be raised above this level.

15.08 **RG>** **Switching frequency**

⇅ 0 to 4: [3, 4.5, 6, 9, 12] ⇨ 0: [3kHz] kHz RW Txt P

This parameter sets the PWM frequency and also determines the sample frequency for loops.

The sampling frequency of the control system is based on the switching frequencies as follows:

Current control

Switching frequency	Control frequency
3kHz	3kHz
4.5	4.5
6	6
9	4.5
12	6

Dc bus voltage control and synchronisation with the supply

3kHz	3kHz
4.5	2.25
6	3
9	2.25
12	3

15.09 **RG>** **High stability space vector modulation**

⇅ 0 ~ 1 ⇨ 0 RW Bit

Setting this parameter to 1 modifies the IGBT switching pattern so as to reduce the number of switching events. This has the following effects:

- Slightly reduced power loss in the Regen Unit.
- Increased acoustic noise from input inductors.

15.10 **RG>** **Quasi-square operation select**

⇅ 0 ~ 1 ⇨ 0 RW Bit

The rate at which the DC bus voltage can be reduced by the unit depends on the headroom between the bus voltage and the supply voltage. If quasi-square mode is selected this headroom can be effectively increased at some points within a supply cycle. This can give better performance, particularly when the supply voltage is high or the bus voltage set-point is low.

15.11 RG> Sinusoidal rectifier synchronising

↕	0 ~ 1	⇒			RO	Bit			
---	-------	---	--	--	----	-----	--	--	--

When the unit is enabled it must detect the phase and frequency of the mains. During this period this bit is set. Once synchronisation has been completed successfully this bit is cleared. If the supply is very severely distorted or a phase is missing the Drive will repeatedly attempt to synchronise until it is disabled or the supply is suitable for synchronisation.

15.12 RG> Sinusoidal rectifier synchronised

↕	0 ~ 1	⇒			RO	Bit			
---	-------	---	--	--	----	-----	--	--	--

When the unit has been enabled and successfully synchronised this bit will be set to 1. If the unit is disabled, the unit trips or detects that the mains is lost, this bit will be set to 0.

15.13 RG> Sinusoidal rectifier phase loss

↕	0 ~ 1	⇒			RO	Bit			
---	-------	---	--	--	----	-----	--	--	--

If a supply phase is not present the sinusoidal rectifier unit will not synchronise when it is enabled. However, if a phase is lost after synchronisation one of the following will occur:

- Lightly loaded: the unit will continue to operate normally.
- Medium load: the unit will continue to operate, but the phase loss bit is set.
- Heavy load: the unit will detect mains loss, disable itself and attempt to re-synchronise.

15.14 RG> Close soft start contactor

↕	0 ~ 1	⇒			RO	Bit			
---	-------	---	--	--	----	-----	--	--	--

When the regen unit has powered up through the soft start resistor and the dc bus voltage stabilised this bit will change from 0 to 1. This bit must be routed to a digital output terminal which is used to energise the soft start contactor coil.

15.15	RG>	Soft start contactor is closed
--------------	---------------	---------------------------------------

↕	0 ~ 1	⇒				RW	Bit			
---	-------	---	--	--	--	----	-----	--	--	--

When the close contactor output goes active the soft-start contactor should operate and short out the soft-start resistor. This bit should be set as the destination parameter for a digital input connected to an auxiliary contact on the soft start contactor. If this input becomes inactive when bit **15.14** is set then after a 100ms (approx.) delay the Drive will inhibit so as to protect the soft-start circuit.

15.16	RG>	Enable motor drive
--------------	---------------	---------------------------

↕	0 ~ 1	⇒				RO	Bit			
---	-------	---	--	--	--	----	-----	--	--	--

When the unit has been enabled and successfully synchronised this bit will be set to 1. If the regen unit is disabled, the unit trips or detects that the mains is lost, this bit will set to 0.

This bit should be routed to a digital output and used to enable the motor drive(s) connected to the DC link of the Regen Drive.

15.17	RG>	Line sync trip enable
--------------	---------------	------------------------------

↕	0 ~ 1	⇒	0			RW	Bit			
---	-------	---	---	--	--	----	-----	--	--	--

When the Drive is enabled and the main contactor is closed it will try and synchronise the line supply. If this bit is 0 then the Drive will continue to try and synchronise to the line continually until disabled, even if it does not synchronise successfully. If this bit is set to a 1 and the Drive has not successfully synchronised after trying for 30 seconds then the Drive will trip 'LI.SYNC'.

15.18 **RG> Line synchronisation status**

↕	0 ~ 5	⇒				RO	Txt			P
---	-------	---	--	--	--	----	-----	--	--	---

This parameter is the line supply synchronisation status. It is intended to give some diagnostic information if the Drive fails to synchronise to the supply. If no attempt to synchronise to the supply has been made since the Drive was switched on, if the Drive is synchronised to the supply and running, or if it has been running then this parameter will show 'SYNC'. If the Drive can not synchronise to the supply then this parameter will show the reason why synchronisation failed. If the Drive does fail to synchronise to the supply the most likely reasons are that the supply is very distorted, or there are large voltage notches / spikes on the supply.

0	SYNC	Successfully synchronised to line supply
1	Ph Det	Failed to correctly detect the phasing of the supply
2	Fr Lo	Line frequency too low
3	Fr Hi	Line frequency too high
4	PLL OI	Over current during final synchronisation of PLL to supply
5	PLL Ph	Phasing error during final synchronisation of PLL to supply

Menu 16 is only present when a small option module (SOM) is fitted.

On power down the Drive remembers which option module is fitted and on power up the Drive checks that the module currently fitted is the same as was present on power down. If the Drive finds a different option module fitted it will load defaults for the new option module. If the Drive finds no option module fitted then it will trip on SEP.dis. This is to protect against any possibility of the option module being left unplugged after maintenance or coming loose during cubicle transit etc.

The trip can be cleared by saving parameters (0.00 to 1000 and reset).

16.01 Option module code

⇅	OL> 0 to 100	⇒			RO	Uni			P
⇅	CL> 0 to 100	⇒							

This parameter will display a code depending on which option module is fitted.

Codes allocated so far are:

- 1 Additional I/O module
- 2 Second Encoder interface module
- 3 Resolver feedback module
- 4 SINCOS encoder interface module

Additional I/O module

The additional I/O module offers the following extra I / O functions:

1. Two programmable relays
2. Three dedicated programmable digital inputs
3. Three programmable digital input / outputs.
4. Two programmable analog inputs
5. One programmable analog output

Please see table below for detail:

Name	Direction	Mode	Terminal
Relay 2	output	volt free	40
Relay 3	output	volt free	41
Relay common	output	volt free	42
0V	n/a	n/a	43
Dig. I/P (F10)	input	voltage	44
Dig. I/P (F11)	input	voltage	45
Dig. I/P (F12)	input	voltage	46
0V	n/a	n/a	47
Dig. I/O (F7)	input/output	voltage	48
Dig. I/O (F8)	input/output	voltage	49
Dig. I/O (F9)	input/output	voltage	50
Analog I/P4	input	voltage	51
Analog I/P5	input	voltage	52
0V	n/a	n/a	53
Analog O/P3	output	voltage	54
0V	n/a	n/a	55

The Module logic sense can be changed from Negative logic (default) to Positive logic using parameter **16.40**.

Please note only the logic sense of digital inputs change. The sense of digital outputs must be changed independantly using the invert parameters if required. Please see the table below for detail:

Logic sense	Input		Output	
	0	1	0	1
Negative	24V	0V	24V	0V
Positive	0V	24V	24V	0V

Additional I/O module: connections

40	Relay 2 (N/O)
41	Relay 1 (N/O)
42	Relay common
43	0v
44	DI6
45	DI5
46	DI4
47	0V
48	DIO6
49	DIO5
50	DIO4
51	AI5
52	AI6
53	0V
54	AO3
55	0V (should not be used unless the Drive control board is UD90A or later)

Additional I/O module: parameter descriptions

16.02	Status relay 2 output indicator
16.03	Status relay 3 output indicator

⇅	OL> 0 ~ 1	⇒			RO	Bit			P
⇅	CL> 0 ~ 1	⇒							

These parameters indicates the state of expansion relay's 2 and 3 respectively, 0 = de-energised, 1 = energised.

16.04	Analog input 4 level
16.05	Analog input 5 level

⇅	OL> ±100.0	⇒		%	RO	Bi			P
⇅	CL> ±100.0	⇒							

These parameters display the level of the analog inputs 4 and 5 respectively. The processor A-D converters are used for these analog inputs, the resolution is 10 bit plus sign.

16.07	F7 Input/Output indicator
16.08	F8 Input/Output indicator
16.09	F9 Input/Output indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

These parameters indicate the input state of the terminals if they are set up as inputs, or the output state if they are set up as outputs. For inputs 0 = inactive, 1= active; and for outputs a 1 will cause the terminal to sink current, and a 0 will cause the terminal to Drive current.

16.10	F10 Input indicator
16.11	F11 Input indicator
16.12	F12 Input indicator

⇕	OL> 0 ~ 1	⇒			RO	Bit			P
⇕	CL> 0 ~ 1	⇒							

These parameters indicate the state of inputs F10 to F12, 0 = inactive, 1 = active.

16.13	Analog input 4 scaling
--------------	-------------------------------

⇕	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇕	CL> 0.000 to 4.000	⇒	1.000						

This parameter can be used to scale analog input 4 if required. However in most cases it is not necessary as each input is automatically scaled such that for 100.0% input the destination parameter will be at a maximum.

16.14	Analog input 4 invert bit
--------------	----------------------------------

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This parameter can be used to invert analog input 4 reference if so desired.

16.15 Analog input 4 destination

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0.00						

The parameter which analog input 4 is required to control is programmed here. Only a non bit parameter which is not protected can be controlled by an analog input. If a non valid parameter is programmed then the input is not routed anywhere. After modification of this parameter the destination is only changed when a reset is performed (or the Drive is powered down and then up again).

16.16 Analog input 5 scaling

⇅	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

This parameter can be used to scale analog input 5 if required. however in most cases it is not necessary as each input is automatically scaled such that for 100.0% input the destination parameter will be at a maximum.

16.17 Analog input 5 invert bit

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This parameter can be used to invert analog input 5 is so desired.

16.18 Analog input 5 destination

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0.00						

The parameter which analog input 5 is required to control is programmed here. Only a non bit parameter which is not protected can be controlled by an analog input. If a non valid parameter is programmed then the input is not routed anywhere. After modification of this parameter the destination is only changed when a reset is performed (or the Drive is powered down and then up again).

16.19 Analog output 3 source parameter

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	0.00						

The parameter which is desired to be read via the analog output should be programmed here. Only a non bit parameter can be programmed. If a non valid parameter is programmed the output will remain at the minimum level After modification of this parameter the source is only changed when a reset is performed (or the Drive is powered down and then up again).

16.20 Analog output 3 scaling

⇅	OL> 0.000 to 4.000	⇒	1.000		RW	Uni			
⇅	CL> 0.000 to 4.000	⇒	1.000						

This parameter is used to scale analog output 3 if so desired. Automatic scaling is provided such that when the source parameter is at its maximum value the analog output will be at a maximum.

16.21 F7 destination or source parameter

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This parameter should be programmed with either:

1. The destination parameter for when terminal 48 is an input
2. The source parameter for when terminal 48 is an output.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed:

1. An input is not routed anywhere
2. An output will Drive current

After modification of this parameter the source / destination is only changed when a reset is performed (or the Drive is powered down and then up again).

16.22 F7 Input/Output Invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 48.

Setting this parameter to a 1 causes the input sense to the destination parameter to be inverted or the output sense from the source parameter to be inverted.

16.23 Activate F7 output

⇅	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇅	CL> 0 ~ 1	⇒	0						

This parameter is for enabling terminal 48 as an output.

A setting of 1 is for an output and a setting of 0 is for an input.

16.24 F8 destination or source parameter

⇕	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	0.00						

This parameter should be programmed with either:

1. The destination parameter for when terminal 49 is an input
2. The source parameter for when terminal 49 is an output.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed:

1. An input is not routed anywhere
2. An output will Drive current

After modification of this parameter the source / destination is only changed when a reset is performed (or the Drive is powered down and then up again).

16.25 F8 Input/Output Invert

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 49.

Setting this parameter to a 1 causes the input sense to the destination parameter to be inverted or the output sense from the source parameter to be inverted.

16.26 Activate F8 output

⇕	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇕	CL> 0 ~ 1	⇒	0						

This parameter is for enabling terminal 49 as an output.

A setting of 1 is for an output and a setting of 0 is for an input.

16.27 F9 destination or source parameter

⇕	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇕	CL> 0.00 to 20.50	⇒	0.00						

This parameter should be programmed with either:

1. The destination parameter for when terminal 50 is an input
2. The source parameter for when terminal 50 is an output.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed:

1. An input is not routed anywhere
2. An output will Drive current

After modification of this parameter the source / destination is only changed when a reset is performed (or the Drive is powered down and then up again).

16.28 F9 Input/Output *Invert*

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 50.

Setting this parameter to a 1 causes the input sense to the destination parameter to be inverted or the output sense from the source parameter to be inverted.

16.29 Activate F9 output

⇅	OL> 0 ~ 1	⇒	0		RW	Bit		R	
⇅	CL> 0 ~ 1	⇒	0						

This parameter is for enabling terminal 50 as an output.

A setting of 1 is for an output and a setting of 0 is for an input.

16.30 F10 Input destination

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This parameter should be programmed with the destination parameter for terminal 44.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the input is not routed anywhere

After modification of this parameter the destination is only changed when a reset is performed (or the Drive is powered down and then up again).

16.31 F10 Input *invert*

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			P
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 44.

Setting this parameter to a 1 causes the input sense to the destination to be inverted.

16.32 F11 Input destination

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This parameter should be programmed with the destination parameter for terminal 45.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the input is not routed anywhere

After modification of this parameter the destination is only changed when a reset is performed (or the Drive is powered down and then up again).

16.33 F11 Input *invert*

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 45.

Setting this parameter to a 1 causes the input sense to the destination to be inverted.

16.34 F12 Input destination

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni		R	P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This parameter should be programmed with the destination parameter for terminal 46.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the input is not routed anywhere

After modification of this parameter the destination is only changed when a reset is performed (or the Drive is powered down and then up again).

16.35 F12 Input *invert*

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminal 46.

Setting this parameter to a 1 causes the input sense to the destination to be inverted.

16.36 Relay 2 source

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This parameter should be programmed with the source parameter for the status relay on terminals 40 and 42.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the output will be open.

After modification of this parameter the source is only changed when a reset is performed (or the Drive is powered down and then up again).

16.37 Relay 2 state invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminals 40 and 42.

Setting this parameter to a 1 causes the output sense from the source parameter to be inverted.

16.38 Relay 3 source

⇅	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni			P
⇅	CL> 0.00 to 20.50	⇒	0.00						

This parameter should be programmed with the source parameter for the status relay on terminals 41 and 42.

Only bit parameters can be programmed into this parameter.

If a non valid parameter is programmed the output will be open.

After modification of this parameter the source is only changed when a reset is performed (or the Drive is powered down and then up again).

16.39 Relay 3 state invert

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

This invert parameter is used to change the sense of terminals 41 and 42.

Setting this parameter to a 1 causes the output sense from the source parameter to be inverted.

16.40 Logic input polarity

⇕	OL> 0 ~ 1	⇐	0		RW	Bit		R	P
⇕	CL> 0 ~ 1	⇐	0						

This parameter changes the logic polarity on digital inputs. In its default state the input polarity is negative logic which requires digital inputs to be pulled low (< 5V) to activate the input. When this parameter is set to 1 the input polarity is positive logic and digital inputs must be Driven high (> 15V) to activate the input.

Please see note at the beginning of this menu

16.41 Open collector outputs

⇕	OL> 0 ~ 1	⇐	0		RW	Bit		R	P
⇕	CL> 0 ~ 1	⇐	0						

The high side driving on the three digital outputs can be disabled by setting this parameter. This allows the outputs to be connected together in a wired OR configuration.

Note

The wired OR configuration is only possible if negative logic is being used.

16.2 Second encoder interface module (issue 2 or later)

The second encoder option module provides a second encoder interface. The encoder position can be used as a reference for digital locking, or the speed as a reference value for speed, frequency etc. A Frequency and Direction (F and D) or quadrature (A/B) output can be provided from the main Drive encoder or the encoder connected to this module. A freeze input is also provided that latches the second encoder position and the main Drive encoder position when it is activated. The freeze values are only available to the UD70 large option module if fitted. If the freeze input is not selected the main Drive encoder Z signal is present on the freeze terminals.

Second encoder interface module: connections

40	+A
41	-A
42	0V
43	+B
44	-B
45	0V
46	+Z
47	-Z
48	0V
49	+FOUT/+AOUT
50	-FOUT/-AOUT
51	0V
52	+DOUT/+BOUT
53	-DOUT/-BOUT
54	+FREEZE_IN or +ZOUT
55	-FREEZE_IN or -ZOUT

Second encoder interface module: parameter descriptions

16.02 Encoder 2 input rpm

⇅	OL> ±30,000	⇒		rpm	RO	Bi			P
⇅	CL> ±30,000	⇒		rpm					

This parameter will show the rpm of the machine connected to the encoder 2 input provided parameters **16.04** and **16.05** have been set up correctly.

16.03 Encoder 2 position

⇅	OL> 0 to 16383	⇒		revolutions	RO	Uni			P
⇅	CL> 0 to 16383	⇒		/16384					

This parameter gives the encoder position counted from the point when the Drive was powered up, or if an index marker is detected the position relative to the point where the marker was detected.

16.04 No. of encoder lines/pulses per rev

⇅	OL> 0 to 16384	⇒	1024	encoder	RW	Uni			
⇅	CL> 0 to 16384	⇒	1024	lines/pulse					
				per rev					

To obtain correct values in parameters **16.02** (encoder 2 input rpm) and **16.03** (encoder 2 position) the number of lines/pulses per revolution must be set up correctly. The rpm and position values are also used in menu 13 for position control and the revolution counter, and these will not operate correctly if this parameter is not set up. The input may come from a quadrature encoder if parameter **16.05** = 0, or non-quadrature encoder if parameter **16.05** = 1.

16.05 Frequency input select

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

When this parameter is set to 0 the second encoder interface decodes quadrature signals. Setting the parameter to 1 allows frequency and direction input instead.

16.06 Simulated encoder output source select

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

This parameter is used to select the source of the encoder output signals. When at 0 the simulated encoder output signals are derived from the second encoder input and when it is at 1 the encoder output signals are derived from the Drives standard encoder input (encoder 1).

16.07 Simulated encoder output scaling

⇕	OL> 0 to 15	⇒	0	power of 2	RW	Uni			
⇕	CL> 0 to 15	⇒	0	power of 2					

This parameter can be used to scale down the encoder output such that the number of pulses/rev is reduced. Scaling can only be done in powers of 2 and the value set here is the power of 2 used.

e.g. to divide the encoder output by 16 this parameter should be set to 4 ($2^4 = 16$).

16.08 Simulated encoder output mode select

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

The encoder output can be A and B quadrature signals or frequency and direction. Setting this parameter selects Fand D output mode.

16.09 Encoder termination disable

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

Setting this parameter to a 1 disables the 120R termination resistors across the encoder inputs. Normally termination is required if the incoming signals are connected to one Drive only. However if the signals are connected to several Drives the termination should only be present on the furthest Drive from the source of the signals.

16.10 Enable freeze input

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

Setting this parameter enables the freeze input. If the freeze input is not enabled, the main encoder Z signal is present on the freeze terminals.

16.11 Freeze input termination disable.

↕	OL> 0 ~ 1	↕	0		RW	Bit			
↕	CL> 0 ~ 1	↕	0						

Setting this parameter disables the termination across the freeze input.

16.3 Resolver module

If the resolver interface module is fitted the Drive will automatically use the speed and position feedback derived from the resolver to control the machine operated by the Drive. The main Drive encoder interface automatically becomes the auxiliary encoder (See menu 13).

The resolution of the Resolver to Digital (R to D) converter is set up automatically based on the maximum speed parameter(1.06) as follows:

Maximum speed (rpm)	Resolution
0 - 3000	14bit
3001 - 12000	12bit
12001 - 30000	10bit

When a resolver is used with an induction machine in closed loop vector mode the relative angle between the machine and the resolver is not important. When a resolver is used with a servo machine the relative angle affects the operation of the Drive. Either the resolver can be aligned for zero offset operation, or the Drive can be made to carry out a phasing test to measure the required offset angle, or if the offset angle is known it may be entered manually. The offset is then automatically included in the servo Drive control algorithm. When a resolver is used either with an induction machine in closed loop vector mode or with a servo machine it is important to make the correct connections between the resolver and the small option module. The designation of connections for different resolvers may vary, therefore to avoid problems a detailed description is given below of the convention adopted for Unidrive.

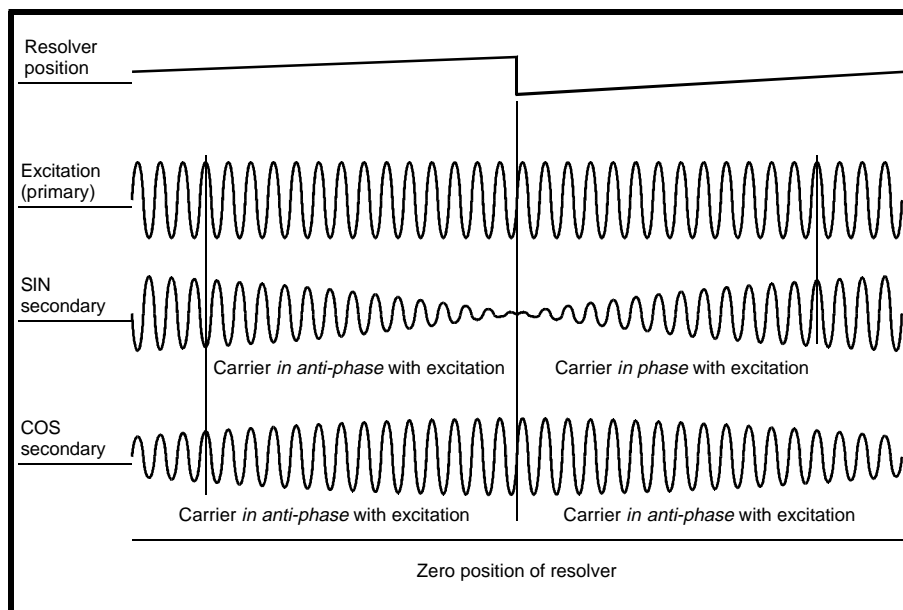
Small option module terminal	Resolver signal	Internal connection
48	SINL	0V via 100R
49	SINH	
50	COSL	0V via 100R
51	COSH	
52	REFH	
53	REFL	0V

$$V_{\sin} = \text{SINH} - \text{SINL}$$

$$V_{\cos} = \text{COSH} - \text{COSL}$$

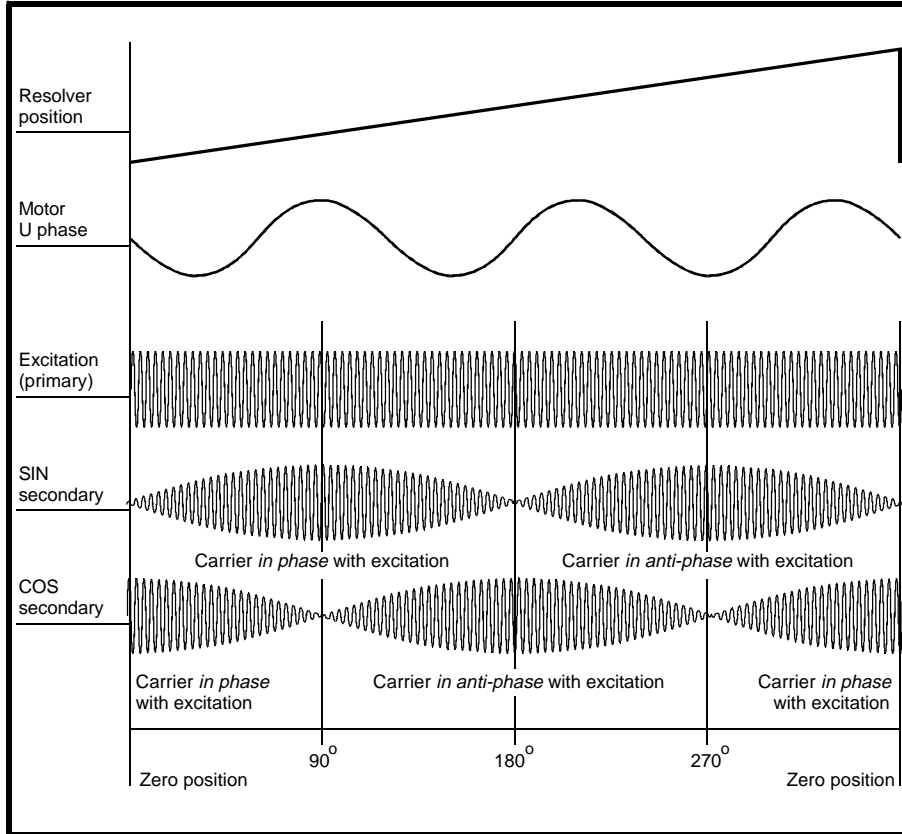
$$V_{\text{ref}} = \text{REFH} - \text{REFL}$$

The definition of the machine and resolver rotating forwards is when the output phase sequence from the Drive is Vu leading Vv by 120deg and Vv leading Vw by 120deg. When a resolver test is carried out (see below) the machine will be rotated by the Drive in the forwards direction. When the machine is rotating forwards v_{cos} must "lead" v_{sin} by 90deg. However, v_{sin} and v_{cos} are amplitude modulated waveforms with v_{ref} as the carrier, and so they appear as an envelope and not waveforms with defined half cycles. This is demonstrated in the waveforms below, showing the resolver voltages and the position as the resolver passes through zero in the forwards direction. If v_{sin} and v_{cos} are considered to be positive when they are in phase with v_{ref} and negative when they are out of phase with v_{ref} then v_{sin} is at the zero crossing from the negative to positive half cycles at zero position and v_{cos} is at its positive peak. This is the correct phase relationship with v_{cos} "leading" v_{sin} and the resolver position parameter **16.03** will increase when the machine rotates forwards.



If the resolver output phase relationship is not correct an ENC.PH7 trip will occur during the resolver test for a servo machine, or during the magnetising current test for an induction machine operated in closed loop vector mode.

The waveforms below are with a longer timebase and show the relationship between v_{\sin} and v_{\cos} and the resolver position. Also included is V_u (Drive output voltage) for a six pole machine where the resolver has been aligned for zero offset operation (see parameter **16.05**).



Resolver module: connections

- 40 +FOUT/+AOUT
- 41 -FOUT/-AOUT
- 42 0V
- 43 +DOUT/+BOUT
- 44 -DOUT/-BOUT
- 45 0V
- 46 +ZOUT (derived from resolver position)
- 47 -ZOUT (derived from resolver position)
- 48 SINL
- 49 SINH
- 50 COSL
- 51 COSH
- 52 REFH
- 53 REFL
- 54 0V
- 55 0V should not be used unless Drive control board is UD90A or later

Resolver module: parameter descriptions

16.02 CL> Resolver rpm

⇅	±30,000	⇒		rpm	RO	Bi			P
---	---------	---	--	-----	----	----	--	--	---

Speed of rotation of the resolver in rpm.

16.03 CL> Resolver position

⇅	0 to 16383	⇒		rev/16384	RO	Uni			P
---	------------	---	--	-----------	----	-----	--	--	---

Absolute resolver position.

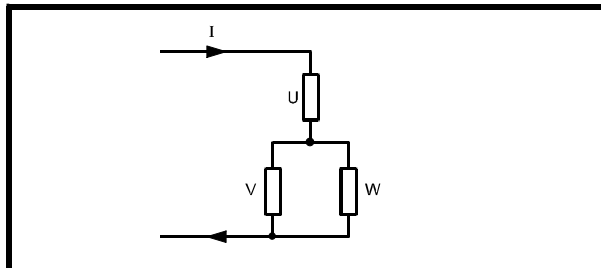
16.04 CL> Resolver test

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

For operation with a servo machine either the resolver must be aligned for zero offset operation (**16.09** should be zero), or the alignment offset must be calculated by the Drive, or the correct offset must be entered manually into parameter **16.09**.

If zero offset alignment is required the alignment of the machine and resolver can be tested in one of two ways. The first is to adjust the alignment until the correct relationship between the phase voltage V_u and the resolver outputs is obtained when the machine is rotated as given in the section above.

Alternatively a static test can be performed by injecting dc current into the machine as shown below.



The machine will rotate to one of several positions depending on the number of pole pairs in the machine (i.e. number of poles/2). The resolver position **16.03** is given by

$$n \times 16384 / \text{pole_pairs}$$

where $0 \leq n < \text{pole_pairs}$

Therefore a six pole machine will stop at one of three places with **16.03** = 0, 5461 or 10923. With current passing through the machine windings the resolver can be adjusted until parameter **16.03** shows one of these values. Alternatively the resolver can be adjusted until v_{\sin} is zero and v_{\cos} is at its positive peak (i.e. in phase with v_{ref}).

If the resolver is not aligned for zero offset operation it is possible for the Drive to measure the necessary offset and automatically store it in parameter **16.09**. This measurement can be initiated by setting parameter **16.05** and enabling the Drive. The machine will then rotating slowly through part of a revolution. The test must be done with no load on the machine. If any load is applied during the test the offset measured by the Drive could be incorrect. The offset value stored is in electrical units (0 to 6143) and not mechanical units (0 to 16383).

If the resolver is not aligned for zero offset operation, but the required offset is known, this may be entered manually into parameter **16.09**.

16.07 Simulated encoder output scaling

⇅	OL> 0 to 15	⇒	0	power of 2	RW	Uni			
⇅	CL> 0 to 15	⇒	0	power of 2					

An encoder output may be simulated from the resolver position. The ratio between the resolver position and the simulated encoder output is defined by this parameter. The ratio is always a power of two and is $1 / 2^{16.07}$. E.g. a ratio of 1/16 is produced by setting this parameter to 4. Unlike other small option modules the simulated encoder output cannot be derived from Encoder 1, but can only be derived from the resolver.

16.08 Simulated encoder output mode select

⇅	OL> 0 ~ 1	⇒	0		RW	Bit			
⇅	CL> 0 ~ 1	⇒	0						

Setting this parameter allows the simulated encoder output to be F/D signals, the default setting gives A/B quadrature signals.

16.09 CL> Phasing offset

⇅	0 to 6143	⇒			RW	Uni	S		P
---	-----------	---	--	--	----	-----	---	--	---

This parameter shows the offset value in electrical units from 0 to 6143 (unlike the normal mechanical position units which vary from 0 to 16383). As this is saved at power-down the offset applies from the point when the test is done until it is repeated. Loading default parameters does not affect this value, and so the offset is not reset. However changing Drive type does reset this parameter to zero.

16.4 SINCOS Module

If the SINCOS interface module is fitted the Drive will automatically use the speed and position feedback derived from the SINCOS encoder to control the machine operated by the Drive. The main Drive encoder (Encoder 1) automatically becomes the auxiliary encoder. However this automatic changeover can be overridden if required by setting parameter **16.14**, so that the Drive uses Encoder 1 to control the machine and the SINCOS encoder becomes the auxiliary encoder. (See menu 13). Care should be taken to ensure that other appropriate Drive parameters are also modified when parameter **16.14** is changed. **This should not be done when the Drive is enabled. The encoder phasing offset for the main Drive encoder (parameter 3.28) and for the SINCOS encoder (parameter 16.09) both hold the same value, i.e. the last value set in either parameter manually or by the phasing test. Therefore if parameter 16.14 is changed the phasing offset for the new encoder must be entered manually or by the phasing test.**

A SINCOS encoder produces sinusoidal quadrature outputs instead of the square waveforms produced by a more standard encoder. The small option module converts the sinusoidal signals into square waves and counts the edges to give an incremental position value. This only gives a position value equivalent to four times the number of Lines per revolution. The Drive also uses the sinusoidal waveforms to interpolate between the edges derived from the square waves to increase the resolution up to 2048 times the number of Lines per revolution (e.g. a 512 line encoder can give a resolution equivalent to 1048576 counts per revolution).

The SINCOS encoder interface small option module is designed to operate with single or multi-turn SINCOS encoders and can determine their absolute position within one or many revolutions respectively. The absolute position information is taken by the Drive once at power-up via a serial communications link. Once this has been obtained the incremental position changes are used to track the absolute position until the Drive is powered-down again. The position displayed by parameters **16.03** to **16.05** is therefore the absolute position which can be read via serial comms or by the large option module for absolute position control.

The position information as shown in parameters **16.04** and **16.05** is used by the Drives own speed controller if the SINCOS encoder is selected as feedback to control the machine.

The position information can be used in the functions described in Menu 13. The absolute position value in parameter **16.04** only (16384 steps per revolution) is used as an input to the menu 13 position control algorithms in the same way as resolver absolute position feedback (the fine position is not used). This allows absolute orientation within one revolution to be performed. Unlike a standard encoder which must rotate past its marker pulse the absolute information for orientation is correct from power-up. Multi-turn absolute orientation is not supported. The digital lock algorithm only uses incremental changes in position from parameter **16.04** and ignores the multi-turn information in parameter **16.05**, therefore only incremental digital lock is performed. Whichever revolution counter is related to the SINCOS encoder (**13.15** or **13.16**) is reset to zero at power-up and is not affected by any multi-turn information or absolute information from the SINCOS encoder.

When a SINCOS encoder is used with an induction machine in closed loop vector mode the absolute position and relative angle between the machine and the encoder are not required for correct operation of the machine control algorithm. The absolute position does not need to be taken via the encoder serial communications link at power-up for the machine to operate, therefore an encoder with only sine and cosine feedback and no serial comms can be used. To prevent a comms error at power-up parameter **16.16** should be set to one.

When a SINCOS encoder is used with a servo machine the absolute position is used by the Drive control algorithm. Also the correct relative offset between the machine and the encoder angles must be stored in the offset parameter (**16.09**). Either the encoder can be aligned for zero offset operation (**16.09** = 0), or the Drive can be made to carry out a phasing test to measure the required offset angle, or if the offset angle is known it may be entered manually. The offset is then automatically included in the servo Drive control algorithm.

Absolute position measurement via the encoder serial comms is always required at power-up for correct operation with the SINCOS encoder as the feedback to control a servo motor. Therefore parameter 16.16 must not be set to one unless the SINCOS is being used as the auxiliary feedback (parameter 16.14 = 1).

The SINCOS encoder interface module is designed to operate with encoders with 256, 512, 1024, 2048 or 4096 lines per revolution. The maximum operating frequency is 102.4kHz, i.e. 3000rpm with a 2048 line encoder. The serial communications interface supports the Stegmann RS485 two wire interface (SCS60, SCM60, SCS70, SCM70 encoders).

The sinusoidal signals from a SINCOS encoder are sensitive analog signals, and so care must be taken to ensure that electrical noise from the Drive/machine does not adversely affect the encoder feedback (i.e. use properly screened control and power cables, input filter etc.).

The SINCOS small option module can cause a number of trips:

SEP	power supply short circuit
SEP EC	SINCOS RS485 comms fail
SEP EF	SINCOS encoder internal fault

The SEP EC trip indicates that communication with the encoder via the RS485 link is not possible. This could be because the comms link is not connected properly or has a hardware fault. Alternatively the encoder may not be operating because the supply voltage is incorrect, or the power supply is not connected, or the power supply is not active. If an SEP EC trip occurs the Drive will not have the absolute position information from the encoder, even if the fault is subsequently rectified. The Drive should be powered-down and up again to acquire the absolute position.

SINCOS Module: connections

40	+SIN
41	REFSIN
42	+COS
43	REFCOS
44	0V
45	+V
46	+485
47	-485
48	Do not connect
49	Do not connect
50	+FOUT/+AOUT
51	-FOUT/-AOUT
52	0V
53	+DOUT/+BOUT
54	-DOUT/-BOUT
55	0V

SINCOS Module: parameter descriptions

16.02 CL> SINCOS encoder rpm

⇅	±30,000	⇒	rpm	RO	Bi		P
---	---------	---	-----	----	----	--	---

Speed of rotation of the SINCOS encoder in rpm. Parameter **16.12** must be set up correctly for the speed given by this parameter to be correct.

16.03 CL> SINCOS encoder revolution count

⇅	0 to 16383	⇒	revolutions	RO	Uni		P
---	------------	---	-------------	----	-----	--	---

This parameter displays the number of turns from the point where the Drive powered-up. The maximum value of this parameter before roll-over is defined by parameter **16.13**. Some SINCOS encoders include a facility to count multiple turns. If this type of encoder is fitted this parameter will be preset with the power-up number of turns from the encoder. It will then track the encoder turns until the Drive powers-down.

16.04	CL>	Position
--------------	---------------	-----------------

⇅	0 to 16383	⇒	rev/16384	RO	Uni			P
---	------------	---	-----------	----	-----	--	--	---

The absolute position within 1 Revolution is given by this parameter with an accuracy of 1/16384 of a Revolution. This position is derived from the counted edges of the squares waves produced within the option module and some of the interpolated information.

16.05	CL>	Position (fine)
--------------	---------------	------------------------

⇅	0 to 255	⇒	rev/16384/256	RO	Uni			P
---	----------	---	---------------	----	-----	--	--	---

The interpolated position information will give higher resolution than can be represented by parameter **16.04**, and so the extra information is displayed by this parameter. The resolution information in excess of 1/16384 of a revolution that is available will depend on the number of encoder lines per revolution. The least significant bit of this parameter would represent smallest detectable position change from a 2048 line encoder with 2048 times interpolation, i.e.

$$\text{Effective counts per revolution} = 2048 \times 2048$$

Extra counts req. to give full resolution in addition to:

$$\begin{aligned} \mathbf{16.04} &= 2048 \times 2048 / 16384 \\ &= 256 \end{aligned}$$

If a SINCOS encoder with a lower number of counts is used this parameter will change in steps of more than one unit. If a 4096 line encoder is used the least significant digit of interpolated information is lost.

16.06	Simulated encoder output source select
--------------	---

⇅	OL> 0 ~ 1	⇒	0		RW	Bit		
⇅	CL> 0 ~ 1	⇒	0					

This parameter is used to select the source for the encoder simulation output. **16.06** = 1 selects Encoder 1 (the main Drive encoder) and **16.06** = 0 selects the SINCOS encoder connected to the small option module. The simulation information is derived only from the counted edges of the SINCOS encoder output and does not include interpolation. No zero pulse information is available with this option module.

16.07	Simulated encoder output scaling
--------------	---

⇅	OL> 0 to 15	⇒	0	power of 2	RW	Uni		
⇅	CL> 0 to 15	⇒	0	power of 2				

The ratio between the selected source position and the simulated encoder output is defined by this parameter. The ratio is always a power of two and is $1/2^{16.07}$. E.g. a ratio of 1/16 is produced by setting this parameter to 4.

16.08 Simulated encoder output mode select

↕	OL> 0 ~ 1	⇒	0		RW	Bit			
↕	CL> 0 ~ 1	⇒	0						

The encoder output format can be selected as A/B quadrature signals (**16.08** = 0) or Frequency and Direction signals (**16.08** = 1).

16.09 CL> Phasing offset

↕	0 ~ 6143	⇒			RW	Uni	S		P
---	----------	---	--	--	----	-----	---	--	---

This parameter shows the offset value (see parameter **16.10**) in electrical units from 0 to 6143 (unlike the normal mechanical position units which vary from 0 to 16383). As this is saved at power-down the offset applies from the point when the test is done until it is repeated. Loading default parameters does not affect this value, and so the offset is not reset. However changing Drive type does reset this parameter to zero.

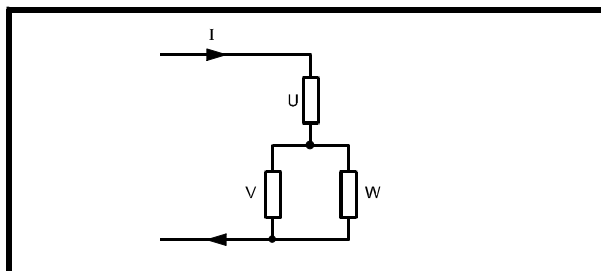
16.10 CL> Phasing test

↕	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

For operation with a servo machine either the SINCOS encoder must be aligned for zero offset operation (**16.09** should be zero), or the alignment offset must be calculated by the Drive, or the correct offset must be entered manually into parameter **16.09**.

If zero offset alignment is required the alignment of the machine and SINCOS encoder can only be aligned when the encoder is connected to a Drive. This cannot be done by observing the encoder waveforms as it can with a conventional encoder or resolver.

D.C. current should be injected as shown below.



The machine will rotate to one of several positions depending on the number of pole pairs in the machine (i.e. number of poles/2). The encoder position **16.04** is given by

$$n \times 16384 / \text{pole_pairs}$$

where $0 \leq n < \text{pole_pairs}$

Therefore a six pole machine can stop at one of three places with **16.04** = 0, 5461 or 10923. With current passing through the machine windings the SINCOS encoder can be adjusted until parameter **16.04** shows one of these values.

If the SINCOS encoder is not aligned for zero offset operation it is possible for the Drive to measure the necessary offset and automatically store it in parameter **16.09**. This measurement can be initiated by setting parameter **16.10**, and enabling the Drive. The machine will then rotate slowly through part of a revolution. **The test must be done with no load on the machine. If any load is applied during the test the offset measured by the Drive could be incorrect.**

If the SINCOS encoder is not aligned for zero offset operation, but the required offset is known, this may be entered manually into parameter **16.09**.

16.11	CL>	Update disable
--------------	---------------	-----------------------

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

The encoder position value spans three parameters (**16.03** to **16.05**). If the position is read by a large option module or via serial comms the value could change during the read process, which could result in large position errors. If this parameter is zero the position parameters (**16.03** to **16.05**) track the latest position information from the encoder. If this parameter is set to 1 all three position values are held at the last tracked value until the parameter is reset. Therefore when reading position updating should be disabled to prevent the risk of large position errors.

16.12	CL>	No. of encoder lines per revolution
--------------	---------------	--

⇅	256 to 4096	⇒	512	encoder lines per revolution	RW	Uni			
---	-------------	---	-----	------------------------------	----	-----	--	--	--

Number of cycles in the encoder sinewave outputs per revolution. This parameter can only be a power of 2.

16.13	CL>	No. of encoder turns
--------------	---------------	-----------------------------

⇅	0 to 15	⇒	0	power of 2	RW	Uni			
---	---------	---	---	------------	----	-----	--	--	--

Number of turns that can be measured by the encoder. This parameter is used to ensure that the revolution counter **16.03** is reset at the correct point. The number of turns that can be counted is specified by $2^{16.13}$. For single turn encoders this parameter can be set to 0.

16.14	CL>	SINCOS as auxiliary encoder
--------------	---------------	------------------------------------

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

Overrides the automatic selection of the SINCOS encoder as the feedback for machine control as described in the first section, **16.14** = 0 no override, **16.14** = 1 override active.

16.15	CL>	SINCOS encoder supply voltage <i>select</i>
--------------	---------------	--

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

The SINCOS interface can provide a +5V or +8V supply for the encoder. The level is selected by this parameter. **16.15** = 0 gives +5V, **16.15** = 1 gives +8V. **Care should be taken not to set this parameter when an encoder requiring a 5V is being used.**

16.16	CL>	Serial comms disable
--------------	---------------	-----------------------------

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

The Drive will not attempt to communicate via serial comms with the encoder if this bit is set. This can only be used with asynchronous machines where absolute position is not required for machine control.

16.17	CL>	Interpolation disable
--------------	---------------	------------------------------

⇅	0 ~ 1	⇒	0		RW	Bit			
---	-------	---	---	--	----	-----	--	--	--

The interpolator can be enabled or disabled at any time using this bit parameter. When interpolation is disabled the basic count from the encoder including quadrant information is used to give the position.

This menu contains the parameters used for controlling the setup of the second processor, 'Large Application Module'.

17.1 Parameter descriptions

17.01 Option module code

⇅	OL> 0 to 100	⇒			RO	Uni			P
⇅	CL> 0 to 100	⇒							

This parameter indicates a code defining the large option module which is fitted. A code of 0 indicates no option module or comms option module fitted which cannot be detected.

17.02 Option module Software Version

⇅	OL> 0.00 to 99.99	⇒			RO	Uni			P
⇅	CL> 0.00 to 99.99	⇒							

Indicates the software version in the large option module fitted.

17.03 DPL Line number where trip occurred

⇅	OL> 0 to 32000	⇒			RO	Uni			P
⇅	CL> 0 to 32000	⇒							

This parameter is only used when the DPL program has been compiled with the debugging information switched on. The value it gives is the actual line number within the DPL program where a run-time error occurred. If no run-time error has occurred the value will be meaningless.

17.04 Available resource in %

⇅	OL> 0 to 100	⇅		%	RO	Uni			P
⇅	CL> 0 to 100	⇅							

This parameter gives an indication on the level of processor resource available in the UD70. Continually measured over a 128ms period, it will indicate what % of the 128ms period the background task will be executed. Larger, more complex programs, or programs which operate on a fast time base will result in a reduction of the available resource. Always allow approximately 20% available to cope with peak execution loads. (A bar-graph indication of this parameter is presented on the status bar of the DPL Toolkit.)

17.05 RS485 Address

⇅	OL> 1 to 99	⇅	11		RW	Uni			P
⇅	CL> 1 to 99	⇅	11						

This parameter defines the ANSI address for the RS485 serial port when in Modes 1 or 5. The address consists of two numbers: the first defines the group and the second defines the unit within the group. The number zero (0) is not allowed for either the group or unit address. For example, valid addresses are 11, 12, 13, 21, 31, etc.

This parameter has no relevance in serial modes other than 1 and 5.

17.06 RS485 Mode

⇅	OL> 0 to 255	⇅	1		RW	Uni			P
⇅	CL> 0 to 255	⇅	1						

The EIA RS485 port can be placed in a number of different operating modes as follows:

Mode	Function
1	Standard 4-wire EIA RS485, ANSI protocol (default)
2	Master mode: The value of the parameter defined by parameter 17.08 , scaled to ± 16000 is continually transmitted. The baud rate is fixed at 9600.
3	Slave mode: Data is received and scaled using parameter 17.10 and then placed into the parameter as defined by 17.08 .
4	Cascade mode: The parameter pointed to by 17.08 is transmitted to the remote drive and the parameter pointed to by 17.09 receives data from a remote drive. The data is not scaled. Baud rate is fixed at 9600bps.
5	2-wire EIA RS485, ANSI protocol.
6	User mode. 1 start bit, 7 data bits, EVEN parity, 1 stop bit
7	User mode. 1 start bit, 8 data bits, EVEN parity, 1 stop bit
8	User mode. 1 start bit, 8 data bits, NO parity, 1 stop bit
9	User mode. 1 start bit, 9 data bits, NO parity, 1 stop bit
10	I/O Box Mode

More details of the modes can be found in the LAM manual.

17.07 RS485 Baud Rate

⇕	OL> 0 to 8	⇒	4		RW	Txt			P
⇕	CL> 0 to 8	⇒	4						

This parameter defines the communications rate for the General Purpose RS485 port. Selectable between 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 and 76800. This parameter is only valid in serial modes 1 and 5 to 9.

Parameter value	Baud rate
0	300
1	600
2	1200
3	2400
4	4800
5	9600
6	19200
7	38400
8	76800

17.08 RS485 Parameter Pointer 1

⇕	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	0.00						

This parameter defines the source parameter used in mode 2 communications, and the destination parameter in modes 3 and 4.

17.09 RS485 Parameter Pointer 2

⇕	OL> 0.00 to 20.50	⇒	0.00	Menu. Parameter	RW	Uni			P
⇕	CL> 0.00 to 20.50	⇒	0.00						

This parameter defines the destination parameter in mode 4 communications.

17.10 Serial Scaling factor

⇕	OL> 0.000 to 4.000	⇒	1.000	Menu. Parameter	RW	Uni			
⇕	CL> 0.000 to 4.000	⇒	1.000						

This defines the scaling factor used in communications mode 4.

17.11 Clock Task Tick Time

⇅	OL> 0 to 100	⇒	10	ms	RW	Uni				P
⇅	CL> 0 to 100	⇒	10	ms						

This parameter defines the tick-time for the CLOCK task. The parameter represents the tick-time in milliseconds, the minimum being 5ms and the maximum 100ms.

17.12 Position Controller Setup

⇅	OL> 0 - 255	⇒	0		RW	Uni				P
⇅	CL> 0 - 255	⇒	0							

This parameter defines the setup of the internal position controller of the UD70.

- 0 Disabled
- 1 Synchronous with ENCODER task.
- 2 Synchronous with SPEED task.

17.13 Auto-run

⇅	OL> 0 - 255	⇒	1		RW	Bit				
⇅	CL> 0 - 255	⇒	1							

Setting this parameter to 1 will cause the program in the UD70 to automatically execute whenever the drive is powered up. If set to a zero, a run command must be issued via the DPL Toolkit for the program to run.

17.14 Global Run-time trip enable

⇅	OL> 0 ~ 1	⇒	0		RW	Bit				
⇅	CL> 0 ~ 1	⇒	0							

This parameter when set to 0 will disable all run-time trips such as divide by zero, parameter over-range, RS485 link failed, etc. It will not disable fatal trips such as wrong system loaded or internal errors. Note that the DPL program will always stop when an error occurs, irrespective of the setting of this parameter.

17.15 RS485 Trip Enable

⇅	OL> 0 ~ 1	⇒	0		RW	Bit				
⇅	CL> 0 ~ 1	⇒	0							

If the RS485 port is being used in mode 3 (slave) or 10 (I/O Box mode) and this parameter is set to 1 and Parameter **17.14** is set to 1, the UD70 will trip the drive whenever the comms link fails (due to excessive bad data). If this parameter is 0, the drive will never trip on a comms failure. It is recommended that the trip is enabled otherwise no guarantee can be made on the validity of the data on the serial comms link.

17.16 IO Link RS485 Synchronisation Source

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

When running in I/O Link mode (10) the clock time for the data transmission and receive can be sourced from either the CLOCK task or ENCODER task. This parameter selects between the two. The data transmission time between the UD70 and IO Box takes 4ms.

17.17 Trip if parameter write over-ranges

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

Each drive parameter has a finite range of values which can be accepted. Any value written which is outside the parameter limits could signify a program failure. When this parameter is set at 1 and Parameter **17.14** = 1, the drive will trip if a parameter is outside the limits (error code 44). When it is set at 0, the UD70 places a limit on the value written (which is the parameter limit) and no error occurs.

17.18 Watchdog Trip Enable

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

The watchdog facility functions in conjunction with the command called WDOG. With watchdog enabled, by issuing the WDOG command in the initial task, this command must be executed by the user's DPL program at least every 200ms in the BACKGROUND task to prevent the drive tripping on Watchdog trip (Prc2). Note, if these tasks are single stepped there will be a watchdog trip.

17.19 Non-volatile Data Save Request

⇕	OL> 0 ~ 1	⇒	0		RW	Bit			
⇕	CL> 0 ~ 1	⇒	0						

A special applications menu, menu 20, can be stored in the UD70. To save on request, simply set parameter **17.19** to 1. It is important to realise that a standard drive parameter save (Parameter xx.00 to 1000) does not save this menu. Note: Menu 20 only appears when a LAM (UD70) is fitted.

17.20 Non-volatile Data Power Down Save

⇕	OL> 0 ~ 1	⇨	0		RW	Bit			
⇕	CL> 0 ~ 1	⇨	0						

A special applications menu, menu 20, can be stored in the UD70 automatically on drive power down. To save on power down (UU trip), set parameter **17.20** to 1.

17.21 Enable dumb-terminal mode

⇕	OL> 0 ~ 1	⇨	0		RW	Bit			
⇕	CL> 0 ~ 1	⇨	0						

Setting this parameter to 1 puts the RS232 serial port into a plain ASCII mode, and disables all the communications protocols for debugging and using the DPL Toolkit. This parameter must be set at 0 for the DPL Toolkit to communicate to the UD70.

17.22 ~ 17.28 These parameters are specific to the Large application module fitted enabling particular features. Please consult the relevant user guide for the Large application module required.

18

Menu 18 User menu one

This menu contains general purpose integer and bit values for use in user applications.

18.1 Parameter descriptions

18.01 Application Menu 1 Read Write Integer

⇅	OL> ±32000	⇄	0		RW	Bi	S		
⇅	CL> ±32000		0						

This parameter is a read write parameter saved at power down, and is intended for user applications which require the last state of a run time parameter to be re-initialised at power up.

18.02 Application Menu 1 Read Only Integers

~

18.10

⇅	OL> ±32000	⇄	0		RO	Bi			
⇅	CL> ±32000		0						

All these parameters are for read only integers.

18.11 Application Menu 1 Read Write Integers

~

18.30

⇅	OL> ±32000	⇄	0		RW	Bi			
⇅	CL> ±32000		0						

All these parameters are for read write integers.

18.31 Application Menu 1 Read Write Bits

~

18.50

⇅	OL> 0 ~ 1	⇄	0		RW	Bit			
⇅	CL> 0 ~ 1		0						

All these parameters are for read write bits.

19

Menu 19 User menu two

This menu contains general purpose integer and bit values for use in user applications.

19.1 Parameter descriptions

19.01 Application Menu 2 Read Write Integer

⇕	OL> ±32000	⇨	0		RW	Bi	S		
⇕	CL> ±32000	⇨	0						

This parameter is a read write parameter saved at power down, and is intended for user applications which require the last state of a run time parameter to be re-initialised at power up.

19.02 Application Menu 2 Read Only Integers

~

19.10

⇕	OL> ±32000	⇨	0		RO				
⇕	CL> ±32000	⇨	0						

All these parameters are for read only integers.

19.11 Application Menu 2 Read Write Integers

~

19.30

⇕	OL> ±32000	⇨	0		RW				
⇕	CL> ±32000	⇨	0						

All these parameters are for read write integers.

19.31 Application Menu 2 Read Write Bits

~

19.50

⇕	OL> 0 ~ 1	⇨	0		RW	Bit			
⇕	CL> 0 ~ 1	⇨	0						

All these parameters are for read write bits.

This menu contains user application Read/Write integers but unlike the Read/Write parameters in other menus these parameters are stored in the Large Application Module (LAM) memory and not in the Unidrive EEPROM. See parameters **17.19** and **17.20** for how to store these parameters.

20.1 Parameter descriptions

20.01 ~ 20.50	LAM user integer parameters
-----------------------------------	------------------------------------

⇅	OL> ±32000	⇅	0		RW	Bi				
⇅	CL> ±32000	⇅	0							

Large Application Module user parameters.

